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ENCYCLOPÆDIA BRITANNICA.

EIGHTH EDITION.

THE

ENCYCLOPÆDIA BRITANNICA,

OR

DICTIONARY

OF

ARTS, SCIENCES, AND GENERAL LITERATURE.

EIGHTH EDITION.

WITH EXTENSIVE IMPROVEMENTS AND ADDITIONS;
AND NUMEROUS ENGRAVINGS.

VOLUME VII.

ADAM AND CHARLES BLACK, EDINBURGH.
MDCCCLIV.

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EDINBURGH: PRINTED BY NEILL AND CO.

ENCYCLOPÆDIA BRITANNICA.

CLIMAX (κλῖμαξ, a ladder, gradation), a figure in rhetoric, by which a sentence, or the several members of a discourse, gradually rise in force, dignity, or importance, to the close. It is opposed to anti-climax, in which the ideas sink in succession ;—a principal cause of that vice in composition called *bathos*.

CLINCH, in nautical language, that part of a cable which is fastened about the ring of the anchor.

CLINCHER, or CLINKER-BUILD, in ship-building, that construction in which the lower edge of each plank overlaps the next below it, like the slates of a roof.

CLINCHING, the operation of securing a bolt or nail by hammering the point on a ring or rove of iron so as to make it spread. It also denotes a slight kind of caulking used at sea.

CLINIAS, of Tarentum, a Pythagorean philosopher, a contemporary and friend of Plato. It is said that he was wont to assuage his anger by playing on the lyre. (*Diog. Laert.* ix.)

CLINICAL (κλίνη, a bed), pertaining to a bed. Hence a *clinical lecture* is a discourse delivered at the bedside of the sick, or from notes taken at the bedside.

CLINOMETER. See KLINOMETER.

CLIO, the first of the nine muses, presided over history. She appears crowned with laurels, holding in one hand a trumpet, and in the other a book. Sometimes she holds a plectrum or quill with a lute. Her name is derived from κλέος, *gloria ;* and it was her office to record the actions of illustrious heroes. Clio bore a son, Hyacinthus, to Pierus. See MUSES.

CLITHEROE, a parliamentary and municipal borough and market-town of England, county of Lancaster, and parish of Whalley. It stands on the E. bank of the Ribble, at the base of Pendle hill (which rises to 1800 feet above the level of the sea), 21 miles S.E. of Lancaster, and 217 from London. From the reign of Elizabeth to the passing of the Reform act, it returned two members to parliament; but at the latter period it was deprived of one of its members. The parliamentary borough includes besides the municipal boroughs the townships of Chatburn, Downham, Mearley, Twiston, Whalley, Wiswell, Worston, Pendleton, and Little Mitton, and in 1851 contained 11,480 inhabitants. Electors (1851-2), 448. The municipal borough is governed by a mayor, four aldermen, and 12 councillors; and had (1851) 7244 inhabitants. Clitheroe possesses two churches, three chapels, free grammar-school, mechanics' institute, moot-hall, and jail; and has extensive printworks, cotton manufactories, and lime kilns. Market-day Tuesday.

CLITOMACHUS (B.C. 140), was a native of Carthage; whence he removed to Athens, where he became a distinguished pupil of Carneades, and succeeded that philosopher as head of the new academy. Of his writings a few titles and quotations in Cicero are alone extant.

CLITUMNUS (the *Clitumno*), a small river of Umbria, rising about half-way between Hispellum (Spello) and Spoletium (Spoleto). The spot at which it rises is called *Le Vene* from the number of springs which issue from the rock, and whose united waters speedily form a stream navigable for small barges. After a course of about nine miles it assumed the name of *Tinia*, and kept this designation till it fell into the Tiber a short distance below Vettona. The Clitumnus was anciently famous for the clearness of its waters, and for the beauty of the white cattle that grazed on its banks. To these animals a peculiar sacredness was attached, which made it unlawful for any one to put them in the yoke. They were expressly reserved for the sacrifices which followed the triumphal procession of a victorious general, or such other occasions of solemnity.

CLITOR, in *Ancient Geography*, a town of Arcadia, on a hill, and near a river of the same name which falls into the Aroanius. In the vicinity was a fountain, the waters of which were said to deprive those who drank them of the taste for wine. The ruins of Clitor (now called Paleopoli) are still to be seen, about three miles from a village which bears the name of the ancient town. A spring flowing from the hill on which the ruins stand is supposed to be the fountain above mentioned.

CLITUS, a Macedonian, the familiar friend of Alexander the Great, was brother to Hellanice, the foster-mother of that prince. He followed Alexander in his conquests, and saved his life when he was about to be cut down by Spithridates at the passage of the Granicus. He commanded the right wing at Arbela, and was on the eve of departing to Bactria as governor of the province, when Alexander invited him to a banquet. During the repast Clitus, heated with wine, ventured to depreciate the exploits of that prince

Clive ‖ Clock and Watch Work.

as compared with those of Philip; on which Alexander, in a moment of exasperation, killed him with his own hand. (Plutarch's *Alexander*.)

CLIVE, Robert, Lord, the founder of the British empire in India, was born September 29, 1725, at Styche, near Market-Drayton, Shropshire, where his father was a lawyer and small proprietor. In his youth his strong will and fiery passions caused considerable uneasiness to his family, and gave no small annoyance to the inhabitants of the neighbourhood, who were glad to purchase immunity from the depredations of Clive and his companions by the payment of a petty tribute. After having been sent from school to school without making any progress in his education, his parents gladly accepted the offer of a writership for him in the service of the East India Company at Madras, where he landed in 1744. In this new situation he had to submit to the greatest privations, while his shy disposition kept him aloof from society. His haughty spirit was always breaking out in acts of insubordination, which frequently hazarded his situation. For these he was compelled to make a prompt apology; but so keenly did he feel the ignominy of submission that he twice attempted to destroy himself, and was saved on both occasions by the pistol which he snapped at his own head failing to go off. A more congenial field was opened up for the display of his abilities in the actions which followed the aggressions of Dupleix on the Company's station at Madras. (His exploits from this period are amply detailed under Hindostan.) In 1767 he returned to England for the last time; but on his arrival he found himself assailed by a powerful party of those whose rapacity he had checked by his reforms, and suspected by those who were indignant at all Eastern abuses. He boldly vindicated the latter part of his administration; but his earlier diplomacy presented more vulnerable points of attack. On these his adversary, Burgoyne, fastened; and the commons were compelled to vote the illegality of his acquisitions, especially of the large sums which he had received from Meer Jaffier. They indignantly refused, however, to acknowledge that he had abused his powers; and, in recollection of his distinguished actions, unanimously passed a motion to the effect that he had rendered great and meritorious services to his country. From this time forward his health began to decline, and in inaction his constitutional misery returned with tenfold violence. To obtain ease from physical suffering he had recourse to opium, and became gradually enslaved to the use of that drug. His health gradually sunk under a complication of maladies, and his mental faculties became at last seriously impaired. He perished by his own hand November 22, 1774.

Cloacæ ‖ Clock and Watch Work.

CLOACÆ, the great sewers of ancient Rome, which are justly reckoned among the grand works of that people. The most remarkable of these was the *Cloaca Maxima*, said to to have been constructed by Tarquinius Priscus, and which still exists in its original state. It is built of enormous blocks of stone joined together without cement, and consists of three arches overlying each other in close contact, the innermost of which is a vault of 18 Roman palms, and about 14 feet in diameter. By means of this great cloaca, the waters brought from the adjacent hills into the Velabrum and the valley of the Forum were discharged into the Tiber, opposite one end of the Insula Tiberina. Pliny states that a wain loaded with hay could pass through it with ease; which will not seem any exaggeration when we consider the inferior size of the Roman vehicles as compared with those of modern times. Also, in speaking of the numerous subterranean passages by which the foundations of Rome were intersected, he calls it "a city suspended in air" (*urbs pensilis*). We are told by Dion Cassius (xlix.), that when Agrippa undertook the cleansing of the cloacæ he passed through the Cloaca Maxima in a boat. This stupendous structure, even after a lapse of more than 2000 years, still serves as the common sewer of the city.

Agrigentum was also celebrated for its works of this kind.

CLOACINA or Cluacina, a surname of Venus at Rome, said by Lactantius to be derived from the *Cloaca Maxima*, in which an image of the goddess was found; but Pliny is doubtless right in deriving it from the verb *cloare* or *cluere*, to wash or purify. (*H. N.* xv. 36.) Smith's *Dict. of Greek and Roman Biog. and Mythol.*

CLOCK AND WATCH WORK.

The origin of clock work is involved in great obscurity. Notwithstanding the statements by many writers that clocks, *horologia*, were in use so early as the ninth century, and that they were then invented by an archdeacon of Verona, named Pacificus, there appears to be no clear evidence that they were machines at all resembling those which have been in use for the last five or six centuries. But it is certain that for that period at least clocks have been made depending on the action of a weight on a train of wheels, as distinguished from the water clocks, *clepsydræ*, which are well known to have been used many centuries before. However, we intend to confine this article as far as possible to matters of practical interest, as we cannot afford the space to enter into the history of horology; and we will, therefore, at once refer the reader who is curious about it to the articles on clocks, chronometers, &c., in Rees's Cyclopædia, and the various works there cited. We will only add to the information there given, that it appears from a communication of Captain Smith to the Antiquarian Society in 1851, that there is still a clock in existence at Dover Castle bearing the date 1348, earlier by 30 years than that of the clock made by De Vick for the palace of the French king Charles V., which has generally been described as the earliest clock of which the actual construction is known. Mr Denison also, in his Rudimentary Treatise on Clocks (of which we have largely availed ourselves throughout this article, and also of various papers by him in the Cambridge Philosophical Transactions, and the Journal of the Society of Arts), mentions a clock in Peterborough cathedral, still in use as to the striking part, of which the construction is more like that of the Dover Castle clock than that of De Vick; and Lord Chief Justice Coke tells us that a clock was set up in Westminster Hall in the thirteenth century out of a fine levied on one of his predecessors in that seat, from which perhaps the appropriate inscription *Discite justitiam moniti* was copied on to the sun-dial on a house now facing the hall.

De Vick's clock having been frequently described before, and the description being of no value except as a matter of curiosity, we shall say no more of it than that it was a large striking clock going one day, and with one hand (the hour hand), and much the same, except in the escapement, as many old church clocks still in existence. Pendulums were not invented for three centuries after; and strange as it may seem, the escapement was much like that which is called the "vertical escapement" in a watch, only the time of vibration depended entirely on the *moment of inertia* of the balance, and not on a spring, that also being of much later invention. We shall, therefore, proceed at once to describe the going part of an eight-day house clock, or of an astronomical clock or "regulator," for in the general arrangement they are the same.

In figure 1, B is the barrel with the rope coiled round it

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generally 16 times for the 8 days; the barrel is fixed to its arbor K, which is prolonged into the winding square coming

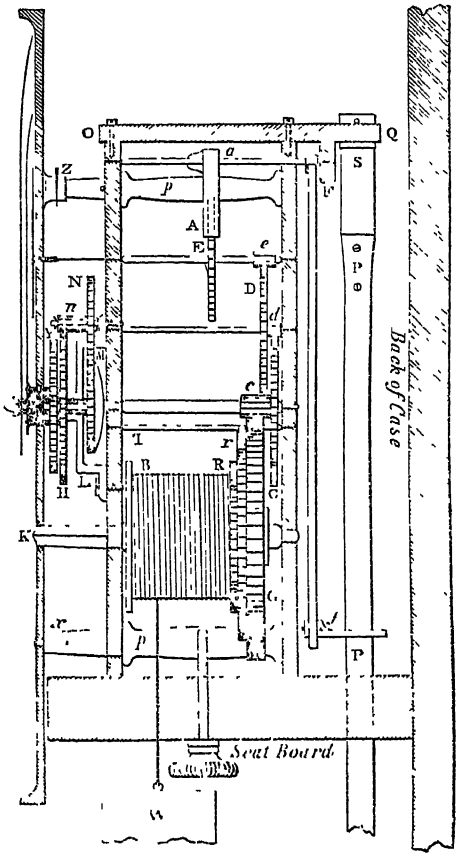


Fig. 1.

up to the face or dial of the clock; the dial is here shown as fixed either by small screws *x*, or by a socket and pin *z* to the prolonged pillars *p p*, which (4 or 5 in number) connect the plates or frame of the clock together, though the dial is commonly, but for no good reason, set on to the front plate by another set of pillars of its own. The great wheel G rides on the arbor, and is connected with the barrel by the ratchet R, the action of which is shown more fully in fig. 12. The intermediate wheel *r* in this drawing is for a purpose which will be described hereafter, and for the present it may be considered as omitted, and the click of the ratchet R as fixed to the great wheel. The great wheel drives the pinion *c*, which is called the centre pinion, on the arbor of the *centre wheel* C, which goes through to the dial, and carries the long or minute-hand; this wheel always turning in an hour, and the great wheel generally in 12 hours, by having 12 times as many teeth as the centre pinion. The centre wheel drives the "second wheel" D by its pinion *d*, and that again drives the scape-wheel E by its pinion *e*. If the pinions *d* and *e* have each 8 teeth or *leaves* (as the teeth of pinions are usually called), *c* will have 64 teeth and D 60, in a clock of which the scape-wheel turns in a minute, so that the seconds hand may be set on its arbor prolonged to the dial. A represents the pallets of the escapement, which will be described presently, and their arbor *a* goes through a large hole in the back plate near F, and its back pivot turns in a cock O F Q screwed on to the back plate. From the pallet arbor at F descends the *crutch* F*f*, ending in the *fork f*, which embraces the pendulum, so that as the pendulum vibrates, the crutch and the pallets necessarily vibrate with it. The pendulum is hung by a thin spring S from the cock Q, so that the bending point of the spring may be just opposite the end of the pallet arbor, and the edge of the spring as close to the end of that arbor as possible—a point frequently neglected.

Clock and Watch Work.

We may now go to the front (or left hand) of the clock, and describe the dial or "motion work." The minute hand fits on to a squared end of a brass socket, which is fixed to the wheel M, and fits close, but not tight, on the prolonged arbor of the centre wheel. Behind this wheel is a bent spring which is (or ought to be) set on the same arbor with a square hole (not a round one as it sometimes is) in the middle, so that it must turn with the arbor; the wheel is pressed up against this spring, and kept there by a cap and a small pin through the end of the arbor. The consequence is, that there is friction enough between the spring and the wheel to carry the hand round, but not enough to resist a moderate push with the finger for the purpose of altering the time indicated. This wheel M, which is sometimes called the minute wheel, but is better called the *hour-wheel* as it turns in an hour, drives another wheel N, of the same number of teeth, and which has a pinion attached to it; and that pinion drives the twelve-hour wheel H, which is also attached to a larger socket or pipe carrying the hour hand and riding on the former socket, or rather (in order to relieve the centre arbor of that extra weight) on an intermediate socket fixed to the *bridge* L, which is screwed to the front plate over the hour-wheel M. The weight W, which drives the train and gives the impulse to the pendulum through the escapement, is generally hung by a catgut line passing through a pulley attached to the weight, as shown in fig. 14, the other end of the cord being tied to some convenient place in the clock frame or *seat-board* to which it is fixed by screws through the lower pillars. It has usually been the practice to make the cases of house clocks and astronomical clocks not less than 6 feet high; but that is a very unnecessary waste of space and materials; for by either diminishing the size of the barrel, or the number of its turns, by increasing the size of the great wheel by one-half, or hanging the weights by a treble instead of a double line, a case just long enough for the pendulum will also be long enough for the fall of the weights in 7 or 8 days. Of course the weights have to be increased in the same ratio, and indeed rather more, to overcome the increased friction.

PENDULUM.

The claim to the invention of the pendulum, like the claim to most inventions, is disputed; and we have no intention of trying to settle it. It was, like many, perhaps most, other discoveries and inventions, probably made by various persons, independently, and almost simultaneously, when the state of science had become ripe for it. That peculiarly valuable property of the pendulum called *isochronism*, or the disposition to vibrate different arcs in very nearly the same time (provided the arcs are none of them large), was known long before the time of the earliest clocks we have described; for it is said that the ancient astronomers of the East employed pendulums in measuring the times of their observations, counting their vibrations during the phases of an eclipse or transit, and renewing them by a push of the finger when they languished. This knowledge, however, appears itself to have languished before the time of Galileo, if credit is to be given to the well-known story of his being struck with the apparent isochronism of a chandelier hung by a long chain from the roof of the church at Florence. And Galileo's son appears as a rival of Avicenna, Huygens, Dr Hooke, and a London clockmaker named Harris, for the honour of having first applied the pendulum to regulate the motion of a clock train, all in the early part of the seventeenth century. Be this as it may, there seems little doubt that Huygens was the first who mathematically investigated, and therefore really knew the true nature of those properties of the pendulum, which may now be found explained in any mathematical book on me-

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chanics. He discovered, that if a *simple* pendulum (*i. e.*, a weight or *bob* consisting of a single point, and hung by a rod or string of no weight) can be made to describe, not a circle, but a cycloid of which the string would be the radius of curvature at the lowest point, all its vibrations, however large, will be performed in the same time. For a little distance near the bottom, the circle very nearly coincides with the cycloid; and hence it is, that for small arcs, a pendulum vibrating as usual in a circle, is nearly enough isochronous for the purposes of horology; more especially when contrivances are introduced either to compensate for the variations of the arc, or, better still, to destroy them altogether, by making the force on the pendulum so constant that its arc may never sensibly vary. The difference between the time of any *small* arc of the circle and *any* arc of the cycloid, or an infinitely small arc of the circle, varies nearly as the square of the circular arc; and again, the difference between the times of any two small and nearly equal circular arcs of the same pendulum, varies nearly as the arc itself. If a, the arc, is increased by a small amount da, the pendulum will lose $10800\,ada$ seconds a-day, which is rather more than 1 second if a is 2° (from zero) and da is 10′, since the numerical value of 2° is ·035. If the increase of arc is considerable, it will not do to reckon thus by differentials, but we must take the difference of time for the day as 5400 $(a_1^2 - a^2)$, which will be just 8 seconds if $a = 2°$ and $a_1 = 3°$. For many years it was thought of great importance to obtain cycloidal vibrations of clock pendulums, and it was done by making the suspension string or spring vibrate between *cycloidal cheeks*, as they were called. But it was in time discovered that all this is a delusion. First, because there is and can be no such thing in reality as a simple pendulum, and cycloidal cheeks will only make a simple pendulum vibrate isochronously; secondly, because a very slight error in the form of the cheeks (as Huygens himself discovered) would do more harm than the *circular error* uncorrected at all, even for an arc of 10°, which is much larger than the common pendulum arc; thirdly, because there was always some friction or adhesion between the cheeks and the string; and fourthly (a reason which applies equally to all the isochronous contrivances since invented), because a common clock escapement itself generally tends to produce an error exactly opposite to the circular error, or to make the pendulum vibrate quicker the farther it swings; and therefore (as was shown by Mr Denison in the Cambridge Philosophical Transactions in 1848) the circular error is actually useful for the purpose of helping to counteract the error due to the escapement, and the clock goes better than it would with a simple pendulum, describing the most perfect cycloid. At the same time, the thin spring by which pendulums are always suspended, except in some French clocks where a silk string is used (a very inferior plan), causes the pendulum to deviate a little from circular and to approximate to cycloidal motion, because the bend does not take place at one point, but is spread over some length of the spring.

Cycloidal cheeks for pendulums.

The accurate performance of a clock depends so essentially on the pendulum, that we shall go somewhat into detail respecting it. First, then, the time of vibration depends entirely on the length of the pendulum, the effect of the spring being too small for consideration until we come to differences of a higher order. But the time does not vary as the length, but only as the square root of the length; *i.e.*, a pendulum to vibrate two seconds must be four times as long as a seconds pendulum. The relation between the time and the length of a pendulum is expressed thus — $t = \pi\sqrt{\frac{l}{g}}$, where t is the time in seconds, π the well-known symbol for 3·14159, the ratio of the circumference of a circle to its diameter, l the length of the pendulum, and g the force of gravity at the latitude where it is intended to vibrate; this letter g, in the latitude of London, is the symbol for 32·2 feet, that being the velocity (or number of feet per second) at which a body is found by experiment to be moving at the end of the first second of its fall, being necessarily equal to twice the actual number of feet it has fallen in that second. Consequently, the length of a pendulum to beat seconds in London is 39·14 inches. But the same pendulum carried to the equator, where the force of gravity is less, would lose 2¼ minutes a day.

Clock and Watch Work.

The seconds we are here speaking of are the seconds of a common clock indicating *mean solar time*. But as clocks are also required for sidereal time, it may be as well to mention the proportions between a mean and a sidereal pendulum. A sidereal day is the interval between two successive transits over the meridian of a place by that imaginary point in the heavens called ♈, the first point of Aries, at the intersection of the equator and the ecliptic; and there is one more sidereal day than there are solar days in a year, since the earth has to turn more than once round in space before the sun can come a second time to the meridian, on account of the earth's own motion in its orbit during the day. A sidereal day or hour is shorter than a mean solar one in the ratio of ·99727, and consequently a sidereal pendulum must be shorter than a mean-time pendulum in the square of that ratio, or in the latitude of London the sidereal seconds pendulum is 38·87 inches. As we have mentioned what is 0 or 24 o'clock by sidereal time, we may as well add, that the mean day is also reckoned in astronomy by 24 hours, and not from midnight as in civil reckoning, but from the following noon; thus, what we call 11 A.M. May 1 in common life, is 23 h. April 30 with astronomers.

Different kinds of time.

It must be remembered that the pendulums whose lengths we have been speaking of are simple pendulums; and, as that is a thing which can only exist in theory, the reader may ask how the length of a real pendulum to vibrate in any required time is ascertained. In every pendulum, that is to say in every body hung so as to be capable of vibrating freely, there is a certain point, always somewhere below the centre of gravity, which possesses these remarkable properties: that if the pendulum were turned upside down, and set vibrating about this point, it would vibrate in the same time as before; and, moreover, the distance of this point from the point of suspension is exactly the length of that imaginary simple pendulum which would vibrate in the same time. This point is therefore called the *centre of oscillation*. The rules for finding it by calculation are too complicated for ordinary use, except in bodies of certain simple and regular forms; but they are fortunately not requisite in practice, because in all clock pendulums the centre of oscillation is only a short distance below the centre of gravity of the whole pendulum, and generally so near to the centre of gravity of the bob—in fact a little above it—that there is no difficulty in making a pendulum for any given time of vibration near enough to the proper length at once, and then adjusting it by screwing the bob up or down until it is found to vibrate in the proper time.

Revolving pendulum.

Thus far we have been speaking of vibrating pendulums; but the notice of pendulums would be incomplete without some allusion to revolving or *conical* pendulums, as they are called, because they describe a cone in revolving. Such pendulums are used where a continuous instead of an intermittent motion of the clock train is required, as in the clocks for keeping an equatorial telescope directed to a star, by driving it the opposite way to the motion of the earth, to whose axis the axis on which the telescope turns is made parallel. Clocks with such pendulums might also be used in bedrooms by persons who cannot bear the ticking of a common clock. The pendulum, instead of being hung by a flat spring, is hung by a thin piece of piano-forte wire; and it should be understood that it has no tendency to twist

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on its own axis, and so to twist off the wire, as may be apprehended: in fact it would require some extra force to make it twist, if it were wanted to do so. The time of revolution of a revolving pendulum may be easily ascertained as follows:—Let l be the length of the pendulum, α the angle which it makes with the vertical axis of the cone which it describes; ω the angular velocity; then the centrifugal force $= \omega^2 l \sin\alpha$; and as this is the force which keeps the pendulum away from the vertical, it must balance the force which draws it to the vertical, which is $g \tan\alpha$: and therefore

$\sqrt{\frac{g}{l\cos\theta}} = \omega$, the angular velocity, or the angle described in 1 second of time; and the time of a complete revolution through the angle 360°, or 2π, is $\frac{2\pi}{\omega} = 2\pi\sqrt{\frac{l\cos\alpha}{g}}$. That is to say, the time of revolution of a pendulum of any given length is less than the time of a double oscillation of the same pendulum, in the proportion of the cosine of the angle, which it makes with the axis of revolution, to unity.

A rotary pendulum is kept in motion by the train of the clock ending in a horizontal wheel with a vertical axis, from which projects an arm pressing against a spike at the bottom of the pendulum; and it has this disadvantage, that any inequality in the force of the train, arising from variations of friction or any other cause, is immediately transmitted to the pendulum; whereas it will be seen that in several kinds of escapement which can be applied to a vibrating pendulum, the variations of force can be rendered nearly or quite insensible. And it is a mistake to imagine that there is any self-correcting power in a conical pendulum analogous to that of the governor of a steam engine; for that apparatus, though it is a couple of conical pendulums, has also a communication by a system of levers with the valve which supplies the steam. The governor apparatus has itself been applied to telescope-driving clocks, with a lever ending in a spring which acts by friction on some revolving plate in the clock, increasing the friction, and so diminishing the force as the balls of the governor fly out farther under any increase in the force. And with the addition of some connection with the hand of the observer, by which the action can be farther moderated, the motion can be made sufficiently uniform for that purpose; though for a clock to be kept going constantly and accurately without attendance, some further provisions are necessary, as will be explained under the head of *train remontoires*. It has indeed been proposed to obtain a uniform motion of the clock train from a vibrating pendulum, by means of a crank attached to a wheel revolving in two beats of the pendulum, and connected with it by a rod so long that it may be considered always nearly horizontal; since it will be found on investigation that the horizontal velocity of any point in a pendulum swinging freely varies in the same ratio as that of the end of a crank revolving uniformly. But this will not do in practice, because any increase in the force of the train would immediately make the pendulum desire to increase its arc and its velocity, and the motion of the crank would be no longer uniform, but be checked at the end of every vibration; and if the force were diminished the pendulum would not go far enough to carry the crank past the dead points, and the clock would stop.

PENDULUM SUSPENSION.

The suspension of the pendulum on what are called *knife-edges*, like those of a scale-beam, has often been advocated. But though it may do well enough for short experiments, in which the effects of the elasticity of the spring are wanted to be eliminated, it fails altogether in use, even if the knife-edges and the plates which carry them are made of the hardest stones. A suspension on friction wheels, or the small portion of the entire wheel which is required, has also been used, but only in two instances, by the late Mr Vulliamy, under an erroneous impression respecting the nature of the compensation for temperature required, both for the spring and the rod of a pendulum when of great size. This suspension may, no doubt, be made to answer; but as it involves extreme delicacy of adjustment and great expense, and possesses no corresponding advantage over the common method, it will probably never be used again. The suspension which is now used universally in all but some inferior foreign clocks, which have strings instead, is a thin and short spring, with one end let into the top of the pendulum, and the other screwed between two *chops* of metal with a pin through them, which rests firmly in a nick in the cock which carries the pendulum; and the steadiness of this cock is essential to the accurate performance of the clock. The thinner the spring the better, provided, of course, it is strong enough to carry the pendulum without being bent beyond its elasticity, or bent short; not that there is much risk of that in practice. Pendulum springs are much oftener too thick than too thin; and it is worth notice that, independently of their greater effect on the natural time of vibration of the pendulum, thick and narrow springs are more liable to break than thin and broad ones of the same strength. It is of great importance that the spring should be of uniform thickness throughout its breadth; and the bottom of the chops which carry it should be exactly horizontal; otherwise the pendulum will swing with a twist, as they may be often seen to do in ill-made clocks.

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The bob of the pendulum used, till lately, to be generally made in the shape of a lens, with a view to its passing through the air with the least resistance. But after the importance of making the bob heavy was discovered, it became almost necessary to adopt a form of more solid content in proportion to its surface. A sphere has been occasionally used, but it is not a good shape, because a slight error in the place of the hole for the rod may make a serious difference in the amount of weight on each side, and give the pendulum a tendency to twist in motion. The mercurial jar pendulum suggested the cylindrical form, which is now generally adopted for astronomical clocks; and it has also lately been used in the best turret clocks, with a round top to prevent the effect of any bits of mortar or dirt falling and resting upon it, which would alter the time; it has also been thought to look better than a flat-topped cylinder. There is no rule to be given for the weight of pendulums. It will be shown hereafter, that whatever escapement may be used, the errors due to any variation of force are expressed in fractions which invariably have the weight and the length of the pendulum in the denominator, though some kinds of escapements require a heavy pendulum to correct their errors much less than others. And as a heavy pendulum requires very little more force to keep it in motion than a light one, being less affected by the resistance of the air, we may almost say that the heavier and longer a pendulum can be made the better; at any rate, the only limit is one of convenience; for instance, it would obviously be inconvenient to put a large pendulum of 100 lb. weight in the case of an astronomical or common house clock. It may perhaps be laid down as a rule, that no astronomical clock or *regulator* (as they are also called) will go as well as is expected of such clocks with a pendulum of less than 12 lb. weight, and no turret clock with less than 1 cwt. Long pendulums are generally made with heavier bobs than short ones; and such a clock as that for the houses of parliament, with a two-seconds pendulum of 6 cwt., ought to go 44 times as well as a small turret clock with a one-second pendulum of 60 lb. Pendulums longer than 14 feet (2 seconds) are inconvenient, liable to be disturbed by wind, and impossible, or at least enormously expensive, to compensate, and they

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are now quite disused. An old clock with a 56 feet pendulum (4 seconds) was lately removed from Halifax church to be replaced by one with an 8 feet compensated pendulum, and a clock such as we shall have to describe when we come to turret clocks.

PENDULUM REGULATION.

The regulation of pendulums, or their exact adjustment to the proper length, is almost always effected by a nut on the end of the rod, by which the bob can be screwed up or down. In the best clocks the rim of this nut is divided, with an index over it; so the exact quantity of rise or fall may be known, or the exact acceleration or retardation, the amount due to one turn of the nut being previously ascertained. By the calculation used below for compensation of pendulums, it may be seen that if the length of the pendulum rod is l, and the breadth of one thread of the screw is called dl, then one turn of the nut will alter the rate of the clock by $43200\frac{dl}{l}$ seconds a-day; which would be just 30 seconds, if the pendulum rod is 45 inches long, and the screw has 32 threads in the inch. To accelerate the clock the nut has always to be turned to the right, as it is called, and *vice versa*. But in astronomical and in large turret clocks, it is desirable to avoid stopping, or in any way disturbing the pendulum; and for the finer adjustments, other methods of regulation are adopted. The best is that of fixing a collar, as shown in fig. 2, capable of having very small weights laid upon it, half-way down the pendulum, this being the place where the addition of any small weight produces the greatest effect; and where, it may be added, any moving of that weight up or down on the rod produces the least effect. An addition there of a weight $= \frac{1}{1000}$th of the weight of the pendulum will accelerate it a little more than 1 second a day, or 10 grains will do that on a pendulum of 15 lb. weight (7000 gr. being = 1 lb.), or an ounce on a pendulum of 6 cwt.; and these small weights can be easily taken off and put on without any risk of disturbing the pendulum. The weights should be made in a series, and marked $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, according to the number of seconds a day by which they will accelerate, and the pendulum adjusted at first to lose a little, perhaps a second a day, when there are no weights on the collar, so that it may always have some weight on, which can be diminished or increased from time to time, with certainty, as the rate may vary.

COMPENSATION OF PENDULUMS.

Soon after pendulums began to be generally used in clocks, it was discovered that they contained within themselves a source of error independent of the action of the clock upon them, and that they lost time in hot weather and gained in cold, in consequence of all the substances of which they could be made expanding as the temperature increases. If l is the length of a pendulum, and dl the small increase of it from increased heat, t the time of the pendulum l, and $t+dt$ that of the pendulum $l+dl$; then $\frac{t+dt}{t} = \frac{\sqrt{l+dl}}{\sqrt{l}} = 1+\frac{dl}{2}$; since $\left(\frac{dl}{l}\right)^2$ may be neglected as very small; or $dt = \frac{t\,dl}{2l}$; and the daily loss of the clock will be $43200\,\frac{dl}{l}$ seconds. The following is a table of the values $\frac{dl}{l}$ for 10° of heat in different substances.

White deal	·000024
Flint glass	·000048
Steel rod	·000064
Iron rod	·000070
Brass	·00010
Lead	·00016
Zinc	·00017
Mercury (in bulk, not in length)	·00100

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Thus a common pendulum with an iron wire rod would lose $43200 \times ·00007 = 3$ seconds a-day for 10° of heat, and if adjusted for winter temperature would lose about a minute a-week in summer, unless something in the clock happened to produce a counteracting effect, as we shall see may be the case when we come to escapements. We want, therefore, some contrivance which will always keep that point of the pendulum on which its time depends, viz., the *centre of oscillation*, at the same distance from the point of suspension. A vast number of such contrivances have been made, but there are only three which can be said to be at all in common use; and the old *gridiron pendulum*, made of 9 alternate bars of brass and steel is not one of them, having been superseded by one of zinc and iron, exactly on the same principle, but requiring much fewer bars on account of the greater expansion of zinc than brass. Although this is the most modern of the compensated pendulums, in consequence of the working of zinc being a modern art, we will describe it first. And as the centre of oscillation so nearly coincides in all clock pendulums with the centre of the *bob*, we may practically say that the object of compensation is to keep the bob always at the same height. Fig. 2 is a section of the great Westminster clock pendulum above mentioned. The iron rod which runs from top to bottom ends in a screw with a nut N for adjusting the length of the pendulum after it was made by calculation as near the right length as possible. On this nut rests a collar M, which can slide up the rod a little way, but is prevented from turning by a pin through the rod. On a groove or annular channel in the top of this collar stands a zinc tube 10 feet 6 inches long, and nearly half an inch thick, made of three tubes all drawn together, so as to become like one; for it should be observed that *cast* zinc cannot be depended on; it must be drawn. On the top of this tube or hollow column fits another collar with an annular groove much like the bottom one M. The object of these grooves is to keep the zinc column in its place, not touching the rod within it, as contact might produce friction, which would interfere with their relative motion under expansion and contraction. Round the collar C is screwed a large iron tube, also not touching the zinc, and its lower end fits loosely on the collar M; and round its outside it has another collar of its own, D, fixed to it, on which the bob rests. The iron tube has a number of large holes in it down each side, to let the air get to the zinc tube: before that was done it was found that the compensation lagged a day or two behind the changes of temperature, in consequence of the iron rod and tube being exposed while the zinc tube was inclosed without touching the iron. The bottom of the bob is 14 feet 11 inches from the top of the spring A, and the bob itself is 18 inches high, with a dome-shaped top and 12 inches in diameter. As it is a 2-seconds pendulum, its centre of oscillation is 13 feet from the top A, which is very near the centre of gravity of the pendulum, and higher than usual above the centre of gravity of the bob, on account of the great weight of the compensation tubes. The whole weighs 682 lb., which is half as large again as Mr Vul-

Zinc compensation.

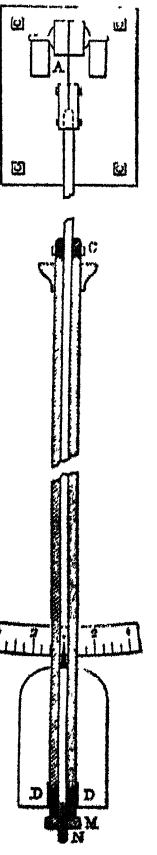


Fig. 2.

liamy's Post-office clock pendulum, which was before the heaviest probably in the world, but it is only a wooden one. The same proportions, of course, will hold for zinc compensation pendulums of smaller size, the zinc tube and the iron tube being always nearly two-thirds of the length of the main rod. The compensating action is evidently this: the iron rod and tube both let the bob down as they expand, and the zinc column pushes it up; and as the ratio of the expansion of iron to zinc is ·41, it will be found that by the above proportions the centre of oscillation will remain at the same height; and experience has ratified the calculation, the pendulum having been now (1854) going for two years in Mr Dent's factory.

Lead compensation.

The second kind of compensation pendulum in use is still more simple, but not so effective or certain in its action; and that is merely a wooden rod with a long lead bob resting on a nut at the bottom. According to the above table, it would appear that this bob ought to be 14 inches high in a 1-second pendulum; but the expansion of wood is so uncertain, that this proportion is not found capable of being depended on, and a somewhat shorter bob is said to be generally more correct in point of compensation. And we believe that all persons who have tried wood pendulums severely, have come to the same conclusion as Mr Reid did long ago, that they are capricious in their action, and consequently unfit for the highest class of clocks.

Mercurial compensation.

The best of all the compensations is undoubtedly the mercurial, which was invented by George Graham, a London clockmaker, above a century ago, who also invented the well-known dead escapement for clocks, and also the horizontal or cylinder escapement for watches, which will be hereafter explained. And the best form of the mercurial pendulum is that which was introduced by the late Mr Dent, in which the mercury is inclosed in a cast iron jar or cylinder, into the top of which the steel rod is screwed, with its end plunged into the mercury itself. For by this means the mercury, the rod, and the jar, all acquire the new temperature at any change, more nearly together, than when the mercury is in a glass jar hung by a *stirrup* (as it is called) at the bottom of the rod; and moreover the pendulum is safe to carry about, and the jar can be made perfectly cylindrical by turning, and also air tight, so as to protect the mercury from oxydation; and, if necessary, it can be heated in the jar so as to drive off any moisture, without any risk of breaking. The height of mercury required in a cast iron jar 2 inches in diameter is about 6½ inches; for it must be remembered in calculating the rise of the mercury, that the jar itself expands laterally, and that expansion has to be deducted from that of the mercury in bulk.

There are several other kinds of compensation which may be found described in Mr Denison's treatise, and other books. But as the mercurial is indisputably the best, though expensive, and the zinc and iron pendulum is both better and cheaper than any of those others, we shall not fill our pages by describing them. We will only add this caution to persons who may be captivated with the apparent simplicity of that class of compensations in which the pendulum spring is drawn up through a slit, so as to shorten it as the length of the pendulum increases, that that method in any of its forms is not to be relied on. All the compensations also on the lever principle, invented by Mr Ellicott, many years ago, are equally fallacious and uncertain; though this, as well as the spring-shortening methods, do not seem to have been yet abandoned by the French clockmakers—at least they had not at the time of the Great Exhibition in 1851.

We alluded a short time ago to the effect of the spring upon the time of vibration. However thin it may be, it has some tendency to make the pendulum move more quickly than if it were suspended on knife-edges; and as all springs are stiffer the colder they are, the spring accelerates the pendulum in cold weather a little more than in hot, though to a far less extent than the variation in the length of the pendulum itself. It is impossible to give any rule for the extra compensation thus required, except such as might be deduced from a large and careful series of experiments on pendulums and springs of various sizes. The late Mr Dent stated in a paper read before the British Association in 1840, that he had found such a spring as is generally used in astronomical clock pendulums to require about ¼th to be added to the ordinary compensation for the rod. It should be remembered that this effect is much greater on a short pendulum than a long one; indeed, on a 2-seconds pendulum of considerable weight it seems not perceptible at all when the spring is of no more than the proper thickness.

ESCAPEMENTS.

The escapement is that part of the clock in which the rotary motion of the wheels is converted into the vibratory motion of the balance or pendulum, which by some contrivance or other is made to let one tooth of the quickest wheel in the train escape at each vibration; and hence that wheel is called the "scape wheel." Fig. 3 shows the form of the earliest clock escapement, if it is held sideways, so that the arms on which the two balls are set may vibrate on a horizontal plane. In that case the arms and weights form a balance, and the farther out the weights are set, the slower would be the vibrations. If we now turn it as it stands here, and consider the upper weight left out, it becomes the earliest form of the pendulum clock, with the *crown-wheel* or *vertical* escapement. CA and CB are two flat pieces of steel called *pallets* projecting from the axis about at right angles to each other, one of them over the front of the wheel as it stands, and the other over the back. The tooth D is just escaping from the front pallet CA, and at the same time the tooth at the back of the wheel falls on the other pallet CB a little above its edge. But the pendulum, which is now moving to the right, does not stop immediately, but swings a little further (otherwise the least failure in the force of the train would stop the clock, as the escape would not take place), and in so doing it is evident that the pallet B will drive the wheel back a little, and produce what is called the *recoil*; which is visible enough in any common clock with a seconds hand, either with this escapement or the one which will be next described.

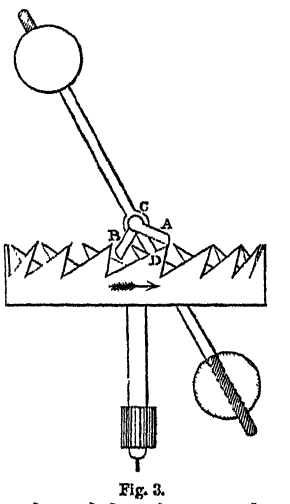


Fig. 3.

It will be seen, on looking at the figure, that the pallet B must turn through a considerable angle before the tooth can escape; in other words, the crown wheel escapement requires a long vibration of the pendulum. This is objectionable on several accounts; first, because it requires a great force in the clock train, and a great pressure and therefore friction, on the pallets; and besides that, any variation in a large arc, as was explained before, produces a much greater variation of time due to the circular error than an equal variation of a small arc. The crown wheel escapement may indeed be made so as to allow a more moderate arc of the pendulum, though not so small as the 2° usually adopted now in the best clocks, by putting the pallet arbor a good deal higher above the scape wheel, and giving a small number of teeth to the wheel; and that also diminishes the length of run of the teeth, and consequently the friction, on the pallets, though it makes the recoil very great and sudden; but, oddly enough, it never appears to

have been resorted to until long after the escapement had become superseded by the "anchor" escapement, which we shall now describe, and which appears to have been invented by the famous Dr Hooke as early as the year 1656, very soon after the invention of pendulums.

Common recoil escapement.

In fig. 4 a tooth of the scape wheel is just escaping from the left pallet, and another tooth at the same time falls upon the right hand pallet at some distance from its point. As the pendulum moves on in the same direction, the tooth slides farther up the pallet, thus producing a recoil, as in the crown-wheel escapement. The acting faces of the pallets should be convex, and not flat, as they are generally made, much less concave, as they have sometimes been made, with the view of checking the motion of the pendulum, which is more likely to injure the rate of the clock than to improve it. But when they are flat, and of course still more when they are concave, the points of the teeth always wear a hole in the pallets at the extremity of their usual swing, and the motion is obviously easier, and therefore better, when the pallets are made convex; in fact they then approach more nearly to the "dead" escapement, which will be described presently. We have already alluded to the effect of some escapements in not only counteracting the circular error, or the natural increase of the time of a pendulum as the arc increases, but overbalancing it by an error of the contrary kind. The recoil escapement does so; for it is almost invariably found that whatever may be the shape of the pallets, the clock loses as the arc of the pendulum falls off, and *vice versa*. It is, however, unfortunately impossible so to arrange the pallets that the circular error may be thus exactly neutralized, because the escapement errors depend, in a manner reducible to no law, upon variations in friction of the pallets themselves, and of the clock train, which produce different effects; and the result is, that it has long been recognised as impossible to obtain very accurate time-keeping from any clock of this construction.

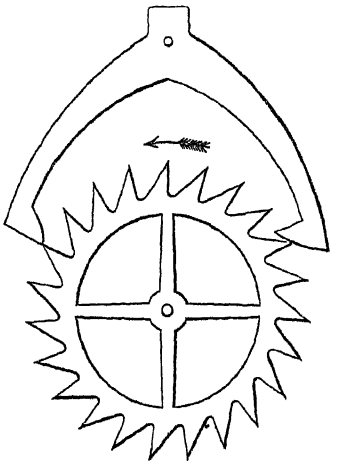


Fig. 4.

But before we pass on to the dead escapement, it may be proper to notice an escapement of the recoiling class, which was invented for the purpose of doing without oil, by the famous Harrison, who was at first a carpenter in Lincolnshire, but afterwards obtained the first government reward for the improvement of chronometers. We shall not however stop to describe it, since it never came into general use, and it is said that nobody but Harrison himself could make it go at all. It was also objectionable on account of its being directly affected by all variations in the force of the clock. It had the peculiarity of being very nearly silent, though the recoil was very great. Those who are curious about such things will find it described in the earlier editions of this Encyclopædia, and in others. The recorded performance of one of these clocks which is given in some accounts of it, is evidently fabulous.

Dead escapement

The escapement which has now for a century and a half been considered the best practical clock escapement (though there have been constant attempts to invent one free from the defects which it must be admitted to possess), is the *dead escapement*, or as the French call it with equal expressiveness, *l'echappement à repos*; because, instead of the recoil of the tooth upon the pallet which took place in the previous escapements, it falls dead upon the pallet and reposes there until the pendulum returns and lets it off again. It is represented in fig 5. It will be observed that the teeth of the scape wheel have their points set the opposite way to those of the recoil escapement in fig. 4, the wheels themselves both turning the same way, or (as our engraver has represented it) *vice versâ*. The tooth B is here also represented in the act of dropping on to the right hand pallet as the tooth A escapes from the left pallet. But instead of the pallet having a continuous face as in the recoil escapement, it is divided into two, of which BE on the right pallet and FA on the left are called the impulse faces, and BD, FG the dead faces. The dead faces are portions of circles (generally of the same circle), having the axis of the pallets C for their centre; and the consequence evidently is, that as the pendulum goes on, carrying the pallet still nearer to the wheel than the position in which a tooth falls on to the corner A or B of the impulse and the dead faces, the tooth rests on the other dead faces without any recoil, until the pendulum returns and lets the tooth slide down the impulse face, giving the impulse to the pendulum as it goes.

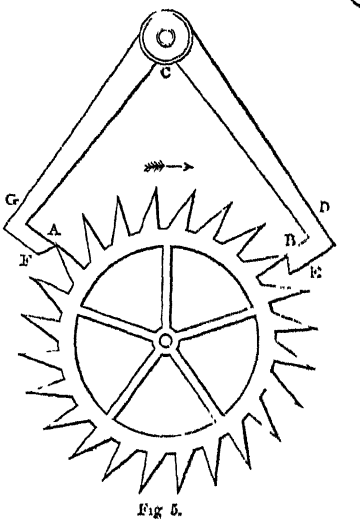


Fig 5.

The great merit of this escapement is that a moderate variation in the force of the clock train produces a very slight effect in the time of the pendulum. This may be shown in a general way, without resorting to mathematics, thus:— Since the tooth B drops on to the corner of the pallet (or ought to do so), immediately after the tooth A has escaped, and since the impulse will begin at B when the pendulum returns to the same point at which the impulse ceased on A, it follows that the impulse received by the pendulum before and after its vertical position is very nearly the same. Now that part of the impulse which takes place before zero, or while the pendulum is descending, tends to augment the natural force of gravity on the pendulum, or to make it move faster; but in the ascending arc the impulse on the pallets acts against the gravity of the pendulum, and therefore tends to make it go slower; and so the two parts of the impulse tend to neutralize each other's disturbing effects on the time of the pendulum, though they both concur in increasing the arc, or (what is the same thing) maintaining it against the loss from friction and resistance of the air. However, on the whole, the effect of the impulse is to retard the pendulum a little, because the tooth must fall not exactly on the corner of the pallet, but (for safety) a little above it; and the next impulse does not begin until that same corner of the pallet has come as far as the point of the tooth; in other words the retarding part of the impulse, or that which takes place after zero, acts rather longer than the accelerating part before zero. Again, the friction on the dead part of the pallets tends to produce the same effect on the time; the arc of course it tends to diminish. For in the descent of the pendulum, the friction acts against gravity, but in the ascent with gravity, or accelerates the pendulum; and the action on the dead part of the pallets is a little shorter in the ascent than the descent. For these reasons the time of vibration of a pendulum driven by a dead escapement is a little greater than of the same

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pendulum vibrating the same arc freely; and when you come to the next difference, the variation of time of the same pendulum with the dead escapement under a moderate variation in the force is very small indeed; which is not the case in the recoil escapement, for there the impulse begins at each end of the arc, and there is much more of it during the descent of the pendulum than during the ascent from zero to the arc at which the escape takes place, and the recoil begins, on the opposite tooth; and then the recoil itself is an action on the pendulum in its ascent in the same direction as gravity, and therefore accelerative. And hence it is that an increase of the arc of the pendulum with a recoil escapement is always accompanied with a decrease of the time.

But something more than this general mode of reasoning is requisite in order to compare the real value of the dead escapement with others of equal or higher pretensions, or of the several contrivances that have been suggested for remedying its defects. In the year 1827, Mr Airy, the present astronomer royal, wrote a paper in the *Cambridge Philosophical Transactions*, vol. iii. p. 105, on the disturbances of pendulums and the theory of escapements, which, though erroneous in some of the practical conclusions, is extremely valuable as the mathematical foundation for subsequent investigations; it is too long to insert here, and it may be found in Pratt's *Mechanics*. We shall therefore take it up at the point which is convenient for making the proper deductions from it. He proved, that if ϕ is the disturbing force on the pendulum of length l at the angle θ from zero, α the extreme arc, and g the accelerating force of gravity, the increase of time of one vibration due to the disturbance $= \frac{l}{\pi g \alpha^2} \int \frac{\phi\theta\, d\theta}{\sqrt{\alpha^2 - \theta^2}}$ taken between the limits within which the disturbing force acts. He also gives an expression for the increase of the arc; but though of course mathematically correct, it is practically useless, because the increase of the arc for one vibration is no guide at all to what it will reach before the influence of friction and the resistance of the air prevents any further increase.

Proceeding with Mr Airy's formula for the variation of the time, and adopting the farther results obtained by Mr Denison in his paper of 1848, in the eighth volume of the *Cambridge Transactions*, let us call the angle which the impulse faces of the pallets make with the dead faces δ; then, since the tooth, considered as a prolonged radius of the wheel, ought to be a tangent to the dead face, δ will also be the inclination of the tooth to the impulse face at the beginning of the impulse, and it may be assumed to remain the same throughout: though, in fact, it increases towards the end of the impulse. Let p be the distance of each pallet from their arbor, and Pg the moving force of the clock-weight referred to the points of the scape-wheel, after deducting the force required to move the train, M the mass of the pendulum (supposed to be a simple one) and l its length, and θ the angle which the pendulum makes with the vertical; then the equation of motion of the pendulum is

$$\frac{d^2\theta}{dt^2} = -\frac{g}{l}\left(\theta + \frac{Pp\tan\delta}{Ml^2}\right)$$

and therefore ϕ, the disturbing force, is $\frac{g\,Pp\tan\delta}{Ml^2}$; and the increase of time for one vibration, which we may call

$$\Delta = \frac{Pp\tan\delta}{Ml\pi\alpha^2}\int \frac{\theta\, dt}{\sqrt{\alpha^2 - \theta^2}}$$

If β is the angle before zero at which the impulse begins, and γ the angle after zero at which it ends, and which is necessarily rather larger than β, then this integral has to be taken between the limits $\theta = -\beta$, and $\theta = \gamma$, and the result is—

$$\Delta = \frac{Pp\tan\delta}{Ml\pi\alpha^2}\left(\sqrt{\alpha^2 - \beta^2} - \sqrt{\alpha^2 - \gamma^2}\right)$$

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And as β and γ are always small compared with α, higher powers than $\frac{\gamma^2}{\alpha^2}$ may be neglected, and the equation may assume the simpler form $\Delta = \frac{Pp\tan\delta}{2Ml\pi\alpha^3}(\gamma+\beta)(\gamma-\beta)$.

Theory of the dead escapement.

Since in a well-made clock β may be made very nearly $= \gamma$, *i.e.* the tooth may be made to drop almost exactly on the corner of the dead face, Mr Airy concludes that "this escapement approaches nearly to absolute perfection." Mr Denison shows, however, that this conclusion is somewhat too rapid; that the accuracy which really is found in the going of a good clock of this kind is due to a cause not apparent in this value of Δ; that an escapement of another kind, in which Δ is very much larger, admits of still greater perfection, inasmuch as it is not the magnitude but the variation of Δ which measures the goodness of the clock. And besides all this, the assumption that the friction of the pallets does not affect the performance of a dead escapement clock is very far from correct: on the contrary, it has generally more to do with the actual errors of time than all the other causes. In order to arrive at the actual amount of these errors we will proceed with the examination of the quantity Δ.

Let h be the daily fall of the clock-weight Wg, T the number of beats of the pendulum in the day ($= 86400$ if it is a seconds pendulum); the drop of the tooth at each beat is a little less than the thickness of the pallets, which $= p(\gamma+\beta)\tan\delta$; and therefore we may say (intending to make some deduction afterwards from the actual amount of W for the friction of the train and the loss of force at each drop)—

$$\Delta T = \frac{Wh}{Ml}\frac{(\gamma-\beta)}{2\pi\alpha^3}$$

in which you observe that $\gamma+\beta$ has disappeared: $\gamma-\beta$ is seldom made less than 30′; and therefore we may put $\frac{1}{720}$ for $\frac{\gamma-\beta}{2\pi}$, and that reduces the equation to the simple form, $\Delta T = \frac{Wh}{720\,Ml\alpha^3}$.

Now, though the clock weight and its daily fall are constant in any given clock, yet the quantity of this moving force which arrives at the escapement is not constant, because it is diminished by friction, which varies with the state of the oil and other circumstances; and that produces the same effect as if the clock-weight itself varied. Let us call that variation of force on the escapement dW. The clock is also subject to variations of α, the arc of the pendulum, partly depending on these changes in the force of the clock train, but still more upon the variations in the friction on the pallets themselves, so that no definite relation can be established between any increase of arc $d\alpha$, and the variations of force or friction in the train. And in order to learn what effect is produced upon the rate of the clock by any given *small* changes in the arc or the force, we must differentiate the above equation, and we shall have (treating, as we shall throughout, the differences as finite)

$$d\Delta T = \frac{Wh}{720\,Ml\alpha^3}\left(\frac{dW}{W} - \frac{3\,d\alpha}{\alpha}\right)$$

And to this must be added a third term to express the circular error due to the increase of the arc from α to $\alpha + d\alpha$. This, as stated before, is theoretically $+10800\,\alpha\,d\alpha$; but practically it is a great deal less, from the effect of the pendulum spring, which has a tendency to isochronize the pendulum, though all attempts to make it do so completely have failed, and no other figures can be given for estimating the actual amount of the circular error. The

Clock and Watch Work.

Theory of the dead escapement.

quantity we have called $d\Delta T$ is that which is technically called the *daily rate*, only with the sign reversed, as the rate is always called + when the clock is gaining, and assuming the pendulum to be properly adjusted so that the daily rate, but for the escapement errors, would be 0.

Now, as to the numerical value of this quantity in seconds, or fractions of a second: in an ordinary astronomical clock, after allowing for the friction of the train, Wh may be taken as 2 lb. × 9 in.: l is 39 inches, and M about 15 lb., and α the angle 2° is ·035 in numerical value. Therefore $\frac{Wh}{720\,Ml\,\alpha^3}$ = 1 second very nearly. As to the other parts of the expression for $d\Delta T$, it generally happens that the clock gains if the arc falls off, which shows that the two + terms, $\frac{dW}{W}$ and the circular error term, then preponderate over the other, involving $\frac{d\alpha}{\alpha}$. Sometimes, however, the contrary is the case, as where the friction on the pallets alone is altered by oiling them, or by the self-polishing which they often perform for themselves in the course of a few months after the clock is made, especially in turret clocks. Mr Denison says in his Cambridge paper of 1853 (vol. ix.), that from a number of experiments made for testing the value of an invention in the Great Exhibition for rendering pendulums isochronous, as well as from observations made before, it is clear that not only can no isochronizing of the pendulum for different arcs counteract the errors of the dead escapement; but that when the variation of time is due to the change of pallet friction, it would be still worse with an isochronous pendulum, because the circular error (as the above equation shows) tends to counteract the other error which is due to the change of arc, $d\alpha$.

Mr Airy showed, in his before-mentioned paper, that the friction on the dead faces of the pallets, if it acted through exactly instead of nearly the same arc before and after zero, would produce no direct effect upon the time. But it is a great mistake to infer that this friction does not materially affect the clock nevertheless. The fallacy of such an inference is shown at once by the above expressions for the escapement errors; for the effect of all the friction on the pallets is to reduce the arc, or to require a larger force to produce the same arc. And as the cube of the arc appears in the denominator, and a large increase of force is required to produce a small increase of arc, it is obvious that the friction on the pallets indirectly and largely increases all the errors of the escapement, although it may produce very little direct effect upon the time, as compared with that of a free pendulum vibrating the same arc. In order to diminish the friction and the necessity for using oil as far as possible, the best clocks are made with jewels (sapphires are the best for the purpose) let into the pallets. Mr Dent used them in the large clock at the Royal Exchange, probably the first time they had ever been used in a turret clock, though softer and cheaper stones had been occasionally used.

The pallets are generally made to embrace about one-third of the circumference of the wheel, and it is not at all desirable that they should embrace more; for the longer they are, the longer is the run of the teeth upon them, and the greater the friction. In the Great Exhibition Messrs Wagner of Paris had an apparatus for practically illustrating this, which however is obvious enough without any illustration. There is a good deal of difference in the practice of clockmakers as to the length of the impulse, or the amount of the angle $\gamma+\beta$. Sometimes you see clocks in which the seconds hand moves very slowly and rests a very short time, showing that $\gamma+\beta$ is large in proportion to 2α; and in others the contrary. The transit clock at Greenwich was altered by the late Mr Dent to a short impulse, the escape taking place at only 30′ after zero; and he was decidedly of opinion that a short impulse was the best, probably because there is less of the force of the impulse wasted in friction then. It is not to be forgotten, as Mr Bloxam remarks in his paper on escapements in the *Transactions of the Astronomical Society* for 1853, that the scape-wheel tooth does not overtake the face of the pallet immediately, on account of the moment of inertia of the wheel. The wheels of astronomical clocks, indeed of all English house-clocks, are generally made too heavy, especially the scape-wheel, which by increasing the moment of inertia, requires a larger force, and consequently more friction. We shall show presently, from another escapement, how much of the force is really wasted in friction in the dead escapement.

Clock and Watch Work.

But before proceeding to other escapements, it is proper to notice a very useful form of the dead escapement, which is adopted in many of the best turret clocks, called the pin-wheel escapement, the invention of which is commonly ascribed to Lepaute of Paris about the middle of the last century, though it appears to have been used as early by Whitehurst of Derby. Fig. 6 will sufficiently explain its action and construction. Its advantages are:—that it does not require so much accuracy as the other; if a pin gets broken, it is easily replaced, whereas in the other the wheel is ruined if the point of a tooth is injured; a wheel of given size will work with many more pins than teeth, and therefore a train of less velocity will do, and that in fact sometimes amounts to a saving of one wheel in the train, and a good deal of friction; and the blow on both pallets being downwards, instead of one up and the other down, the action is more steady; all of which things are of more consequence in the heavy and rough work of a turret clock than in an astronomical one. The pins are generally semicylinders, as the upper half of the cylinder would obviously be of no use, and would waste nearly half the force in drop without action. But when the wheel is small, and the pallets short, as they ought to be for the reason before given, it is impossible to get a short angle of escape with semicylindrical pins unless they are very small, and therefore Mr Denison suggested the form on the left side of fig. 6, which Mr Dent used in his Great Exhibition clock, and subsequently in others. The pins are bits of brass wire driven into the wheel, about ten for every inch of diameter, and then the upper half, and a small slice of the bottom, cut off in a cutting engine. The distance of the lowest pallet from their axis should not be more than the diameter of the wheel. The cross section of pallets as now generally made is convex, and not flat, which involves greater accuracy, and therefore greater risk of inaccuracy. It has also been found expedient to make the dead faces not quite dead, but with a very slight recoil, which rather tends to check the variations of the arc, and also the general disposition to lose time if the arc is increased; when so made, the escapement is generally called "half-dead."

Pin-wheel escapement.

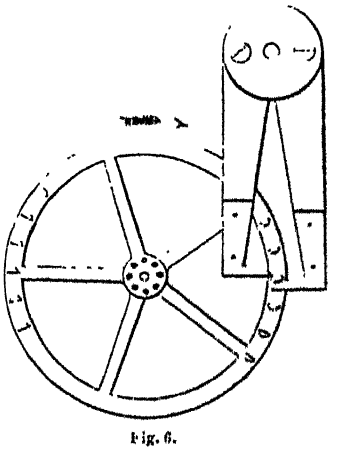


Fig. 6.

Passing by the various other modifications of the dead escapement which have been suggested and tried with little or no success, we proceed to describe one of an entirely different form, which was patented in 1851 by Mr C. Macdowall of Hyde Street, Bloomsbury, though it appeared afterwards that one very similar to it had been tried before

Single pin escapement.

Clock and Watch Work.

but failed from the proportions being badly arranged. It is represented in fig. 7. The scape-wheel is only a small disc with a single pin in it, made of a ruby, parallel, and very near to the arbor. The disc turns half round at every beat of the pendulum, and the pin gives the impulse on the vertical faces of the pallets, and the dead friction takes place on the horizontal faces. Its advantages are, that the greatest part of the impulse is given directly across the line of centres, and consequently with very little friction; and therefore, also, the friction on the dead faces is less than usual, and scarcely any oil is required; it is also very easy to make. But there must be two more wheels in the train, consuming a good deal of the force of the clock-weight by their friction, which rather more than makes up for the friction saved in the escapement. It has however been applied successfully to watches, and they appear to be affected by cold less than the common lever watch with its oblique impulse, exactly like that of the common dead escapement. A prize medal was awarded for it in the Exhibition. In order to make the angle of escape not more than 1°, the distance of the pin from the centre of the disc must not be more than $\frac{1}{60}$th of the distance of centres of the disc and pallets.

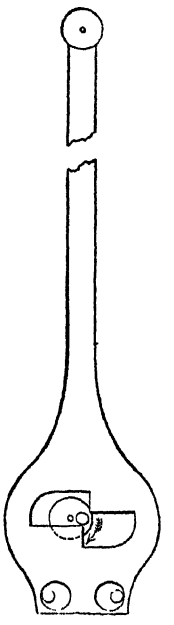


Fig. 7.

Three-legged dead escapement.

With the view of getting rid of one of these extra wheels in the train, and that part of the impulse which is least effective and most oblique, Mr Denison shortly afterwards invented what he called the *three-legged dead escapement;* which, though he afterwards superseded it by his *three-legged gravity escapement*, is still worth notice on account of the exceedingly small force which it requires, thereby giving a practical proof of the large proportion of the force which is wasted in friction in all the other impulse escapements.

In fig. 8, the three long teeth of the scape-wheel are only used for locking on the dead pallets DE, which are set on the front of the pallet plate; AB are the impulse pallets, being hard bits of steel or jewels set in the pallet plate, and they are acted on by the three sharp-edged pins which are set in the scape-wheel pointing backwards. As soon as the pendulum moves a little further to the left than is here shown, the long tooth will slip past the dead pallet or stop D, and the pin at B will run after and catch the corner of that impulse pallet, and drive it until the wheel has turned through 60°, and then it will escape; and by that time the uppermost tooth will arrive at the stop E, and will slide along it as in the common dead escapement, but with a pressure as much less than that which gives the impulse as the points of the teeth are further from the centre of the wheel than the impulse pins are. But the impulse is here given with so little friction, that even where the points of the teeth were made identical with the pins, the clock-weight required to keep the same pendulum with the same train (a common turret-clock movement), swinging the usual arc of 2°, was only *one-fifth* of what had been required with the common pin-wheel escapement. It appears also that it would be possible so to adjust the recoil of the half-dead pallets that the time would not be affected by any small variation of the force and the arc; since it was found that, when a certain amount of recoil was given, the clock gained instead of losing, under an increase of arc due to an increase of clock-weight. And if the force were kept constant by a train-remontoire, such as will be described hereafter, there would in fact be nothing capable of altering the arc or the time. But on account of the small depth of intersection of the circles of the pins and the pallets, on which its action depends, this escapement requires very careful adjustment of the pallets; and considering the superior qualities of the corresponding gravity escapement, it is not likely to be used, except perhaps in clocks required to go a long time, in which economy of force is a matter of consequence. The pallets should be connected with the pendulum by a spring fork (which indeed is advisable in the other dead escapements with a heavy pendulum, especially the pin-wheel escapement), to prevent the risk of their driving backwards against the scape-wheel when it is not in motion, as it will not clear itself. The distance of the centres should be not less than 25 times the radius of the circle of the edges of the impulse pins.

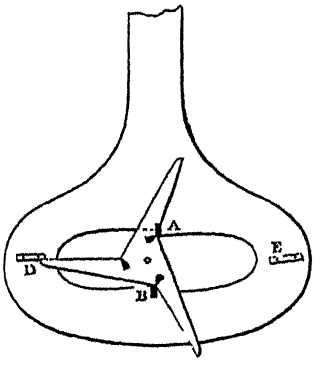


Fig. 8.

REMONTOIRE, OR GRAVITY ESCAPEMENTS.

A remontoire escapement is one in which the pendulum does not receive its impulse from the scape-wheel, but from some small weight or spring which is lifted or wound up by the scape-wheel at every beat, and the pendulum has nothing to do with the scape-wheel except unlocking it. When this impulse is received from a weight the escapement is also called a *gravity escapement;* and inasmuch as all the remontoire clock escapements that are worth notice have been gravity escapements, we may use that term for them at once. The importance of getting the impulse given to the pendulum in this way was recognised long before all the properties of the dead escapement, as above investigated, were known. For it was soon discovered that, however superior to the old recoil escapement, it was far from perfect, and that its success depended on reducing the friction of the train and the pallets as far as possible, which involves the necessity of high-numbered pinions and wheels, small pivots, jewelled pallets, and a generally expensive style of workmanship. Accordingly the invention of an escapement which will give a constant impulse to the pendulum, and nearly free from friction, has been for the last century the great problem of clock-making. We can do no more than shortly notice a very few of the attempts which have been made to solve it. The most simple form of gravity escapement, and the one which will serve the best for investigating their mathematical properties (though it fails in some essential mechanical conditions) is that exhibited in fig. 9. The tooth A of the scape-wheel is there resting against the stop or detent *a* at the end of the pallet CA, from the axis or arbor of which descends the half fork CP to touch the pendulum. From the other pallet CB descends the other half fork CQ. The two arbors are set

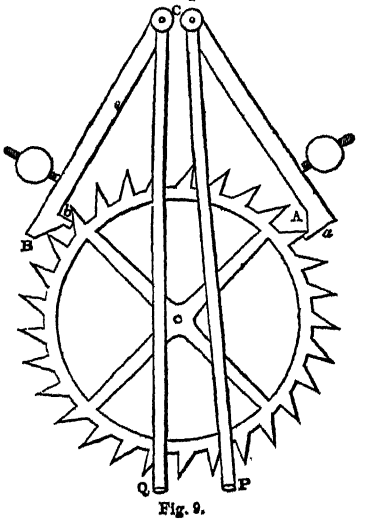


Fig. 9.

Clock and Watch Work.

Gravity escapements.

as near the point of suspension, or top of the pendulum spring, as possible. The pendulum, as here represented, must be moving to the right and just leaving contact with the left pallet and going to take up the right one; as soon as it has raised that pallet a little it will evidently unlock the wheel and let it turn, and then the tooth B will raise the left pallet until it is caught by the stop b on that pallet, and then it will stay until the pendulum returns and releases it by raising that pallet still higher. Each pallet therefore descends with the pendulum to a lower point than that where it is taken up, and the difference between them is supplied by the lifting of each pallet by the clock, which does not act on the pendulum at all; so that the pendulum is independent of all variations of force and friction in the train.

If the angle of the pendulum after zero, at which it takes up the pallet is called γ, and that at which it leaves the other $\pm\beta$, according as the pendulum is then ascending or descending, the impulse is received through $\gamma \pm \beta$. And if one pallet is taken up just when the other is left, the angle of impulse becomes 2γ, equally divided on each side of zero. Let P be the mass, and therefore Pg the weight of each pallet, p the distance of its centre of gravity from the axis C, and δ the angle which a straight line from C to that centre of gravity would make with the pendulum when they are in contact; M the mass, and l the length of the pendulum, as before; then the equation of motion of the pendulum (omitting the small moment of inertia of the pallets as immaterial to this investigation) will be—

$$\frac{d^2\theta}{dt^2} = -\frac{g}{l}\left\{\sin\theta + \frac{Pp\sin(\delta+\theta)}{Ml}\right\}$$

This will expand into terms containing sin θ, for which θ may be substituted because it is very small, and one involving cos θ, which for the same reason may be treated as = 1; those containing θ only produce a permanent alteration of the time, just as if l was altered; the other is the term to which the escapement errors are due. Mr Denison shows, by following up Mr Airy's calculations, that from this equation may be deduced the result, that the daily increase of time over that of the same pendulum swinging freely, due to this cause, may be thus expressed:—

$$\Delta T = -\frac{Wh(\sqrt{\alpha^2-\gamma^2}+\sqrt{\alpha^2-\beta^2})}{Ml\pi\alpha^2(\gamma+\beta)}$$

Wh being the clock-weight × its daily fall, after deducting for all the friction involved in moving the train and lifting the pallets. If the descending pallet is left by the pendulum before zero, we must remember that $\gamma+\beta$ becomes $\gamma-\beta$, and consequently ΔT much larger than where the impulse is given through the middle of the arc. If one pallet is taken up by the pendulum just when it leaves the other (which is the best form of the escapement), then $\beta = \gamma$, and the expression assumes the more simple form—

$$\Delta T = -\frac{Wh}{Ml\pi\alpha^2}\sqrt{\frac{\alpha^2}{\gamma^2}-1}.$$

The − sign indicates that the rate of a pendulum with this escapement is faster than without it, and the difference is a good deal more than the difference the other way in the case of a dead escapement. Hence too it follows that if you reduce the arc in a gravity escapement by lightening the pallets, the clock will not gain, but lose, because lightening the pallets is lowering the centre of gravity of the compound pendulum, which is formed by the pendulum and pallets together. But it does not follow that a gravity escapement must therefore be inferior to a dead one; for the going of the clock depends not on the magnitude, but on the variation, of this quantity ΔT; and where a gravity escapement is free from the usual mechanical defects, which will be noticed presently, the variation of rate can only arise from some slight change in the arc, owing to a change in the density of the air or in the very small friction of the pallets on their pivots or on the stops. We must therefore differentiate ΔT with regard to α, and then we have— Clock and Watch Work.

$$d\Delta T = \frac{Wh}{Ml\pi\alpha^2}\frac{\frac{\alpha^2}{\gamma^2}-2}{\sqrt{\frac{\alpha^2}{\gamma^2}-1}}\frac{d\alpha}{\alpha}$$

And it is evident that if γ is made $= \frac{\alpha}{\sqrt{2}} = \cdot 71\alpha$, this quantity vanishes altogether: that is to say, the variation of the difference of time of a gravity escapement pendulum from a free pendulum of the same length may be made *nothing* by making the difference itself a *maximum;* for this happens to be a maximum, and not a minimum, though the result would of course be the same in that case, by virtue of the well known property of maxima and minima. And it is not necessary to adhere strictly to this proportion of α and γ. Mr Denison found that, after allowing for the friction of the train, the quantity $\frac{Wh}{Ml}$ cannot be more than $\frac{1}{1800}$ in the great Westminster clock; and Mr Bloxam found it rather more in an astronomical clock pendulum, as it ought to be, because a light pendulum loses more of its vibration by the resistance of the air than a heavy one; but it will be seen, by applying this value to the above expression for the rate, that the variation will be quite inconsiderable for any such change of arc as is likely to occur in a gravity escapement, even if γ be made as small as $\frac{\alpha}{3}$.

In those escapements where the pendulum leaves one pallet before it takes up the other, the expression for the variation of rate is

$$d\Delta T = \frac{Wh\,d\alpha}{Ml\pi\alpha^3(\gamma+\beta)}\left\{\frac{\alpha^2-2\gamma^2}{\sqrt{\alpha^2-\gamma^2}} + \frac{\alpha^2-2\beta^2}{\sqrt{\alpha^2-\beta^2}}\right\}$$

remembering that if the descending pallet is left before zero, $\gamma+\beta$ becomes $\gamma-\beta$: from which it is evident that that kind of escapement is very inferior to the other, although the pendulum being left free in the middle of its swing has a tempting appearance. Indeed this result may be easily arrived at without mathematics, because the angle through which the impulse is given (the difference between the drop and the lift of each pallet), is necessarily smaller when one is dropped before zero; and consequently any given variation of the arc of vibration bears a larger proportion to the arc of impulse, and also to the whole arc through which the pallets act on the pendulum at all. This expression however may be reduced to 0 like the former one, by making α, β, and γ satisfy a certain condition, viz.:—

$$\sqrt{\alpha^2-\gamma^2}\ \sqrt{\alpha^2-\beta^2} = \frac{\alpha^2}{2}$$

Thus if $\gamma = 90'$ instead of $85'$, $\pm\beta$ should $= 78'$, α being taken at 2° as usual; but for the reason just now given, any deviation from these proportions will produce much larger errors where the descending pallet is left before zero than where it is left just when the other is taken up. Mr Bloxam notices the changes of the density of the air as sensibly affecting the arc and the rate of a gravity escapement pendulum; probably they affect a dead escapement less, because there the friction on the pallets greatly preponderates over every other cause of disturbance. He says (p. 133, note), that though "it has been repeatedly *proved* in works on dynamics that the resistance of the air does not alter the time of vibration, this is only true on the supposition that the resistance is the same in the ascent and the descent;" whereas the current produced by the increasing velocity in the descent prevents the ascent from being retarded as it would be if the air were at rest; and he has no doubt that any increased density of the air makes the pen-

Clock and Watch Work.

dulum go slower; as indeed it must from this cause also, that it practically diminishes the specific gravity of the pendulum; and therefore a rise of the barometer tends to make the clock gain, some persons have thought, as much as $\frac{1}{8}$ or $\frac{1}{4}$ of a second a-day for one inch. But there does not seem yet to exist any sufficient collection of experiments to allow a definite conclusion to be arrived at as to the magnitude of this disturbance. No doubt the resistance of the air tends to diminish considerably the effect of the circular error, which Mr Bloxam and others have found to be always much less than its theoretical value, even judging from the dead escapement with its large amount of friction.

Besides the above mathematical condition, there are several mechanical ones which are still more essential to the success of a gravity escapement. The first is, that it must be safe from what is called *tripping*. Referring again to fig. 9, it will be seen at once that if the scape-wheel should happen to move too fast when it is released, the left pallet will not be raised gradually by the tooth B, but be thrown up with a jerk, perhaps so high that the tooth slips past the hook; and then not only will that tooth slip, but several more, and at last when the wheel is stopped it will be running fast, and the points of some of the teeth will probably be bent or broken by catching against the pallet. And even if the pallet is not raised high enough for the tooth to get past or completely trip, it may still be raised so high that the point of the tooth does not rest on the hook exactly where the slope of the pallet ends, but lower, and the friction between them is quite enough to keep the pallet there; and consequently the pendulum does not begin to lift it at the angle γ, but at some larger angle; and as the pallet always descends with the pendulum to the same point the duration of the impulse is increased, and the pendulum made to swing farther. Mr Denison calls this *approximate tripping*, and though not so injurious to the clock as actual tripping, it is obviously fatal to its accurate performance, though it appears not to have been noticed before. Various contrivances have been resorted to for the purpose of getting rid of the liability to trip. Cumming, the first inventor of gravity escapements, used two pairs of pallets, one pair being only for the locking, and not lifted at all by the scape-wheel, but only by the pendulum; and this was effectual; but still the teeth suffered in time from the constant blows on the pallets, and the friction at unlocking was considerable. Hardy's escapement was just the same in principle, but worse, because he set the four pallets on springs instead of pivots, which being stronger in cold weather, and acting on the pendulum at the extremity of its arc, made the clock gain in winter; and accordingly his escapement was taken out of the transit clock at Greenwich by Mr Dent, and replaced by a dead escapement, with a short angle of escape, as before mentioned. The late Captain Kater invented an escapement in which he attempted to get rid of tripping by making the impulse pallets drop on to an anchor, like that of a dead escapement with the impulse faces cut off, and so unlock the wheel by their own weight. Mr Gowland's escapement was on the same principle as regards the unlocking, but he provided against tripping by putting paddles on to the pallets descending into a pot of oil. M. Gannery of Paris had an escapement in the Great Exhibition also on this principle as to the unlocking, but to prevent the trip he gave the wheel only a few teeth and a long run, with a very gradual rise of the pallets. Mr Bloxam had previously done the same thing with a wheel also of nine teeth, and with much less friction, as will be noticed presently. But on account of the delicacy required in all of these escapements (which we select out of a multitude of others as the best of their respective classes), and other objections, none of them have ever come into use. In fact, none of the inventors of them seem to have felt sufficient confidence in their success to venture upon a coarse and cheap train of wheels; whereas, if a gravity escapement is not so independent of the force of the train that all variations in its friction may be disregarded, it fails in the most essential point, and descends to the condition of a common impulse escapement.

Clock and Watch Work.

For this reason also it is necessary that it should be independent of oil, or, at any rate, that the friction which affects the pendulum in unlocking should be so small that no difference can be perceived in the arc whether oil is used or not. The oil in the parts which do not affect the pendulum is of no consequence, for the same reason that the friction of the train is of no consequence—if the escapement is what it professes to be. And lastly, it is essential to the success of a gravity escapement that it should be easy to make and tolerably cheap; for, considering the accuracy of performance which can be attained by a highly finished dead escapement clock, there is no chance of superseding it unless you can get at least as much accuracy with less expense. The only one of the above-mentioned escapements which approaches near enough to satisfying all these conditions to be worth any further description is Mr Bloxam's; and we accordingly give a sketch of it in fig. 10, which is copied (with a little alteration for distinctness) from his own description of it, communicated in 1853 to the Astronomical Society, some years after he had had it in action in a clock of his own; it had also been before described in Mr Denison's book. This drawing will enable any one conversant with these matters to understand its action. He made the pallet arbors cranked, to embrace the pendulum spring, so that their centres of motion might coincide with that of the pendulum as nearly as possible; perhaps an unnecessary refinement; at least the three-legged gravity escapement which we shall presently describe, answers very well with the pallet arbors set on each side of the top of the spring. The size of the wheel determines the length of the pallets, as they must be at such an angle to each other that the radii of the wheel when in contact with each stop may be at right angles to the pallet arm; and therefore, for a wheel of this size the depth of locking can only be very small. The pinion in Mr Bloxam's clock only raises the pallet through 40′ at each beat, *i. e.* the angle which we called γ is only 20′; and probably if it were increased to anything like $\frac{a}{\sqrt{2}}$ the escapement would trip immediately. The two broad pins marked E, F, are the fork-pins. The clock which Mr Bloxam had, went very well; but it had an extremely fine train with pinions of 18; and we know that the late Mr Dent was always afraid to adopt the escapement, on account of the great delicacy involved in it; and though the consequent expense would have been of little consequence in the great Westminster clock, yet the risk of the teeth breaking if the wheel got a run, from any accidental lifting of the pallets, and the apparent impossibility of making γ even nearly satisfy the proper mathematical condition without risk of tripping, were considered by the Astronomer Royal and Mr Denison sufficient reasons for not requiring it to be introduced. It should, however, be stated that Mr Bloxam is of opinion that $a = 5\gamma$ is a better proportion than $a = 3\gamma$, on account of the effects of variation of density of the air, as before mentioned. It was not till nearly a year after

Gravity escapements.

Bloxam's.

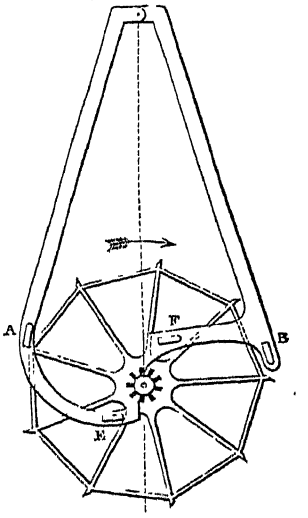


Fig. 10.

Denison's gravity escapement.

that clock was begun, that Mr Denison converted his three-legged dead escapement into the gravity escapement, which is used there, and which we shall now describe. It will be observed that the three teeth or legs are no longer straight, as in figure 8, but bent, so that the lifting pins and the points of the teeth would lie alternately on the radii of a hexagon. The pins too are no longer sharp, but plain bits of brass wire rivetted into the scape-wheel, which is of steel, in an astronomical clock about $\frac{1}{16}$th inch thick, and $\frac{1}{8}$th in a turret clock. The pins raise the pallets by the projecting faces A, B, and the long teeth rest on the stops D, E, which are bits of steel screwed on, and hardened after they are adjusted. The points of the teeth are about six times as far from the centre as the pins are, and consequently their pressure on the stops is not enough to hold the pallets up if they do by accident get thrown too high; and thus the affects of approximate tripping are prevented; for the pallet immediately falls down again, and rests against the pin which lifted it until the pendulum returns and carries it off: moreover the friction at unlocking is thus rendered insensible. The beat is adjusted by two thumb screws with broad and slightly convex steel heads set in the pendulum rod, which are embraced by brass fork pins from the bottom of the pallets. In turret clocks, where there is plenty of room, there are no beat screws, but the fork pins are made eccentric and so adjustable by the nuts which fix them to the pallets. In the finest clocks the lifting faces of the pallets are jewelled, so that no oil is required. In turret clocks, however, there has been a striking proof that the escapement is sufficiently independent of oil; for the first of these clocks was sent out to the cathedral at Fredericton (indeed Mr Denison was led to invent it from being requested to see if any clock could be made which would go tolerably well through the cold of 40° below zero, which they have there in winter), and the person who takes care of it reports that he could observe no variation of the arc during the last winter, even while the oil was frozen as hard as tallow.

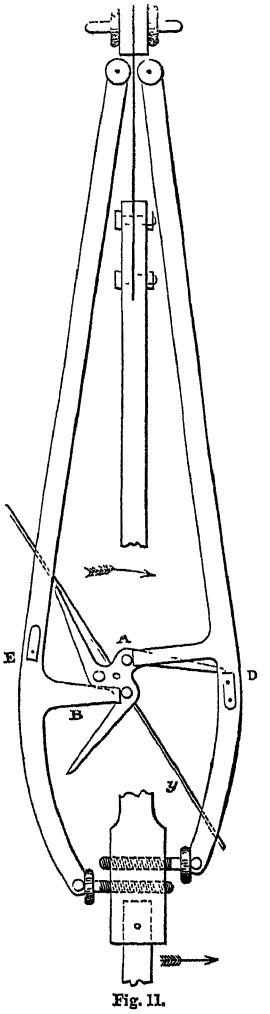


Fig. 11.

But we have not yet noticed a very material feature in this escapement, viz., the fly, which is set on the scape-wheel arbor, with a friction spring, just like a common striking fly. It is this which moderates the velocity and renders it safe against tripping, and against any damage to the teeth from an accidental run, the motion of 60° at each beat being quite enough to render the fly effective. In turret clocks the fly is made about 5 inches long in each vane, and $1\frac{1}{4}$ broad; in regulators, or clocks of astronomical size, about $1\frac{1}{2}$ long and $\frac{3}{4}$ broad. The stop E, which is struck upwards, should be set a little higher than the scape-wheel centre; for if not, the blow has a tendency to throw the pallet out and make it trip, if the force is much increased; the other stop D may be about on a level with the centre. The distance of the pins from the centre may be about $\frac{1}{36}$th of the distance of that centre from the pallet arbors; and the weight of the pallets should be such as to make the pendulum swing not less than 2°, nor more than $2\frac{1}{2}$°: this makes $\alpha = 3\gamma$ or thereabouts. In regulators, the distance of centres has been generally made 6 inches (the scape-wheel being put near the bottom instead of the top of the frame), and in turret clocks 9 inches, except in the great Westminster clock, where it is 12 inches, on account of the great size of the pendulum, which was made before this escapement was invented. For, besides the other advantages, it supersedes the necessity for a long and heavy pendulum, which is generally wanted to resist the variations of force in the escapement; but here no such variations exist, at least none that reach the pendulum. There seems, however, one objection to it for observatory clocks, viz., that the beat makes very little noise; perhaps it might be made loud enough by increasing the weight of the scape-wheel, so as to make the blow on the pallets heavier. Before it was adopted for the Westminster clock, it was tried at the Royal Observatory in a common regulator; and Mr Airy, who was, as we have seen, not likely to be prejudiced in favour of gravity escapements, expressed his complete satisfaction with its performance, after trying upon it what he described as some "malicious experiments." Several clocks of this kind have been since made by Mr Dent and a few other clockmakers, the turret clocks with cast-iron wheels, and the regulators with pinions of only 8 and even 6 leaves; and the weight may be doubled without affecting the arc or the rate. It only remains to be added, that it is very easy to make, and requires less delicacy than the common dead escapement; and as it is not patented, it may be made by anybody. We may now proceed to matters involving merely mechanical, and not mathematical considerations.

GOING BARRELS.

A clock which is capable of going accurately must have some contrivance to keep it going while you are winding it up. In the old-fashioned house-clocks which were wound up by merely pulling one of the strings, and in which one such winding served for both the going and striking parts, this was done by what is called the endless chain of Huygens, which consists of a string or chain with the ends joined together, and passing over two pulleys with deep grooves and spikes in them, so that the chain cannot slip. In one of the two loops or festoons which hang down from the upper pulleys, is a loose pulley, without spikes, carrying the clock weight, and in the other a small weight only heavy enough to keep the chain close to the upper pulleys. Now, suppose one of those pulleys to be on the arbor of the great wheel of the striking part, with a ratchet and click, and the other pulley fixed to the arbor of the great wheel of the going part. Then (whenever the clock is not striking) you may pull up the weight by pulling down that part of the string which hangs down from the other side of the striking part; and yet the weight will be acting on the going part all the time. And it would be just the same if you wound up the striking part and its pulley with a key, instead of pulling the string; and also the same, if there were no striking part at all, but the second pulley were put on a blank arbor, except that in that case the weight would take twice as long to run down, supposing that the striking part generally requires the same weight × fall as the going part.

This kind of "going barrel," however, is evidently not suited to the delicacy of an astronomical clock; and Harrison's going ratchet is now universally adopted in such clocks, and also in chronometers and watches, for keeping the action of the train on the escapement during the winding. This fig. 12 (in which the same letters are used as in the corresponding parts of fig. 1) shows its construction. The click of the barrel ratchet R is set upon another larger ratchet-

Clock and Watch Work.

wheel, with its teeth pointing the opposite way, and its click r T is set in the clock-frame. That ratchet is connected with the great wheel by a spring $s\,s'$ pressing against the two pins s in the ratchet, and s' in the wheel. When you wind up the weight (which is equivalent to taking it off), the click T r prevents that ratchet from turning back or to the right; and as the spring ss was kept by the weight in a state of tension equivalent to the weight itself, it will drive the wheel to the left for a short distance, when its end s is held fast, with the same force as if that end was pulled forward by the weight; and as the great wheel has to move very little during the short time the clock is winding, the spring will keep the clock going long enough.

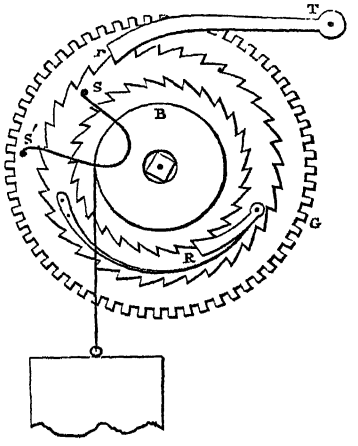


Fig 12.

Bolt and shutter.

In the commoner kind of turret clocks a more simple apparatus is used, which goes by the name of the *bolt and shutter*, because it consists of a weighted lever with a broad end, which shuts up the winding hole until you lift it, and then a spring-bolt attached to the lever, or its arbor, runs into the teeth of one of the wheels, and the weight of the lever keeps the train going until the bolt has run itself out of gear. This spring bolt is sometimes made—and by manufacturers of turret clocks, who ought to know better—in the form of a click, so contrived that in one position of the wheel teeth it will not fall between them, but jams against the top, and stops the clock at once. Moreover, in the common construction of this apparatus there is nothing to ensure its being raised high enough to keep in gear the whole time of winding, if the man loiters over it, or, on the other hand, to enable him to take it out of action when he has done. For this purpose Mr Denison recommends the arbor of the bolt and shutter to be made to *pump* in and out of gear; and, instead of the shutter covering the winding hole, to let it end in a circular arc advanced just far enough to prevent the key or winder from being put on, by obstructing a ring set on the end of the winder. In order to get the winder on, you must raise the lever high enough for the arc to clear the ring. During the two or three minutes which the clock may take to wind the arc will be descending again behind the ring, so that now you cannot get the winder off again without also pulling the maintaining power out of gear; so that even if it is constructed to keep in action ten minutes, if required, still it will never remain in action longer than the actual time of winding.

In clocks with a train remontoire it is hardly safe to rely on a spring going barrel; and, accordingly, in the Royal Exchange clock, Mr Dent adopted a self-acting going barrel, invented by Mr Airy; but on account of the great expense involved in it, it has never been used again; and where it is of consequence (which it seldom can be in a large clock) to avoid the duplication of force for the moment before the man begins winding, and after he has done, it may be done by a self-acting apparatus of very simple character which Mr Denison contrived for the great Westminster clock, because such a large clock would require an inconveniently heavy bolt and shutter work, if it was to be done in that way. In that clock a bar hangs obliquely from the arbor of the great wheel, behind it; and in the lower end of this bar is the pivot of the arbor of the winding pinion, and it has a click which takes into a ratchet cast on the back of the great wheel. When you begin to wind up, the bar is prevented from running upwards by the click, and for the time it becomes the same as if the back pivot of the winding arbor, or the fulcrum for turning the winding pinion, was in the great wheel itself; and consequently the act of winding, or turning the barrel to the left by means of the wheel on its end, close to the great wheel, tends also to turn the great wheel itself to the right, which is its proper direction. In fact, the force upon it is rather greater in winding than when not winding, which is of no consequence; if it were, it might be compensated by weighting the lever to the amount of the difference. The winding arbor is very long, the clock frame being no less than 4½ feet wide, and therefore its angular play in the front pivot-hole during the time of winding is very little. It pumps out, so as to pull the pinion out of gear with the winding wheel.

Clock and Watch Work.

EQUATION CLOCKS.

It is hardly worth while to occupy any space in describing a machine so nearly obsolete as what used to be called *equation* (*i. e.* equation of time) *clocks*. Their object was to show true solar, or sundial time, instead of mean solar time, which, as we all know from the almanacs, is as much as 16 minutes behind the sun in November, and 14 minutes before it in February, and they only agree four times in the year. These clocks were never much used in England: in Paris, even the public clocks, until the year 1826, were furnished with equation work so as to show solar time. But as the principle of this machinery is remarkable, and may be useful for some other purposes, we will shortly indicate the nature of it.

In fig. 13 let Aa be the hour-wheel of the common dial work, with its arbor prolonged to C, and turning the opposite way to what the hands are intended to turn. The minute-hand is set on a pipe b of the wheel Bb, which rides on the arbor aC. Both of these are bevelled wheels of the same number of teeth, and they are connected by an intermediate bevelled wheel or pinion D, of any number. This pinion rides on the end of the bar ED, which itself rides on the arbor aC, at right angles to it. Now, so long as the end D of the bar ED is held fast, the wheel B, which carries the hand, will turn in one hour exactly as A does, only the opposite way. But if while A is moving uniformly with the clock train, we move ED with its pinion, it will evidently superadd another motion to B besides that which it receives from A. If we move ED through α in the same direction as B is naturally moving, it will give B an additional motion of 2α; and if we move the bar the other way it will diminish B's motion by the same angle 2α. If then the end of the bar is made to travel on the edge of a plate of the shape shown at Qq, turning in a year on a centre O, the hand wheel will be constantly accelerated or retarded from the mean time of the other wheel, according as the point of the plate in contact with D is at a longer or shorter distance from its centre O than the average. The equation plate of course is not really in the position drawn here in order to exhibit its shape, but in a plane parallel to the wheels A and B, and it is driven by a slow train of wheels or an endless screw from the arbor a. Instead of bevelled wheels, it will be the same thing if we put a common pinion between

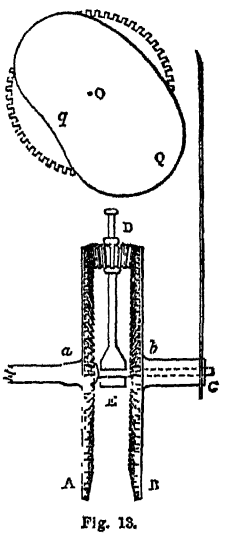


Fig. 13.

Clock and Watch Work.

a common spur-wheel on the arbor *a*, and an internal wheel (*i. e.* a wheel with teeth on the inside of its rim) in the place of B; only in that case the two wheels will move with different velocities in proportion to the numbers of their teeth. The pinion between them rides on a stud in the side of the bar, which rides on the main arbor at one end, and the other end rests on the equation plate, as before. Or again, it may be done without either bevelled or internal wheels, by an arrangement like that which we shall have to describe (see fig. 16) under the head of train remontoires. Professor Willis, in his *Principles of Mechanism*, gives the name of *encyclical trains* to all these arrangements for adding a secondary motion to a wheel without interfering with the primary motion which it receives from the principal train.

We cannot stop to describe the various contrivances for making clocks show the days of the month, periods of the moon, and other phenomena. The old day of the month clocks required setting at the end of every month which has not 31 days, and have long been obsolete. We have lately seen some cheap clocks made at Wolverhampton (the first attempt at rivalling the American clocks) with day of the month work which does not require setting; but it would take more space to describe than our limits allow, and we must proceed to matters of more common use.

STRIKING CLOCKS.

There are two kinds of striking work used in clocks. The older of them, which is still used in all the foreign clocks, and in most turret clocks in England also, will not allow the striking of any hour to be either omitted or repeated, without making the next hour strike wrong; whereas, in that which is used in all the English house clocks, the number of blows to be struck depends merely on the position of a wheel attached to the going part; and therefore the striking of any hour may be omitted or repeated without deranging the following ones. In turret clocks there is no occasion for the repeating movement; and for the purpose of describing the other which is called the *locking-plate* movement, we may as well refer to fig. 18, which is the front view of a large clock, striking both hours and quarters on this plan. In the hour part (on the left), you observe a bent lever BAH, called the "lifting piece," of which the end H has just been let off by the snail on the hour wheel 40 of the going part; and at the other end there are two stops (not shown in the drawing as they were intended to be), one behind, and rather below the other; and against the upper one the bent end of a short lever 9 B, which is fixed to the arbor of the fly, is now resting. We omit the description of the action of the wheels, because it is evident enough. At D may be seen a piece projecting from the lever AB, and dropping into a notch in the wheel 78. That wheel is the locking wheel or locking plate; and it has in reality notches such as D all round it, at distances 2, 3, up to 12, from any given point in the circumference, which may be considered as marked off into 78 spaces, that being the number of blows struck in 12 hours. These notches are shown in the locking plate of the quarter part in fig. 18, but not in the hour part, for want of size to show them distinctly. Now, when the arm AB of the lifting piece is raised by the snail a few minutes before the hour, the fly-pin slips past the first of the stops at B, but is stopped by the second and lower one, until the lever is dropped again exactly at the hour. Thus the pin can pass, and would turn once round freely, allowing the train to go on a little; but before it has got once round, the lifting piece has been lifted again high enough to let both stops clear the fly-pin, by means of the cylinder, with two slices taken off it, which is set on the arbor of the wheel 30, and on which the end of the lifting piece rests by means of a small roller (to diminish the friction). If the clock has only to strike one, the lifting piece will then drop again, and the fly-pin will be caught by the first stop, having made (according to the numbers of the teeth given in fig. 18), 5 turns. But if it has to strike more, the locking wheel comes into action. That wheel turns with the train, either by pinion 20 as shown here, or by a gathering pallet on the arbor of the second wheel, and it will easily be seen that when once the lifting piece is lifted out of a notch in the locking plate, it cannot fall again until another notch has come under the bit D; and as the distance of the notches is proportioned to the hours, the locking plate thus determines the number of blows struck. It may occur to the reader, that the cylinder and roller are not really wanted, and that the locking plate would do as well without; and sometimes clocks are so made, but it is not safe; for the motion of the locking plate is so slow, that unless everything is very carefully adjusted and no *shake* left, the corner of the notch may not have got fairly under the bit D before the fly has got once round, and then the lifting piece will drop before the clock can strike at all.

Locking-plate movement.

Clock and Watch Work.

Fig. 14 shows the other kind of striking work, being the front view of an English house clock when the dial is taken off. As in fig. 1, M is the hour-wheel, on the pipe of which the minute hand is set; N the reversed hour-wheel, and *n* its pinion, driving the 12-hour wheel H, on whose socket is fixed what is called the snail Y, which belongs to the striking work exclusively. The hammer is raised by the 8 pins in the rim of the second wheel in the striking train, in the manner which is obvious. The hammer does not quite touch the bell, as it would jar in striking if it did, and prevent the full sound; and if you observe the form of the hammer-shank at the arbor where the spring S acts upon it, you will see that the spring both drives the hammer against the bell when the tail T is raised, and also checks it just before it reaches the bell, and so the blow on the bell is given by the hammer having acquired momentum enough to go a little farther than its place of rest. Sometimes two springs are used, one for impelling the hammer, and the other for checking it. A piece of vulcanized India rubber tied round the pillar just where the hammer-shank nearly touches it, forms as good a check spring as anything. The pinion of the striking wheel generally has 8 leaves, the same number as the pins; and as a clock strikes 78 blows in 12 hours, the great wheel will turn in that time if it has 78 teeth, instead of 96 which the great wheel of the going part has for a centre pinion of 8. The striking wheel drives the wheel above it once round for each blow, and that wheel drives a 4th (in which you observe a single pin P), 6, or any other integral number of turns, for one turn of its own, and that drives a fan-fly to moderate the velocity of the train by the resistance of the air, an expedient at least as old as De Vick's clock in 1370. The wheel N is so adjusted that within a few minutes of the hour the pin in it raises the *lifting piece* LON so far, that that piece lifts the click C out of the teeth of the *rack* BKRV, which immediately falls back (helped by a spring near the bottom) as far as its tail V can go by reason of the snail Y, against which it falls; and it is so arranged that the number of teeth which pass the click is proportionate to the depth of the snail; and as there is one step in the snail for each hour, and it goes round with the hour hand, the rack always drops just as many teeth as the number of the hour to be struck. This drop makes the noise of "giving warning." But the clock is not yet ready to strike, till the lifting piece has fallen again; for as soon as the rack was let off, the tail of the thing called the *gathering pallet* G, on the prolonged arbor of the 3d wheel, was enabled to pass the pin K of the rack on which it was pressing before, and the striking train began to move; but before the 4th wheel had got half round, its pin P was caught by the end of the lifting piece, which is bent back and goes through a hole in the plate, and when raised stands in the way of the pin P,

Repeating movement.

Clock and Watch Work.

so that the train cannot go on until the lifting piece drops, which it does exactly at the hour, by the pin N then slipping past it. Then the train is free; the striking wheel begins to lift the hammer, and the gathering pallet gathers up the rack, a tooth for each blow, until it has returned to the place at which the pallet is stopped by the pin K coming under it. In this figure the lifting piece is prolonged to F where there is a string hung to it, as this is the proper place for such a string when it is wanted for the purpose of learning the hour in the dark, and not (as it is generally put) on the click C, for if it is put there, and you hold the string a moment too long, the clock will strike too many; and if the string accidentally sticks in the case, it will go on striking till it is run down; neither of which things can happen when the string is put on the lifting piece.

The snail is sometimes set on a separate stud with the apparatus called a *star wheel* and *jumper* (see Denison's *Rudimentary Treatise*, p. 123); but, as this only increases the cost without any advantage that we can see, we omit any further reference to it. On the left side of the frame we have placed a lever, *x*, with the letters *st* below it, and *si* above. If it is pushed up to *si* the other end will come against a pin in the rack, and prevent it from falling, and will thus make the clock silent; and this is much more simple than the common "strike and silent" apparatus, which we shall therefore not describe.

Quarters.

If the clock is required to strike quarters, a third part, or train of wheels, is added on the right hand of the going part; and its general construction is the same as the hour-striking part; only there are two more bells, and two hammers so placed that one is raised a little after the other. There is a method of making the same part do both the quarter and hour striking; but it is very seldom used, and would take too long to describe here. If there are more quarter bells than two, the hammers are generally raised by a chime barrel, which is merely a cylinder set on the arbor of the striking wheel (in that case generally the third in the train), with short pins stuck into it in the proper places to raise the hammers in the order required for the tune of the chimes. The quarters are generally made to let off the hour, and this connection may be made in two ways. If the chimes are different in tune for each quarter, and not merely the same tune repeated two, three, or four times, the repetition movement must not be used for them, as it would throw the tunes into confusion—but the old locking-plate movement, as in turret clocks; and therefore, if we conceive the hour lifting piece connected with the quarter locking plate, as it is with the wheel N in fig. 14, it is evident that the pin will discharge the hour-striking part as the fourth quarter finishes.

But where the repetition movement is required for the quarters the matter is not quite so simple; but the principle of it may be shortly described thus:—the quarters themselves have a rack and snail, &c., just like the hours, except that the snail is fixed on one of the hour-wheels M or N instead of on the twelve-hour wheel, and has only four steps in it. Now, suppose the quarter rack to be so placed that when it falls for the fourth quarter (its greatest drop) it falls against the hour lifting piece somewhere between O and N, so as to raise it and the click C. Then the pin Q will be caught by the click *Qq*, and so the lifting piece will remain up until all the teeth of the quarter rack are gathered up; and as that is done it may be made to disengage the click *Qq*, and so complete the letting off of the hour striking. (This click *Qq*, of course, has no existence except where there are quarters.)

These quarter clocks are sometimes made so as only to strike the quarters at the time when a string is pulled—as by a person in bed, just like repeating watches, which are rarely made now, on account of the difficulty of keeping in order such a complicated machine in such a small space

Clock and Watch Work.

In this case the act of pulling the string to make the clock strike, winds up the quarter barrel, which is that of a spring-

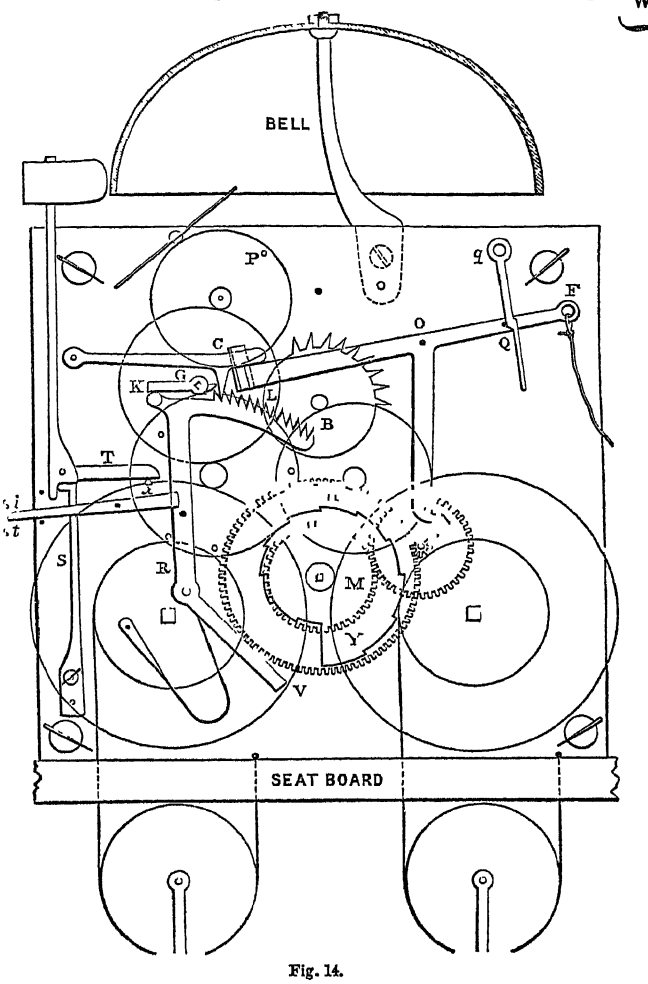


Fig. 14.

clock (not yet described, but well known to everybody), as far as it is allowed to be wound up by the position of a snail on the hour-wheel, against which a lever is pulled, just as the tail of the common striking rack falls against the snail on the 12-hour wheel; and it is easy to see that the number of blows struck by the two quarter hammers may thus be made to depend upon the extent to which the spring that drives the train is wound up; and it may even be made to indicate half-quarters; for instance, if the snail has 8 steps in it, the 7th of them may be just deep enough to let the two hammers strike thrice, and the first of them once more, which would indicate 7½ minutes to the hour. It is generally so arranged that the hour is struck first, and the quarters afterwards. But we cannot afford the space to describe the details of these occasional contrivances.

ALARUMS.

In connexion with these bed-room clocks we ought to mention *alarums*. Perhaps the best illustration of the mode of striking an alarum is to refer to either of the recoil escapements (figs. 3 and 4). If you suppose a short hammer instead of a long pendulum attached to the axis of the pallets, and the wheel to be driven with sufficient force, it will evidently swing the hammer rapidly backwards and forwards; and the position and length of the hammer head may be so adjusted as to strike a bell internally, first on one side and then on the other. Then as to the mode of letting off the alarum at the time required; if it was always to be let off at the same time, you would only have to set a pin

Clock and Watch Work.

in the 12-hour wheel at the proper place, to raise the lifting piece which lets off the alarum at that time. But as you want it to be capable of alteration, this discharging pin must be set in another wheel (without teeth), which rides with a friction spring on the socket of the 12-hour wheel, with a small moveable dial attached to it, having figures so arranged with reference to the pin, that whatever figure is made to come to a small pointer set as a tail to the hour hand, the alarum shall be let off at that hour. The letting off does not require the same apparatus as a common striking part, because an alarum is not to strike a definite number of blows, but to go on till it is run down; and therefore the lifting piece is nothing but a lever with a stop or hook upon it, which, when it is dropped, takes hold of any one of the alarum wheels, and lets them go while it is raised high enough to disengage it. You must of course not wind up an alarum till within 12 hours of the time upon it is wanted to go off, unless the hour hand is one that turns in 24 hours, instead of 12.

Watchman's clock.

The *watchman's* or tell-tale clock the reader may have seen in one of the lobbies of the House of Commons, and in prisons, and some other places, where they want to make sure of a watchman being on the spot and awake all the night; it is a clock with a set of spikes, generally 48 or 96, sticking out all round the dial, and a handle somewhere in the case, by pulling which you can press in that one of the spikes which is opposite to it, or to some lever connected with it, but no others; and it will be observed, that this wheel of spikes is carried round with the hour hand, which in these clocks is generally a 24-hour one.

It is evident that every spike which is seen still sticking out in the morning indicates that at the particular time to which that spike belongs the watchman was not there to push it in—or at any rate, that he did not do it; and hence its name. At some other part of their circuit, the inner ends of the pins are carried over a roller or an inclined plane which pushes them out again ready for business the next night.

SPRING CLOCKS.

Hitherto we have supposed all clocks to be kept going by a weight. But, as is well known, many of them are driven by a spring coiled up in a barrel. In this respect they differ nothing from watches, and therefore we shall defer all consideration of the construction of the parts belonging to the spring till we treat of watches. It may, however, be mentioned here, that the earliest form in which a spring seems to have been used was not that of a spiral ribbon of steel rolled up, but a straight stiff spring held fast to the clock frame at one end, and a string from the other end going round the barrel, which was wound up; of course such a spring would have a very small range. Spring clocks are generally resorted to for the purpose of saving space, and as clocks are generally made in England, it is impossible to make a weight-clock capable of going a week, without either a case nearly 4 feet high, or else the weights so heavy as to produce a great pressure and friction on the arbor of the great wheel. But this arises from nothing but the heaviness of the wheels, and the badness of the pinions used in the English clocks, as is simply proved by the fact that the American clocks go a week with both less weights and less fall for them than the English ones, and this with no assistance from fine workmanship, for the purpose of diminishing friction, as they are remarkable for their want of what is called "finish" in the machinery, on which so much time and money is wasted in nearly all English clock-work. Moreover, in the American clocks the pinions are all of the kind called *lantern pinions* (see fig. 34), which are pinions having their leaves made only of bits of wire set round the axis in two collars; and, oddly enough, are the oldest form of pinion, as well as the best, acting with the least friction, and requiring the least accuracy in the wheels, but now universally disused in all English and French house clocks. The American clocks prove that they are not too expensive to be used with advantage when properly made, although so long as there are no *manufactories* of clocks here as there are in America, it may be cheaper to make pinions in the slovenly way of cutting off all the ribs of a piece of pinion wire, so as to reduce it to a pinion a quarter of an inch wide, and an arbor 2 or 3 inches long. The wheels of the American clocks are all stamped, and the holes in the plates also; in fact, there is probably not two shillings worth of mere manual labour in the whole of an American clock movement. There is no doubt that in the making of machines by machinery the Americans are far ahead of us; witness also Colt's revolvers and Hobbs's locks. On the whole, the common English house clocks, so far from having improved with the general progress of machinery, are worse than they were 50 years ago, and at the same time are of such a price that they are being fast driven out of the market by the American plain clocks, and by the French ornamental ones; for their movements are also made by machinery at surprisingly low prices. Indeed, until very lately we were inferior to the French also in a kind of clock in which above all others we ought to be superior to the rest of the world, viz., in the largest kind of clocks, to which we shall now devote a few pages.

Clock and Watch Work.

TURRET CLOCKS.

Seeing that a clock—at least the going part of it—is a machine in which the only work to be done is the overcoming of its own friction and the resistance of the air, it is evident when the friction and resistance are very much increased, it may become necessary to resort to expedients for neutralizing their effects which are not required with a more moderate friction. In a turret clock the friction is enormously increased by the great weight of all the parts; and the resistance of the wind, and sometimes snow, to the motion of the hands, further aggravates the difficulty of maintaining a constant force on the pendulum; and besides that, there is the exposure of the clock to the dirt and dust which are always found in towers, and of the oil to a temperature which nearly freezes it all through the usual cold of winter. This last circumstance alone will generally make the arc of the pendulum at least half a degree more in summer than in winter; and inasmuch as the time is materially affected by the force which arrives at the pendulum, as well as the friction on the pallets when it does arrive there, it is evidently impossible for any turret clock of the ordinary construction, especially with large dials, to keep any constant rate through the various changes of temperature, weather, and dirt, to which it is exposed. And yet it is remarkable that, with the two exceptions we shall have to mention, the English clock-makers have universally set their faces against the adoption of any of the contrivances, whether of foreign or of English invention, for the purpose of obtaining a constant force on the pendulum, and have even presumed so far on the ignorance of the public as to assert that the compensation of the pendulum is unnecessary, although turret clocks are of course exposed to greater variations of temperature than any others. The only excuse for such an assertion—and indeed with regard to ordinary turret clocks it is a sufficient one, is, that it is not worth while to provide against the errors from change of temperature while the clock is left exposed to errors quite as large from other causes, against which the makers do not know how to provide.

But in the year 1843 a series of improvements began, which in the course of ten years have completely changed the construction and the character of the best English turret clocks, and they can now be made to go better than the best astronomical clocks; while at the same time the merely

Clock and Watch Work.

superficial refinements which it had become the fashion to introduce as a disguise for the absence of all scientific improvement, have been dispensed with, and the price considerably reduced. In that year, it appears from the papers which were afterwards published on the subject, the late Mr Dent was engaged to make the large clock for the newly built Royal Exchange, which was desired to be superior to any public clock in England, and with that view was required to satisfy certain conditions proposed for the first time by the Astronomer Royal, and such as could not be satisfied by any clock of the common construction. He had then no factory of his own for making large clocks, and relied on getting it made under his directions by some of the few real manufacturers of such things. But although these persons are generally willing enough to execute the orders of other clockmakers, and even allow them to put their own names on the clocks, Mr Dent found himself unable to get this clock made for him at all, and it was expected as a matter of course that he would be obliged to give up the contract; but with the energy and genius by which that remarkable man raised himself from a tallow-chandler's apprentice to the position of the first horologist in the world, he at once set up a factory for himself at a great expense, and made the clock there; and of this, the first turret clock he had ever made, the Astronomer Royal certified in 1845, that it not only satisfied his conditions, but that Mr Dent had made some judicious improvements upon his suggestions, and that he had no doubt it was the best public clock in the world. The clock tower of the Exchange seems to have been prolific of disputes, for the peal of bells on which the clock was also to play chimes every three hours have had to be recast twice since they were put up, once by the original founders and once by another; and it was not till after the clock had been going eight or nine years that the chimes were allowed to play regularly.

Clock and Watch Work.

Turret clocks.

The construction of the Exchange clock, however, was too expensive for general use; and accordingly Mr Dent next devoted himself to simplifying it. At first, he borrowed a good deal from the clocks of Messrs Wagner, the eminent makers of Paris; but by degrees he introduced various modifications of their plans, chiefly from the suggestions of Mr Denison; and before his death in 1853 the plans which we shall now describe were adopted as the settled forms for the different kinds of the best turret clocks. They have since been followed by his successor, Mr Dent of the Strand and the Royal Exchange, and also by Mr Joyce of Whitchurch (Salop), who had before enjoyed the reputation of one of the best provincial clockmakers; but as far as we know, by no other makers—certainly by no London ones, though they are free from the incumbrance of patents.

The old, or, as the clockmakers would say, the "long established" form of a turret clock is that of a large iron cage, of which some of the vertical bars take off, and are fitted with brass bushes for the arbors of the wheels to run in; and the wheels of each train, *i. e.* the striking train, the going, and the quarter train, stand over each other with their pivots all in the vertical bar belonging to that part. Occasionally they have advanced so far as to make the bushes moveable, *i. e.* fixed with screws instead of rivetted in, so that one wheel may be taken out without the others; but very few of the makers, except the late Mr Vulliamy, admitted even this most obvious improvement. This cage generally stood upon a wooden stool on the floor of the clock room. The French clockmakers long ago saw the objections to this kind of arrangement, and adopted the plan of a horizontal frame or bed, cast all in one piece, and with such smaller frames or cocks set upon it as might be required for such of the wheels as could not be conveniently got on the same level. Mr Dent's Great Exhibition clock, for which he received the council medal, now at the King's Cross station in London,

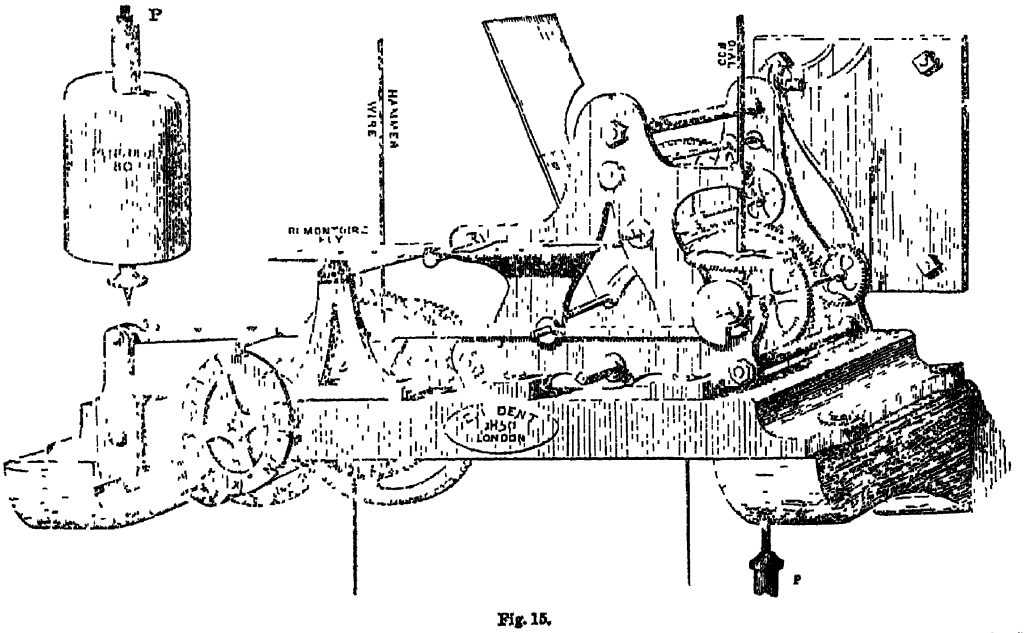


Fig. 15.

was on this plan; and the adjoining sketch (fig. 15) of the clock at Meanwood church, near Leeds, will sufficiently explain it. All the wheels of the going part, except the great wheel, are set in a separate frame called the movement frame, which is complete in itself and light enough to take off and carry away entire, so that any cleaning or repairs required in the most delicate part of the work can be done in the clock factory, and the great wheel, barrel, and rope need never be disturbed at all. Even this movement frame is now dispensed with; but we will reserve the description of the still more simple kind of frame in which *all* the wheels lie on, or under, the great horizontal bed, until we have described that part of the clock which is referred to by the words "remontoire fly" in fig. 15.

TRAIN REMONTOIRES.

Under the head of escapements we mentioned the causes of error in all the common escapements which derive the impulse to the pendulum from the clock train, viz., the variation of friction arising from dirt, want of fresh oil, thick-

Clock and Watch Work.

Turret clocks; train remontoires.

ening of the oil in cold weather, and the action of the wind on the hands. It was long ago perceived that all these sources of error, except the friction of the pallets, might be cut off (assuming the problem of a gravity escapement to be as hopeless as it had come to be considered from the numerous failures) by making the force of the scape-wheel to depend on a small weight or spring wound up at short intervals by the great clock weight and the train of wheels.

This also has the advantage of giving a sudden and visible motion to the minute hand at those intervals, say of half a minute, when the remontoire work is let off, so that time may be taken from the minute hand of a large public clock as exactly as from the seconds hand of an astronomical clock; and besides that, greater accuracy may be obtained in the letting off of the striking part. However, the attempt to secure the advantage of a more constant force was made many years before the possibility of making turret clocks go with anything like the accuracy of astronomical clocks was contemplated; and we believe the first maker of a large clock with a train remontoire, was the late Mr Thomas Reid, clockmaker, of Edinburgh, who wrote the article on clocks in the first edition of this work, afterwards expanded into a well known book, in which this remontoire is described. The scape-wheel was driven by a small weight hung by a Huygens's endless chain, of which one of the pulleys was fixed to the arbor, and the other rode upon the arbor with the pinion attached to it, and the pinion was driven, and the weight wound up by the wheel below (which we will call the 3d wheel), as follows:—Assuming the scape-wheel to turn in a minute, its arbor has a notch cut half through it on opposite sides in two places near to each other. On the arbor of the third wheel, which turns in 10 minutes, suppose there is another wheel with 20 spikes sticking out of its rim, but alternately in two different planes, so that one set of spikes can pass through one of the notches in the scape-wheel arbor and the other set through the other. Whenever then the scape-wheel completes a half turn, one spike is let go and the third wheel is able to move, and with it the whole clock train and the hands, until the next spike of the other set is stopped by the scape-wheel arbor; at the same time the pinion on that arbor is turned half round, winding up the remontoire weight, but without taking its pressure off the scape-wheel. Reid says that so long as this apparatus kept in good order, the clock went better than it did after it had been removed in consequence of its getting out of order from the constant banging of the spikes against the arbor.

The Exchange clock was made on the same principle, except that instead of the endless chain an internal wheel was used with the spikes set on it externally, which (as we explained under *equation work*) is one of the modes by which an occasional secondary motion may be given to a wheel without disturbing its primary and regular motion. A drawing of the Exchange clock remontoire, and also of the bevelled-wheel plan (like the equation work at fig. 13), which is generally used in the French remontoire clocks, is given in Mr Denison's *Rudimentary Treatise*; and for the reasons which will appear presently, it need not be repeated here, especially as the following is a still more simple arrangement of a gravity train remontoire, also used by the French. Let E in fig. 16 be the scape-wheel turning in a minute, and *e* its pinion which is driven by the wheel D having a pinion *d* driven by the second or centre wheel C, which we may suppose to turn in an hour. The arbors of the scape-wheel and centre-wheel are of course distinct, their pivots meeting in a bush fixed somewhere between the wheels. The pivots of the wheel D are set in the frame AP, which rides on the arbors of the centre-wheel and scape-wheel, or on another short arbor between them. The centre wheel also drives another wheel G, which again drives the pinion *f* on the arbor which carries the two arms *f* A, *f* B; and on the same arbor is set a fly with a ratchet, like a common striking fly, and the numbers of the teeth are so arranged that the fly will turn in the same time as the scape-wheel. The ends of the remontoire arms *f* A,

Clock and Watch Work.

Gravity train remontoires.

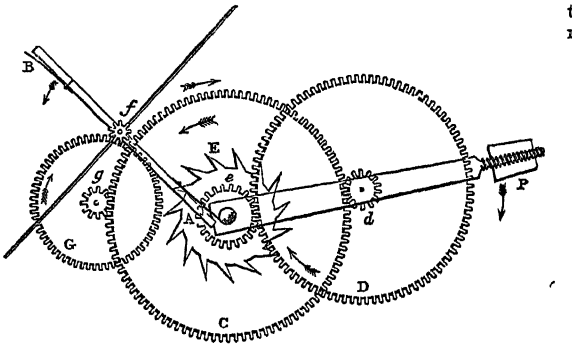


Fig. 16.

f B, are capable of alternately passing the notches cut half through the arbor of the scape-wheel, as those notches successively come into the proper position at the end of every half minute; and as soon as that happens the centre wheel raises the moveable wheel D and its frame through a small angle; but, nevertheless, that wheel keeps pressing on the scape-wheel as if it were not moving, the point of contact of the wheel C and the pinion *d* being the fulcrum or centre of motion of the lever A *d* P. It will be observed that the remontoire arms *f* A, *f* B have springs set on them to diminish the blow on the scape-wheel arbor, as it is desirable not to have the fly so large as to make the motion of the train, and consequently of the hands, too slow to be distinct. In all the French remontoire clocks in the Great Exhibition the motion was too slow, and consequently less easy to observe accurately than in the Westminster clock, the Royal Exchange, and King's Cross Station clocks, in which the half-minute jump of the hands is very distinct. In the French clocks also the fly is generally driven by an endless screw, without the intermediate wheel G; but there is an enormous loss of force by friction in an endless screw, when driven, and consequently considerable risk of the clock stopping from either cold or wasting of the oil.

In all these gravity remontoires, however, it must have been observed that we only get rid of the friction of the heavy parts of the train and the dial work, and that the scape-wheel is still subject to the friction of the remontoire wheels, which, though much less than the other, is still something considerable. And, accordingly, attempts have frequently been made to drive the scape-wheel by a spiral spring, like the mainspring of a watch. One of these was described in the last edition of this work; and Mr Airy, a few years ago, invented another on this principle, of which two or three specimens were made by Mr Dent. But it was found, and indeed it ought to have been foreseen, that these contrivances were all defective in the mode of attaching the spring, and that they only increased the expense of the clock without any corresponding advantage; and the consequence has been, that spring remontoires, and remontoires in general, had come to be regarded as a mere delusion. It has, however, now been fully proved, that they are not so; for, by a very simple alteration of the previous plans, a spiral spring remontoire may be made to act with absolutely no friction, except that of the scape-wheel pivots, and the letting-off springs A, B, in the last drawing. The Meanwood clock (fig. 15) was the first of this kind; but it will be necessary to give a separate view of the remontoire work.

In this figure (17), E, *e*, D, *f*, A, and B, are the same things as in fig. 16. But *e*, the scape-wheel pinion, is no longer fixed to the arbor, nor does it ride on the arbor, as had been

Clock and Watch Work.

the case in all the previous spring remontoires, thereby producing probably more friction than was saved in other respects; but it rides on a stud *k*, which is set in the clock-frame. On the face of the pinion is a plate, of which the only use is to carry a pin *h* (and consequently its shape is immaterial), and in front of the plate is set a bush *b*, with a hole through it, of which half is occupied by the end of the stud *k*, to which the bush is fixed by a small pin, and the other half is the pivot hole for the scape-wheel arbor. On the arbor is set the remontoire spring *s* (a moderate-sized musical box spring is generally used), of which the outer end is bent into a loop to take hold of the pin *h*. In fact, there are

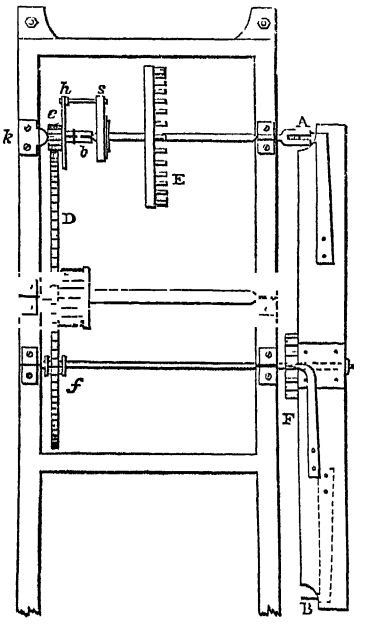


Fig. 17.

two pins at *h*, one a little behind the other, to keep the coils of the spring from touching each other. Now it is evident, that the spring may be wound up half or a quarter of a turn at the proper intervals, without taking the force off the scape-wheel, and also without affecting it by any friction whatever. When the scape-wheel turns in a minute, the letting off would be done, as before described, by a couple of notches in the scape-wheel arbor, through which the spikes AB, in fig. 16, would pass alternately. But in clocks with only three wheels in the train, it is best to make the scape-wheel turn in two minutes, and consequently you would want four notches and four remontoire arms, and the fly would only make a quarter of a turn. And therefore Mr Denison, who invented this remontoire, made the following provision for diminishing the friction of the letting-off work. The fly pinion *f* has only half the number of teeth of the scape-wheel pinion, being a lantern pinion of 7 or 8, while the other is a leaved pinion of 14 or 16 (and therefore the same wheel D will properly drive both, as will be seen hereafter). The scape-wheel arbor ends in a cylinder about $\frac{3}{8}$th inch in diameter, with two notches at right angles cut in its face, one of them narrow and deep, and the other broad and shallow, so that a long and thin pin, such as B, can pass only through one, and a broad and short pin A through the other. Consequently, at each quarter of a turn of the scape-wheel, the remontoire fly, on which the pins AB are set on springs, as in fig. 16, can turn half round. It is set on its arbor *f* by a square ratchet and click, which enables you to adjust the spring to the requisite tension to obtain the proper vibration of the pendulum. The fly is not (except in very large clocks) separate from the letting-off arms, because there is found to be no occasion for it; but the blow on the cylinder is diminished by the fly having to pass over a friction spring (which cannot be distinctly shown in this drawing) just before it reaches the cylinder. It makes, indeed, a considerable noise at each let off, but that is in a great measure from the recoil against the top of this friction spring; and some of these clocks have now been going since the year 1849, without any inconvenience from that cause. And their performance is so much more satisfactory than that of the gravity remontoires, that Mr Dent lately altered the gravity remontoire of the Royal Exchange to a spring one, with the immediate effect of reducing the clock-weight by one-third. It should be observed, however, that even a spring remontoire requires a larger weight than the same clock without one; but as none of that additional force reaches the pendulum, that is of no consequence. The variation of force of the remontoire spring from temperature, as it only affects the pendulum through the medium of the dead escapement, is far too small to produce any appreciable effect; and it is found that clocks of this kind, with a compensated pendulum 8 feet long, and of about 2 cwt., will not vary above a second a month, if the pallets are kept clean and well oiled. No turret clock without either a train remontoire or a gravity escapement will approach that degree of accuracy.

Clock and Watch Work.

Denison's spring remontoire.

The introduction of this remontoire led to another very important alteration in the construction of large clocks. Hitherto it had always been considered necessary, with a view to diminish the friction as far as possible, to make the wheels of brass or gun-metal, with the teeth cut in an engine. The French clockmakers had begun to use cast-iron striking parts, and cast-iron wheels had been occasionally used in the going part of inferior clocks for the sake of cheapness. Mr Vulliamy, we know, proposed, if he did not use them for cheap clocks some years ago; but cast-iron wheels had never been used in any clock making pretensions to accuracy before Mr Dent's clock in 1851, which is stated in the jury report to have only varied 3 seconds in the last 10 weeks of the Exhibition. Since then all the large clocks made at his factory, either with this remontoire or with the three-legged gravity escapement before described, have been made with cast-iron wheels; and in 1852 it was determined by the Astronomer Royal and Mr Denison, who were jointly consulted by the Board of Works about the great Westminster clock, to alter the original requisition for gun-metal wheels there to cast-iron. Some persons have expressed their apprehension of cast-iron wheels rusting; but nothing can be more unfounded, for they are always painted, and the acting surfaces may also be oiled. A remarkable proof of the folly of the clockmakers' denunciations of cast-iron wheels has lately been afforded at the Royal Exchange. In consequence of the bad ventilation of the clock-room, together with the effects of the London atmosphere, some thin parts of the brass-work had become so much corroded that they had to be renewed, and some of it replaced with iron; and all the polished brass-work and iron-work had become as rough as if it had never been polished at all; the only parts of the clock which had not suffered from the damp and the bad air were the painted iron-work. The room has now been ventilated, with a draught through it, and all the iron-work, except acting surfaces, is painted. But even in the most favourable positions brass or gun-metal loses its surface long before cast-iron wants repainting.

Cast-iron wheels.

Fig. 18 is a front view of one of Mr Dent's large quarter clocks, with all the wheels on the great horizontal bed, a gravity escapement, and a compensated pendulum. They are made in two sizes, one with the great striking wheels 18 inches wide, and the other about 15. This pattern has also been followed by Mr Joyce of Whitchurch; the other London makers, and most of the country ones, still adhere to the old cage-pattern frame, and set their faces against compensated pendulums, improved escapements, cast-iron wheels, and wire ropes, and in fact all the improvements which we are now going to notice. Here the striking is done by cams cast on the great wheels, about $1\frac{1}{2}$ inch broad in the large-sized clocks, which are strong enough for an hour bell of two tons weight and corresponding quarters. Wire ropes are used, not only because they last longer if kept greased, but because a sufficient number of coils will go on a barrel of less than half the length which would be required for hemp ropes of the same strength with-

Clock and Watch Work.

out overlapping, which it is as well to avoid if possible, though it is not so injurious to wire ropes as it is to hemp ones. By this means also the striking cams can always be put on the great wheel instead of the second wheel, which

Clock and Watch Work.

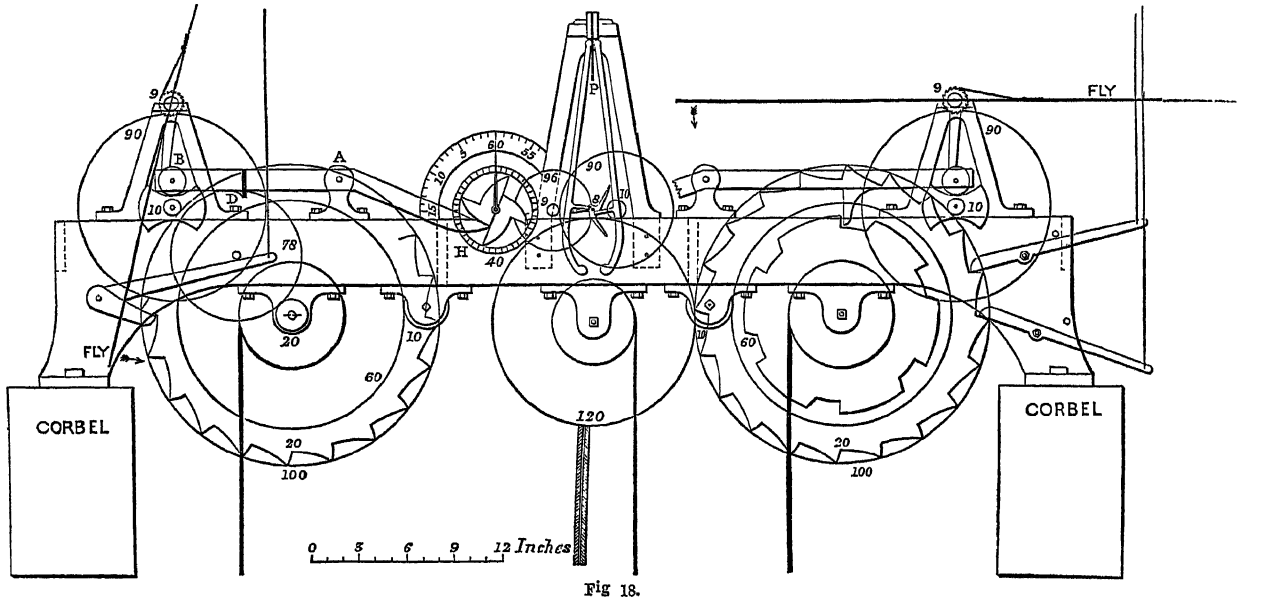


Fig 18.

saves more in friction than could be imagined by any one who had not tried both. In the great Westminster clock it was thought of so much consequence to get the striking from the great wheel, both in the hours and in the quarter chimes on four bells, that eight cam wheels are used for the quarters, as some of the blows are repeated on the same bell too closely to get sufficient drop for the hammer levers without using two alternate hammers to each bell. If that clock had been made on the plan proposed by Mr Vulliamy (who was first consulted, on Sir C. Barry's recommendation), striking from the second wheel, and the friction aggravated by a number of pulleys and hemp ropes, which must have been an inch and a half thick, as he intended, the striking weights would probably have been nearly four tons each, although they have the enormous fall of 170 feet; and the clock would have taken a whole day to wind up. As it is, they will be a ton and a half each, allowing a waste of about a quarter of the force, in friction, and in the interval between the fall of the hammer and its beginning to rise again, which is found enough in clocks of the construction in fig. 18; though in clocks of the common construction two-thirds of the power is often wasted in friction and in the bad arrangement of the hammer work.

We have given the same number of cams to the quarter as to the hour striking wheel, rather for the purpose of suggesting the expediency of omitting the 4th quarter, as has been done in several clocks lately made from this design. It is of no use to strike the quarters at the hour, and it nearly doubles the work to be done, and if it is omitted it allows the quarter bells to be larger, and therefore louder, than they can be otherwise, because the first quarter bell ought to be an octave above the hour bell; whereas, if they are not heard together, the quarters might be the 4th and 7th of a peal of eight bells; and where cheapness has to be considered, and there are no bells ready for the clock, there need only be two bells, the larger of them being used for the 2d quarter bell, and also for the hours, with a rather heavier hammer. This is the case with the clock by Mr Joyce at the new savings-bank at Chester, made on the plan of fig. 18. Moreover, the omission of the 4th quarter enables you to have the celebrated quarter chimes of St Mary's, Cambridge (with a slight variation only in one of them), with a peal of only eight bells, on the 2d, 3d, 4th, and 7th, and at very little additional cost; whereas the full quarters, on four bells, require a considerable addition to the clock, besides a peal of ten bells, as they must be struck on the 1st, 2d, 3d, and 6th—the 10th being the hour bell. The following are the quarter chimes of the before-mentioned clock of the cathedral at Fredericton, which are followed in the clock for Scarborough church, and those of St Mary's, Cambridge, which are adopted also in the great Westminster clock. The Exchange quarters are different, and very inferior to these; and quarters on the 1st, 2d, 3d, and 4th bells of a peal are still worse, though more common.

Quarters.

Fredericton		Cambridge.		
1st	2347			
2d	4237	2d	3126	4th
	4324		3213	
	3724		1326	
3d	7324	3d	6213	
	2347		1236	1st
hour .....8.		hour.....10.		

At Cambridge the chimes are set on a barrel which turns twice in the hour, as this table indicates, and which is driven by the great wheel with a great waste of power; the clock is wound up every day; in an eight-day clock it would require a very large weight, and a very much greater strain on the wheels. We have already stated what was done to avoid this in the Westminster clock.

No particular number of cams is required in the striking wheel: any number about 20 will do; but where four quarters on two bells are used, the quarter striking wheel should have half as many cams again as the hour-wheel; for if not, the rope will go a second time over half of the barrel, as there are 120 quarter blows on each bell in the 12 hours, to 78 of the hours, while with the three quarters there are only 72. If the two quarter levers (commonly called hammer-tails) are on the same arbor, there must be two set of cams, one on each side of the wheel; but one set will do if the hammer-tails are placed as in fig. 18. The hour striking lever, it will be seen, is differently shaped, so as to diminish the pressure on its arbor by making it only the difference instead of the sum of the pressures at the two points of action. This *can* be done with the two quarter levers, as shown in Mr Denison's book; but the arrangement involves a good deal of extra work, and as the quarter hammers are always lighter than the hour, it is hardly worth while to re-

Clock and Watch Work.

sort to it. The shape of the cams is a matter requiring some attention, but it will be more properly considered when we come to the *teeth of wheels*.

Even in the small matter of the fly ratchets there was room for improvement. They are almost always made with sharp teeth like those of a winding ratchet, and the consequence is, that when made of cast-iron, as they sometimes are, by clockmakers who will not use cast-iron wheels on any account, the teeth get broken off by the click. This may be avoided by making the teeth square, *i.e.* a number of inverted V's set round a circle, and the click only reaching so far that the face of the tooth which it touches is at right angles to the click. The spring need only be very slight; in many clocks the object seems to have been to make as much noise as possible with all the clicks, both of the flies and barrels. In the Westminster clock, the annoyance of the clattering of the clicks during the several hours it will take to wind is got rid of by stopping their drop on to the teeth by check springs, for which there is plenty of room.

The hammer of a large clock ought to be left "on the lift," when the clock has done striking, especially if it is a clock with a train remontoire, in which the first blow ought to be struck at the moment the hand jumps from 59½ min. to 60, as there are always a good many seconds lost in the train getting into action and raising the hammer. Moreover, when it stops on the lift, the pressure on the stops, and on all the pinions above the great wheel, is only that due to the excess of the power of the clock over the weight of the hammer, and not the full force of the weight, and it is therefore easier for the going part to discharge, and less likely to break the stops.

In fig. 18 the wheel marked 60 in each of the striking parts is a winding wheel on the front end of the barrel, and the winding pinion is numbered 10; a larger pinion will do where the hammer does not exceed 40 lb., and in small clocks no auxiliary winding wheel is needed. But in that case the locking plate must be driven by a gathering pallet, or pinion with two teeth, on the arbor of the second wheel, with a spring click to keep it steady. In all cases the hammer shanks should be not less than two feet long if possible; for the shorter they are, the more is lost by the change of inclination for any given rise from the bell. In some clocks lately put up by Mr Dent with fixed, not swinging bells, the hammer head is set on a double shank embracing the bell, with the pivots, not above it in the French way which makes the hammer strike at a wrong angle, but on each side of the bell at about three-fourths of its height. On this plan less of the rise is lost than in the common mode of fixing. The Westminster clock hammer will be fixed in this way.

The first thing to remark in the going part in fig. 18 is, that the hour-wheel which carries the snails for letting off the quarters and striking, is not part of the train leading up to the scape-wheel, but independent, so that the train from the great wheel to the scape-wheel is one of three wheels only. If it were a dead escapement instead of a gravity escapement clock, the wheel numbered 96 would be the scape-wheel; and as it turns in 90 seconds, it would require 36 teeth or pins for a 1¼ sec. pendulum, such as these gravity escapement clocks have. The hour-wheel rides loose on its arbor, or rather the arbor can turn within it, carrying the snails and the bevelled wheel which drives all the dials, and the regulating hand, and it is fixed to the hour-wheel by means of clamping screws on the edge of a round plate on the arbor just behind it, which turn by hand. The regulating hand, it will be seen, turns the wrong way; because, where the dial is opposite to the back of the clock, no bevelled wheels are wanted, and the arbor leads straight off to the back of the dial. It used to be the fashion to put clocks for 4 dials near the middle of the room, so that the leading off rod might go straight up to the horizontal bevelled wheel in the middle, which drove all the others. The clock, however, can generally be set more firmly on corbels, or on cast-iron brackets built into the wall; and it is not at all necessary for the leading off rod to be vertical; provided it is in a vertical plane parallel to all the clock wheels (assuming the clock to stand square with the walls) the rod may stand as obliquely as you please; and when it does, it ought on no account to be made, as it generally is, with universal joints, but the pivots should go into oblique pivot holes at the top and bottom. The joints increase the friction considerably, and are of no use whatever, except where the rod is too long to keep itself straight. Where the rod does happen to be in the middle of the room, and there are three or four dials, the two horizontal bevelled wheels at each end of it must be a little larger than all the others, both the one in the clock and those of the dial work; for otherwise the three or four wheels in the middle will meet each other and stick fast.

Clock and Watch Work.

Turret clocks.

When the pendulum is very long and heavy, it should be suspended from the wall, unless the clock-frame has some strong support near the middle; but a six-feet pendulum (which is about the full length for 1¼ sec.) of not more than two cwt. may be suspended from the clock-frame, provided it is as strong as it ought to be for the general construction of the clock, and supported on corbels or iron beams. It has generally been the practice to hang the pendulum behind the clock frame; but inasmuch as the rope of the going part may always be thinner than that of the striking part, and that part requires less depth in other respects, a different and more compact plan is adopted in the clocks we are describing. The back pivots of the going wheels run in bushes on an intermediate bar, three or four inches from the back of the frame, joining the two cross bars, of which the ends are dotted in the drawing. The pendulum cock is set on the back frame, and the pendulum hangs within it. And in the gravity escapement clocks there is yet another thin bar about half way between the back frame and the bar on which the bushes of the wheels are set, the only use of which is to carry the bush of the three-legged scape-wheel; the gravity arms and the fly go between these two intermediate bars, the fork pins coming down below it, and so reaching the pendulum. The pallets are set in a brass cock screwed to the great pendulum cock. In turret clocks the adjustment for beat in the gravity escapement is not made by screws as in fig. 11, but by eccentric fork pins with nuts; of course the same might be done in small clocks, but from the confined space, and the lightness of the gravity arms, it is not so convenient as the beat screws in the pendulum. The fork pins should be of brass wire, not steel, and no oil put to them.

The same general arrangement will serve for a dead escapement clock with or without a train remontoire, only the pendulum will not stand so high, and the front end of the pallet arbor must be set in a cock like those of the striking flies, on the front bar of the frame. And for a dead escapement, especially if there is no remontoire, the pendulum should be longer and heavier than that which is quite sufficient for a gravity escapement.

Concave dials.

In connection with this subject, we have a word to say about dials. The established form of dial for turret clocks is a sheet of copper made convex, to preserve its shape; and this is just the worst form which human ingenuity could have contrived for it. For, in the first place, the minute hand, being necessarily outside of the hour hand, is thrown still farther off the minutes to which it has to point, by the convexity of the dial; and consequently when it is in any position except nearly vertical, it is impossible to see accurately where it is pointing; and if it is bent enough to avoid this effect of *parallax*, it looks very ill. Secondly, a convex dial at a considerable height from the ground looks even more convex than it really is, because the lines of sight from the middle and the top of the dial make a smaller

Clock and Watch Work.

Turret clock dials.

angle with the eye than the lines from the middle and the bottom, in proportion to the degree of convexity. Obvious as is the remedy for these defects, by simply making the dial concave instead of convex, it has, we believe, never been adopted until Mr Dent introduced this improvement also, at Mr Denison's suggestion, in some clocks for the Great Northern railway, at Doncaster, and on the platform at the King's Cross station. As convex dials look more curved than they are, these look less curved than they are, and in fact might easily be taken for flat ones, though the curvature is exactly the same as usual. There is no reason why the same form should be adopted in stone, cement, slate, or cast-iron, in which materials dials are sometimes, and properly enough, made with the middle part countersunk for the hour hand, so that the minute hand may go close to the figures and avoid parallax. When dials are large, as much as 7 or 8 feet, copper dials, or even cast-iron or slate, are quite an useless expense if the stonework is moderately smooth, as most kinds of stone take and retain paint very well, and the gilding will stand upon it better than it often does on copper or iron. The figures are generally made much too large. People have a pattern dial painted, and if the figures are not as long as one-third of the radius, and therefore occupying, with the minutes, about two-thirds of the whole area of the dial, they fancy they are not large enough to be read at a distance; whereas the fact is, the more of the dial is occupied by the figures the less distinct they are, and the more difficult it is to distinguish the position of the hands; which is what people really want to see, and not to read the figures, which might very well be replaced by 12 large spots. The rule which has been adopted, after various experiments, as the best for the proportions of the dial is this: divide the radius into three, and leave the inner two-thirds clear and flat, and of some colour forming a strong contrast to the colour of the hands, black or dark blue if they are gilt, and white if they are black. The figures should occupy the next two-thirds of the remaining third, and the minutes be set in the remainder, near the edge, and with every fifth minute more strongly marked than the rest; and there should *not* be a rim round the dial, as there generally is, of the same colour or gilding as the figures. The worst kind of dial of all are the things called skeleton dials, which either have no middle except the stonework, forming no visible contrast to the hands (to which state the authorities of Trinity College, Cambridge, have lately altered their well-known double striking clock, put up by the famous Dr Bentley, striking, as it used to be said, once for Trinity and once for his former college, St John's, which had no clock), or else taking special trouble to perplex the spectator by filling up the middle with radiating bars. Where a dial cannot be put without interfering with the architecture, it is much better to have none, as is the case in many cathedrals and large churches, leaving the information to be given by the striking of the hours and quarters. This also will save something, perhaps a good deal, in the size and cost of the clock, and if it is one without a train remontoire or gravity escapement, will enable it to go better. The size of public dials is often very inadequate to their height and the distance at which they are intended to be seen. They ought to be at least 1 foot in diameter for every 10 feet of height above the ground, and in many cases more, whenever the dial will be seen far off. A list of the sizes of various public dials, including some specimens of too small ones, is given in Mr Denison's book: it is sufficient here to state the above rule as one which ought to be enforced on architects, as they are often not aware of it till too late.

The art of illuminating dials cannot be said to be in a satisfactory state. Where there happens to be, as there seldom is, a projecting roof at some little distance below the dial, it may be illuminated by reflexion, like that at the Horse-guards—about the only merit which that superstitiously venerated and worn out clock has; and perhaps the same thing might be done by moveable lamp reflectors, like those put before shop windows at night, to be turned back against the wall during the day; but such an arrangement would be expensive in working and attendance, even if it could be conveniently arranged. It has also been proposed to sink the dial within the wall and illuminate it by jets of gas pointing inwards from a kind of projecting rim, like what is called in church windows a "hood-moulding," carried all round. But it is a great objection to sunk dials, even of less depth than would be required here, that they do not receive light enough by day, and do not get their faces washed with the rain. The common mode of illumination is by making the dials either entirely, or all except the figures and minutes and a ring to carry them, of glass, either ground or lined in the inside with linen (paint loses its colour from the gas). The gas is kept always alight, but the clock is made to turn it nearly off or full on at the proper times by a 24-hour wheel, with pins set in it by hand as the length of the day varies, or sometimes perhaps by an entirely self-acting apparatus, which however is somewhat complicated, and an unnecessary expense. But these dials always look very ill by day; and as dials are wanted much more by day than by night, we cannot say that in the present state of the art illumination is to be recommended; and it should not be forgotten that the annual expense of lighting 3 or 4 dials far exceeds the interest of the entire cost of any ordinary clock. Another objection to illuminating large dials from the inside, is that it makes it impossible to counterpoise the hands outside, unless perhaps the counterpoises could be made of glass. And if they are only counterpoised inside, there is no counterpoise at all to the force of the wind, which is then constantly tending to loosen them on the arbor, and that tendency is aggravated by the hand itself pressing on the arbor one way as it ascends, and the other as it descends; and if it once gets in the smallest degree loose, it becomes rapidly worse by the constant shaking. It is mentioned in Reid's book, that the minute-hand of St Paul's cathedral, which is above 8 feet long, used to fall over above a minute as it passed from the left to the right side of XII, before it was counterpoised outside. We observe that, in the conditions to be observed for the Westminster clock, it is expressly required that "the hands be counterpoised externally, for wind as well as weight." The long hand should be straight and plain, to distinguish it as much as possible from the hour-hand, which should end in a "heart" or swell: many clockmakers and architects, on the contrary, seem to aim at making the hands as like each other as they can; and it is not uncommon to see even the counterpoises gilt, probably with the same object of producing apparent symmetry and real confusion.

Clock and Watch Work.

Before leaving the subject of turret clocks, we will add a few particulars of the great clock for the houses of parliament, which, according to the contract (as appears by the parliamentary papers) was to have been fixed by February 1854, but seems likely to have to wait some years longer before the clock tower is ready for it. The clock itself has been going in Mr Dent's factory for some time. It has been made throughout from Mr Denison's designs, and under his superintendence, that of the Astronomer Royal having been merely nominal, and latterly abandoned altogether. The four dials are to be 22 feet in diameter, the largest, we believe, in the world with a minute-hand; the larger dials on the Continent have only an hour-hand. The minute-hand, on account of its greater length, velocity, weight, friction, and the action of the wind upon it, requires at least 20 times as much force to drive it as the hour-hand. Moreover, this clock goes a week instead of a day, and this again very considerably increases the weight and strength required, especially in the

Great Westminster clock.

Clock and Watch Work.

striking parts. The effects of friction and wind with such hands as these would make it impossible for the clock to go even as well as an ordinary church clock if there were no remontoire work; and yet there was a violent opposition made by the other clockmakers to that construction being required or adopted. It has, in fact, both the train remontoire of fig. 17 and the gravity escapement fig. 11; the former for the purpose of giving a visible motion of the hands at every half minute, when the point of the minute hand will move nearly 7 inches; and the latter because it is the most independent of those causes of variation which are likely to affect a turret clock in such a position.

The great wheel of the going part is 27 inches in diameter; the pendulum is 15 feet long and weighs 680 lb., and the scape-wheel, which is driven by the musical-box spring on the third wheel, weighs about half an ounce. All the wheels except the scape-wheel, are of cast iron, *i. e.* with the teeth cast, not cut, and all have five spokes. The barrel is 23 inches diameter but only 14 inches long, as this part will not require a rope above $\frac{1}{4}$ inch thick, and 55 turns, in the $8\frac{1}{2}$ days for which that part is to be capable of going, though the striking parts go only $7\frac{1}{2}$ days, so that in case of an accidental omission to wind it up on the proper day, the clock may not stop, but proclaim the neglect by silence. The second wheel is 12 inches in diameter, with a lantern pinion of 12, driven by 180 teeth on the great wheel; it has 120 teeth, and drives the pinion of the spring remontoire and the fly, as described in fig. 17. This part has all the back pivots on the great clock-frame, and the front ones on an intermediate bar laid upon two cross ones, the width of the frame for the striking parts being very nearly 5 feet, whereas only 2 feet is required for that of the going part. The leading-off arbor, however, comes to the front of the great frame, and there are the snails for discharging the striking parts, and also the first pair of bevelled wheels, which are 16 inches in diameter. The winding arbor before described also comes through the front frame.

The size of the hour bell, which was originally given as 14 or 15 tons, and therefore above 9 feet in diameter and nearly 8 feet high, fixes the size of the striking parts; for that determines the weight of the hammer, which must not be less than 4 cwt., according to the usual proportion, with a rise of at least a foot; it will probably be cast from the pattern of the pendulum bob; and that, with the proper allowance for loss by friction, &c., fixes the striking weight at something more than a ton and a half; and that requires a wire rope of a certain thickness ($\frac{3}{4}$ inch); and that must have a barrel of a certain length and diameter for such a number of coils as will give the most convenient arrangement of the striking cams, which are 18 in number, cast on a wheel of 37 inches in diameter; and that size again was necessary in order to keep all the wheels clear of the barrel. The cams are $2\frac{1}{4}$ inches thick, the same thickness as the great wheels; and the hammer lever is of corresponding size. The winding wheel on the end of the barrel, both of the hour and quarters, is of the same size as the respective great wheels; and as a double multiplying power is required for winding up, the second winding wheel and its pinion are also the same as those of the train in each case; these winding wheels push out of gear with the great winding wheels, but not with their own winding pinions, which are made long for the purpose. There is to be a contrivance for stopping the winding when the clock is going to strike, as the winding of each of the striking parts will probably take two hours. The second wheels are a little more than 18 inches in diameter. The second train wheel in each striking part drives a bevelled wheel which drives the fly above the clock on a vertical arbor, as in the Exchange clock, in order to keep it out of the way of people winding or examining the clock. The great wheels all have 180 teeth; the second wheel of the hour-striking part has 105 and a pinion of 15, so that it turns two-thirds round at each blow, and the lifting cylinder upon its arbor has 3 segments cut out of it, and two of them are passed at each blow—probably a novel arrangement, but the most convenient here with reference to the numbers of the teeth. The size of the hour-bell also determines that of the quarters; the largest quarter-bell will be about the same size as the great bell of St Paul's, which weighs $5\frac{1}{2}$ tons. In the quarter part the arrangement is much the same as the hour. The eight cam wheels, which in fact form a chime barrel for the eight hammers of the four bells, have been mentioned already. But the levers are not of the kind shown in the quarters of fig. 18, for they are 19 inches long from the arbor to the end which is pulled down by the cams, and the wire goes up from near the end, the wheel turning the opposite way from the quarter-wheel in fig. 18, so that the weight acts as directly as possible on the levers, with nothing but differential pressures either on their arbor or on that of the great wheel. The great wheels in this part are $38\frac{1}{2}$ inches in diameter, and the whole mass of the barrel, great wheels, and cam wheels weighs no less than 17 cwt. In fact this clock may be said to be at least eight times as large as a full-sized cathedral clock such as that described in fig. 18, since the wheels of the Westminster clock are rather more than double the size of those in every dimension. The whole of the wheels, except the fly wheels and winding pinions, lie on the top of the great frame, which is a trussed girder frame 19 inches deep (like the girders of the Crystal Palace), resting on two walls 11 feet apart which come right up from the bottom of the tower. The frame will be $15\frac{1}{4}$ feet long; the striking pulleys will be about $2\frac{1}{2}$ feet in diameter, and pivotted in, as clock pulleys always should be. They are generally made too small, and with the pulley running on a thick bolt put through the block or frame, which increases the friction considerably. We may add with reference to the question of the strength of cast-iron teeth, that a segment of one of these great wheels was tried up to breaking point, and it bore a pressure of 6 tons, and then only broke from the pinion not bearing quite flat upon it: the heaviest weight which the teeth can have to bear in action will be about half a ton.

Clock and Watch Work.

ELECTRICAL CLOCKS, AND DIALS.

The application of electricity to clock-work has engaged the attention of scientific men and of a few clockmakers for some years, and of late they have been brought to a state of sufficient perfection to be used even for astronomical purposes. But it should be understood, that under the term electrical clocks two very different things are comprehended; one being mere dials, of which the hands are driven by electrical connexion with some standard clock, on the principles of the electric telegraph, as was first done by Professor Wheatstone about 15 years ago; and the other kind are clocks kept going by electricity instead of gravity, which, until the improvements made by Mr Shepherd of Leadenhall Street, were a complete failure as regards accurate time-keeping, the previous makers having used electricity to impel the pendulum directly, and, of course, failing to get a uniform impulse; whereas Mr Shepherd applied it to raise a small weight, which gives the impulse to the pendulum after the manner of a gravity escapement, but still not without some action on the pendulum, which it is better to avoid, and which may be avoided, as will be explained presently. Without meaning to engage in the unprofitable question of priority of invention, it is proper to mention that there were in the Exhibition of 1851 several foreign electrical clocks on the same principle as Mr Shepherd's, and one of them exactly the same in construction. His large dials erected in the Exhibition certainly failed completely; and it does not appear to us that the tremor of the building, to which he attributed the failure, was sufficient to account for it.

Clock and Watch Work.

Electrical dials.

But he has since made some further improvements in them, which we shall explain after we have described the construction of electrical dials.

If you take the weight off a common recoil escapement clock, and work the pallets backwards and forwards by hand, you will drive the hands round, only the wrong way: consequently, if the escapement is reversed, and the pallets are driven by magnets alternately made and unmade, by the well known method of sending an electrical current through a wire coiled round a bar of soft iron, the contact being made at every beat of the pendulum of a standard clock, the clock without the weight will evidently keep exact time with the standard clock; and the only question is as to the best mode of making the contact, which is not so easy a matter as it appears to be, on account of the short time in which it has to be done. The first plan was to have a wheel set on the scape-wheel arbor divided into 60 conducting, and 60 non-conducting spaces, with a contact spring pressing upon it. But to this there are several objections; one is the friction, which seriously affects the going, unless it is a large clock with a heavy pendulum; and a still more serious evil is, that the contact surfaces will not keep clean enough to ensure the contact, wherever there is rubbing between them, as it promotes oxidation. It seems, that nothing except contact without friction between gold or platinum surfaces will do permanently. The late Mr Dent made an electrical dial, and kept it going in this way long enough to ascertain that it would answer. Then there is the plan (which Mr Shepherd adopts) of letting the pendulum itself make contact with two springs acting near the top, at each vibration; but the objection to this is, that any variation in the force of the springs from temperature, acting at the extremity of the arc, affects the time of the pendulum, the reason why Hardy's escapement failed, as before stated. Still, by making the springs very weak and the pendulum heavy, this method is probably sufficient for most purposes. Another method which has been lately used at the Royal Observatory, is to make a wheel on the scape-wheel arbor with 60 teeth press a slight spring against a contact plate or another spring at every second, the circuit passing through the two springs. But if any change takes place in the friction between the wheel and the spring, it will affect the going of the clock. With the gravity escapement, indeed, the friction would not signify; and if a lantern pinion of 6 is used for the three legged scape-wheel, the minute-wheel will have 60 teeth, and will itself do for making the contact.

There is also another method which may be used with the gravity escapement; and that is, to let the pallets or gravity arms fall against very weak springs which make the contact with pins as in the last case, the current passing through the spring attached to one wire of the battery, and the pin attached to the other. We have seen it tried on the great Westminster clock, with the contact made directly between the pallets and the pins, without any springs, and the current passing to the pallets from the clock-frame through the pivot holes. This acted very well for a short time, but afterwards failed, whether from a defect of the passage through the pivot holes, or some other cause, was not discovered. The time of contact can be increased, if requisite, by increasing the depth of locking, since the falling pallet will remain in contact with the pin or spring until the unlocking of the other pallet is completed, and the wheel begins to move.

But for electrical *dials* it is better, if possible, to make the hands move only by half-minute jumps, so that the time may be taken exactly as with a train remontoire; and in that case nothing is required but the three dial wheels, and some kind of scape-wheel or ratchet for driving them. If they are driven by pallets, a scape-wheel of 60 teeth will do; if it is a ratchet-wheel with a driving click, it will want 120 teeth. But here comes in a difficulty of some weight, at least in large dials, and especially in those exposed to wind. In that case it is found that pallets cannot be relied on to drive with certainty, and the ratchet and click must be resorted to. But if the wind happens to be pushing the hand forward at the time of lifting the click, it may run on 3 or 4 teeth at once. To prevent this, two ratchets have been used, set opposite ways, and the clicks so disposed that the wheels can only move one tooth at a time, under the proper action of the driving click; such at any rate is the intention of them; but it does not seem to be always carried into effect; and besides that, it requires great delicacy in construction. Mr Denison has, therefore, lately contrived the following apparatus for this purpose, which has been made by Mr Dent, and, as far as can be yet seen, is successful; at least it has been tried by pressing the wheel both ways more strongly than the wind could, and it remains quite steady. In fig. 19, H is the wheel on the arbor of the minute-hand, with 120 square teeth in it. When the circuit is com-

Clock and Watch Work

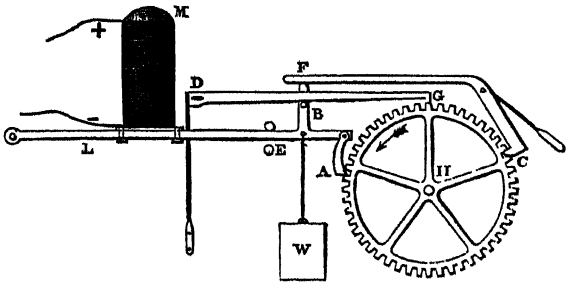


Fig. 19.

plete, the magnet M raises the lever L into the position here shown, and with it the driving click A. The pin B at the same time lifts the forward click DG out of the teeth, and the spring behind it at D sends it forward a little (there being some play left in the pivot hole for the purpose), and makes it trip on to the top of the tooth at G. The top of the lever at F also then reaches the tail of the backward click CF; so that while things are in this state, the wheel cannot go forward without pulling the lever out of contact with the magnet, which no wind would be strong enough to do while it remains a magnet; and as soon as the circuit is broken, the lever ought to go and will go, being pulled down by the weight W, till it rests on the lower banking pin E; and in so doing, the click A will drive the wheel forward one tooth, and the click DG will drop into the space next after the tooth G, and be pressed back against its spring till it is lifted again by the lever. Another advantage of this plan over those in which the magnet drives the wheel directly is, that the weight is always ready to pull down the lever as soon as the current ceases; so that if there should be any momentary impediment from residual magnetism or otherwise, it will not signify; and, moreover, the wind can never prevent the lever from being lifted; and if there should be any resistance to the hands from wind at the moment when the current ceases, the weight is sure to have the opportunity of overcoming it before the next 29 seconds are over; so that a whole move of the hands can never be lost, which has always been liable to happen under the other arrangement in large dials.

There is no such difficulty in making the half-minute contact as there is in seconds contact, because plenty of time can always be taken for it; and it may be done by a slower wheel in the train, and therefore not so liable to affect the force on the pendulum. As the third wheel in the train generally turns in $7\frac{1}{2}$ minutes, there may be 15 pins in it pressing a spring which makes contact, or raising a lever or a spring which drops into a plate. Where the gravity escapement is used, there may be a snail with two steps on the arbor of the minute-wheel, which will drop the lever on to the contact plate at every thirtieth second, and begin to lift

Clock and Watch Work.

it off again at the thirty-first, the snail being made square at the bottom in order to raise it immediately, and waste as little electricity as possible. It was intended to drive the numerous small clocks in and about the houses of parliament by electrical connection with the great clock; but as they are finished, and the great clock is not likely to be put up for some years, we suppose this plan will be abandoned, unless the bad going of some of these small clocks, and the cost of winding them, suggests the expediency of replacing them by electrical dials. In that case there ought to be one other strong gravity clock with which they might be connected in case of any accident at the great clock, which would otherwise stop them all. There is apparently to be a small turret clock at the corner facing the Abbey, which would do very well for this purpose, if it is a good one.

Shepherd's electrical clocks.

Of electrical *clocks*, *i.e.*, clocks where pendulums are kept going by electricity, it is not worth while to notice any before Mr Shepherd's, or the coeval invention of the same kind on the Continent. The latest and best form of his escapement is this: a single pallet like one of the pallets in the pin-wheel escapement (fig. 6) is fixed to the pendulum, and there is a small lever set in the frame, the end of which is lifted on to this pallet at every swing of the pendulum in one direction by the magnet; and as the pendulum draws the pallet away from the lever end, it slides down the sloped face and gives the impulse. This is a single-beat escapement, of which there are other forms without reference to electricity. They have the advantage that the impulse may be made to end exactly at the same arc of the pendulum after zero as it begins before zero, or even less; but there are countervailing disadvantages in the mode of unlocking (not applying, however, to this electrical method, which has no unlocking), and they have consequently never come into use. Still this escapement is not without friction, and the contact is made by the pendulum pressing against a spring as it approaches the extremity of its swing in one direction, which is objectionable for the reasons before mentioned. So far as we have yet described it, we have got nothing but a self-acting pendulum; the connection with a clock train is made in just the same way as if this were an ordinary pendulum from which the pallets of an electrical dial are to be driven by alternate contact springs on each side of the pendulum.

Another peculiarity of Mr Shepherd's clocks is, that the pallets which drive the train are alternately attracted and repelled, not simply attracted and let loose, and this is stated to economise the force. In order to effect it, there are two batteries which come into action alternately; and there are two permanent straight bar magnets set across the pallet arbor, with their poles opposite ways, so that on one side, say the left, the adjacent ends of the two bars would be north and south, and on the right side south and north. Consequently a temporary horse-shoe magnet, with its poles standing south and north, will attract the left side of the pallet magnets, and a similar magnet will repel the right side; and, therefore, if the current is made to pass one way when the pendulum makes the contact on the right side, and the other way when it makes it on the left, the pallets will be driven both ways by the combined force of the attraction and repulsion of both magnets. For this purpose it is only necessary that the right pendulum spring should be connected with the + pole of one battery, and the left spring with the − pole of the other, the other wires of each battery being soldered together, and ultimately connected with the pendulum cock after passing round both the soft-iron magnets.

Time-ball.

If anything is to be let off by electricity at a given second in every day, the requisite precision is obtained by Mr Shepherd thus: there are pins for making contact with springs in the minute-wheel, the hour-wheel, and the 12-hour wheel; and it is only when the contact is made with all of them at once that the circuit is complete. In this way the time-ball at the Greenwich Observatory, and also the one in the Strand in connection with it, are let off at one o'clock every day, by the clock pulling a trigger by a temporary magnet. The balls are pulled up by hand a few minutes before one. The Greenwich one is a large covered basket of wicker work, and it descends with a piston plunging into a tube with a bell-mouth to facilitate the entrance, and the piston compressing the air as it goes down, which acts as an elastic cushion to the ball, makes it drop without concussion: there is a small hole at the bottom through which the air afterwards gradually escapes. Mr Shepherd also describes in his pamphlet some apparatus for striking by means of electricity, without the aid of any striking weight. But we have not heard of any such clocks being in use, and we think it not very likely they should be, on account of the greater force which is required for striking than for keeping a pendulum going.

Clock and Watch Work.

Mr Dent has lately made a self-acting electrical clock on quite a different plan from Mr Shepherd's. It has the three-legged gravity escapement and the usual train, except the great wheel, but has a going ratchet on the centre wheel, with 120 teeth. This is driven by a click on the end of a lever, which is raised the height of one tooth by the magnet at every half minute by any such half-minute contact as we have before described. It requires, however, a strong battery, as there must always be more force in the ratchet spring than is actually required to drive the escapement. There is no doubt yet room for considerable improvement in all these various contrivances.

WATCHES AND CHRONOMETERS.

We said that we should defer a description of spring-clocks until we came to treat of watches, which, as we all know, have a spiral spring instead of a weight for their maintaining power. They seem to have been made as early as the sixteenth century, though Huygens in the seventeenth was the first discoverer of the important rule respecting springs, which he enunciated in the well-known words, *ut tensio sic vis*, the force of a spring varies as the bending of it; which, however, we shall find to be subject to one somewhat inconvenient, and another very convenient exception. The most simple form of mainspring arrangement for a clock or watch is that where the spring has its inner end attached to the arbor, which ends in the winding square, having a ratchet set on it with the click in the clock-frame. The other end of the spring is fixed to the barrel containing it, and on the end of the barrel is the great wheel of the clock or watch. And one advantage of this is, that no going barrel apparatus is wanted, as there is just the same pressure on the train when you are winding up (in fact rather more) as at any other time. But then it will occur to the reader, that by virtue of the rule *ut tensio sic vis*, there must be a much greater force on the train when the watch is wound up than when it is nearly run down. And so there would be, but for that very convenient and singular exception we just now alluded to. For it is found that there is a position of every spring, in which its force does not sensibly alter for four or five turns; and if the spring is such, that this position occurs just at the right degree of tension for using it in a watch barrel, it is evident that we may use it for a mainspring without any further provision for equalizing its force. We are not sure whether this is the case yet with any of the English mainsprings, but it certainly is with many of the foreign ones; and we can testify to the fact of watches made with those mainsprings going as well as those which are made with English mainsprings and a fusee; and we believe that the late Mr Dent, who had been trying some of these watches for several years before his death, had come to the conclusion that with a mainspring properly made and adjusted, the fusee, chain, and going ratchet, are an unnecessary expense, except per

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haps in large chronometers, where not only is a great force required, but a constant force throughout the day, which is not the case in watches.

Fig. 20 shows the general arrangement of a watch or chronometer (it is actually taken from a chronometer). The barrel and fusee will be recognised at once. The fusee is a sort of grooved cone with a concave section; the more rapid swell towards the thick end is required, because one turn of the fusee when the chain is at that end takes much more of it off the barrel than at the thin end; and on the assumption that the force of the spring varies as its tension (except under the circumstances before mentioned), the radius of the cone must increase more rapidly, in order to make the increase of leverage keep pace with the decrease in the force of the spring as it unwinds with an increasing velocity off the thick end of the fusee. The fusee itself is connected with the great wheel by a ratchet and click and going ratchet (of which the spring and click are strongly shown in the figure), just as we described in an astronomical clock. Something is also required to prevent the watch from being overwound, or the chain strained so as to break. This is done by means of a hooked lever set on a hinge in

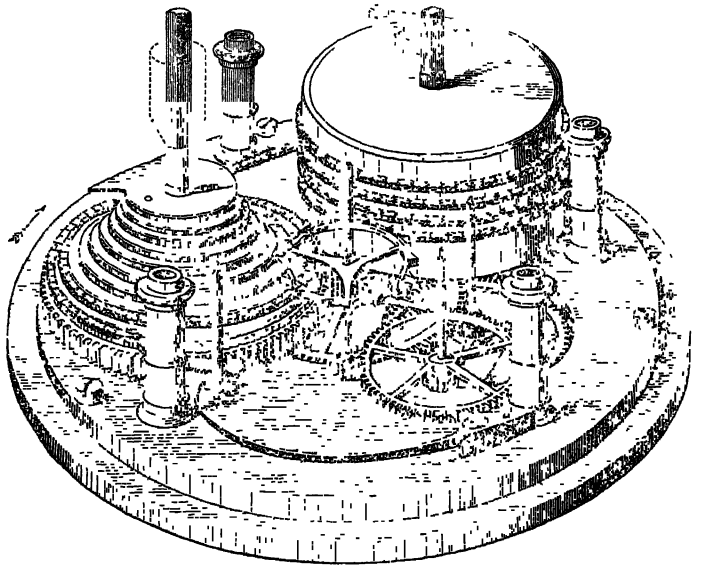


Fig. 20.

the upper frame-plate (which is taken off in this drawing); and when the watch is nearly wound up, the chain moving upwards reaches this lever, and moves it into such a position that its hook catches hold of the long tooth projecting from the thin end of the fusee; and thus the winding is stopped without any strain on the chain by the sudden check. In the Great Exhibition there were some watches by a Mr Jackson, in which the winding was done by a solid key fitting into a square hole in the arbor of a pinion working into a winding wheel on the fusee, just like the winding pinion in turret clocks. The object was to reduce the size of the fusee arbor, and to avoid the inconvenience of a very short winding square when the watch is wanted to be thin. We doubt whether the advantage is worth the additional cost. But we are surprised that a suggestion of the late Mr Mudge's for the reduction of the friction of the fusee arbor has not been adopted, viz., to make the barrel turn the opposite way to the fusee, so that the chain may act between the arbor and the centre pinion, thereby making the pressure on the fusee arbor only the difference, instead of the sum, of the force of the spring and the pressure transmitted to the pinion. In watches without a fusee, the solid key plan might be advantageously adopted, as it would not require the addition of a winding pinion; because the winding arbor is then the arbor of the barrel, which does not turn round except in winding, when the friction from the increased size would not signify.

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In watches without a fusee the apparatus for preventing them from being overwound is different; it goes by the name of the Geneva stop, and the principle of it is simply this: if two wheels work together, of which one has the spaces between some two or more adjacent teeth filled up, it is evident that that wheel cannot be turned quite round. And it will be the same thing if one of the wheels is only a cylinder with a single tooth in it, and the other has a certain number of notches, not going all round, through which that tooth can pass. If, therefore, a one-toothed wheel of this kind is fixed to the barrel arbor, which is turned by the key, and works into a wheel with only 4 or 5 notches in it and a blank space through which the tooth cannot pass, it will evidently allow the barrel to be wound up the 4 or 5 turns and no more; and as it unwinds it turns the stopping wheel back again with it.

Geneva stop.

The other parts of a watch do not differ from those of a clock, except in size, and the position in which they are arranged, to bring them within the circle of the dial, until we come to the escapement, and there a different state of things arises, mainly from the fact that the balance of a watch revolves through sometimes as much as 270°, while a clock pendulum only vibrates through 4° or 5°. The balance being common to all the watch escapements, it will be proper first to describe that, and the conditions to which it is subject. The two equal arms, with equal weights at each end, in fig. 3, are really a balance just as much as the wheel which is commonly used as the more convenient form. But in that figure there is not to be seen that essential element of a modern balance—the thin spiral spring, which you see opening and closing itself at every vibration when you look into a watch. The outer end of this spring is attached to the frame by a cock R (fig. 21), and the inner to the balance at S; and the time of vibration is a compound of the strength of the spring, and the moment of inertia of the balance; for if the spring is perfect, the extent of the vibration does not signify, by virtue of the before-quoted maxim *ut tensio sic vis*, and the further rule (which is one of mathematical certainty, and not empirical and approximate), that wherever the force varies as the angle of vibration, the time of the body vibrating is the same, whatever the space moved over. And as the force of a spring varies (approximately) inversely as its length, this suggests a ready method of regulating the watch; for it is easy to make a pointer or index, or "regulator" PT, turning on a ring fixed to the watch plate, concentric with the balance, and having two pins in it at P, called *curb pins*, just close enough together to embrace the spring, so that, as the index is moved one way or the other, the length of the spring which is free to vibrate may become shorter or longer. When the regulator has been moved as far as it can go towards *fast*, suppose, and the watch still loses, the spring has to be shortened at the cock R into which its outer end is pinned; and in order that the balance may be capable of alteration, so as still to stand square with the escapement when the spring is

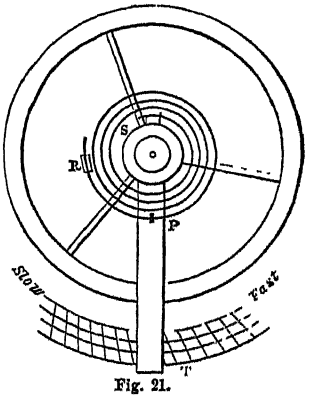


Fig. 21.

Regulation of watch.

Clock and Watch Work.

in its neutral state, the other end is not actually pinned to the balance, but the cock S is on a small ring which is set on the axis or *verge* of the balance pretty tight by friction, but capable of being turned by hand.

It has often been complained, and very justly, that it is almost impossible to move the regulator little enough, and with sufficient accuracy, for a very small variation of rate, not merely because the point is often ill adjusted to the scale, but because the divisions themselves are necessarily very small. One way of obtaining greater accuracy, and probably the best, is to make the regulator moveable by a tangent screw acting on its end, and capable of being turned by the watch key; and in an expensive watch, fitted with all the other modern appliances for securing accuracy of performance, the additional expense of this would be well worth incurring. We have seen several watches of this kind. Mr Dent suggests that a cheaper way of doing it, and accurate enough for most watches, would be to make the scale with oblique divisions (as shown in fig. 21), after the fashion of the old form of vernier, and the regulator itself with bevelled edges: by this means a very small motion of the edge of the regulator along the oblique divisions would be very distinctly seen, and it cannot be doubted that this would be a great improvement. In chronometers the adjustment for time is no longer made by altering the effective length of the spring after its length is once fixed, because of the other exception to the rule about the force of a spring varying as its tension, to which we alluded. For it has long been ascertained that a spring has not this isochronous property at all lengths, but only at certain intervals; and therefore it is necessary in an accurate time-keeper to use only one of those lengths of the spring which are isochronous for different arcs of vibration; and that being fixed, the timing of the balance can only be done by altering its moment of inertia, and this is done in chronometers by screws with heavy heads in the rim of the balance, and set farther in or out as it is wanted to go faster or slower. In marine chronometers, where there is plenty of room for it, the balance spring is generally made in a cylindrical form, with the coils all of the same diameter, instead of the flat spiral used in watches; though it does not seem to be quite clear that the cylindrical form is materially better than the other. It is evident, however, that the goodness of this spring is a matter of primary importance; and in this respect, as well as in mainsprings, there seems some reason for apprehending that our makers are surpassed by the foreign ones. The balance-springs made by M. Lutz of Geneva (by a secret method), stood the tests which the horological jury at the Great Exhibition applied, of pulling out nearly straight, and laying on a hot plate, without altering their form; while those to which special attention was invited by Mr C. Frodsham, a chronometer-maker of reputation in London, were very much distorted under the same operations. The late Mr Dent happened to be present when the springs of M. Lutz were tried, and he expressed great admiration of them.

The timing of a watch for position, as it is called, is a matter which requires some attention. If the balance is not exactly poised on its axis, it will have a tendency to take one position when the watch is carried vertically, as it always is in the pocket; and the time of vibration will be affected by its disposition thus to act as a pendulum. The watch ought therefore to be tried with XII, IX, VI, and III, successively upwards, and if it does not keep the same rate, the balance is not properly poised. Marine chronometers, indeed, being set in *gimbals* (a ring with the two pivots into the box at right angles with the pivots which carry the chronometer) will remain horizontal, though not without some degree of motion under the motion of the ship; and this gives the balance the further advantage of having its weight resting only on the end of the axis or verge, a position in which there is much less friction than that of a watch carried in the pocket: but there it is not of so much consequence, because the balance is so much lighter than a chronometer balance.

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COMPENSATED BALANCES.

The compensation of a balance for temperature is even of more importance than that of a pendulum, especially for chronometers, which are not kept as watches are to a tolerably equable temperature by being carried in the pocket. A pendulum requires scarcely any compensation except for its own elongation by heat; but a balance requires compensation not only for its own expansion, which increases its moment of inertia just like the pendulum, but far more on account of the decrease in the strength of the spring under increased heat. The late Mr Dent, in a pamphlet on Compensation Balances, gave the following results of some experiments with a glass balance, which he used for the purpose on account of its less expansibility than a metal one:—

Temperature.	Vibrations in an hour.
32°	3606
66°	3598·5
100°	3590

If therefore it had been adjusted to go right (or 3600 times in an hour) at 32°, it would have lost 7½ and 8½ seconds an hour, or more than three minutes a-day, for each successive increase of 34°, which is about 15 times as much as a common wire pendulum would lose under the same increase of heat, taking the decrease of elasticity of the spring into account, as well as the elongation of the rod; and if a metal balance had been used instead of a glass one, the difference would have been still greater.

The necessity for this large amount of compensation having arisen from the variation of the elasticity of the spring, the first attempts at correcting it were by acting on the spring itself in the manner of a common regulator. Harrison's compensation consisted of a compound bar of brass and steel soldered together, having one end fixed to the watch-frame, and the other carrying two curb pins which embraced the spring as we described at fig. 21. As the brass expands more than the steel, any increase of heat made the bar bend; and so, if it was set the right way, it carried the pins along the spring, so as to shorten it. This contrivance is called a *compensation curb*; and it has often been reinvented, or applied in a modified form. But there are two objections to it: first, that the motion of the curb pins does not correspond accurately enough to the variations in the force of the spring; and, secondly, it disturbs the isochronism of the spring for short and long arcs, because, as we stated a little while ago, that isochronism only subsists at certain definite lengths of the spring. And the compensation which was next invented left the spring untouched, and provided for the variations of temperature by the construction of the balance itself. Fig. 22 shows the plan of the ordinary compensation balance as it has now been used for many years. Each portion of the rim of the balance is composed of an inner bar of steel with an outer one of brass soldered upon it, and carrying the weights, *b*, *b*, which are screwed to it. As the temperature increases the brass expanding must bend the steel inwards; and so carries the weights farther in, and diminishes the moment of inertia of the balance. The metals are generally soldered together by pouring melted brass round a solid steel disc, and the whole is afterwards turned and filed away till it leaves only the cross-bar in the middle lying flat and the two portions of the rim standing edgeways. The

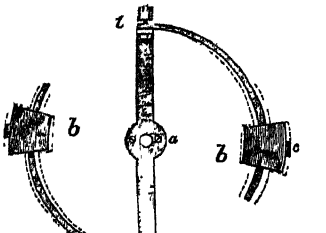


Fig. 22.

Clock and Watch Work.

first person who practised this method of uniting them appears to have been Thomas Earnshaw—the man who brought the chronometer to the state in which it has remained for the last eighty years, with scarcely any alteration; although (from a combination against him in his own time, and the indifference of writers on these subjects since) he has not obtained the reputation he deserves, and has been sometimes dismissed in a single sentence, while pages have been bestowed on the works of inferior artists, whose chronometers were always beaten by his whenever they came into competition, and who afterwards copied his inventions, and did their best to prevent his being rewarded for them.

The adjustment of a balance for compensation can only be done by trial, and requires a good deal of time. It must be done independently of that for time; the former by shifting the weights, because the nearer they are to the cross-bar the less distance they will move over as the rim bends with them. The timing is done by screws with heavy heads (*t*, *t*, in fig. 22) just opposite to the ends of the cross-bar, and consequently not affected by the bending of the rim. The compensation may be done approximately by the known results of previous experience with similar balances; and many watches are sold with compensation balances which have never been tried or adjusted—a matter which a purchaser has no means of ascertaining except by trying the watch himself in two sufficiently different temperatures.

THE CHRONOMETRICAL THERMOMETER.

If a watch or chronometer, going right at a given temperature, is transferred to a higher temperature, it will, of course, lose in proportion to the excess of the new temperature above the old, and the time it is kept there; and consequently, its difference from the true time will show the quantity of additional heat it has received during that period; and if its time is observed and registered every day or every week, it will show what has been the mean heat of that day or week. And if, instead of being furnished with a plain balance, it has one compensated the wrong way, as we may call it, its indications will become still stronger. Such an instrument is called a *chronometrical thermometer*, and is used where the quantity of heat received or lost by some other instrument or apparatus, during a given time, is wanted to be known, without regard to the extremes which the temperature may have reached, or its fluctuations.

SECONDARY COMPENSATION.

When chronometers had been brought to great perfection by the improved workmanship of modern times, and were subjected to more extreme temperatures in the annual trials at Greenwich, it was perceived that there was a residuary error, which was due to changes of temperature, but which no adjustment of the compensation could correct. For if the compensation was adjusted for two extreme temperatures, such as 32° and 100°, then the chronometer gained at mean temperatures; and if adjusted for any two mean temperatures, it would lose for all beyond them. This error was observed, and attempts were made to correct it before anybody had pointed out how it arose: this appears to have been first done in a paper in the *Nautical Magazine* by the late Mr Dent, in the year 1833; and he gave the following illustration of it. The variation of the force of the spring proceeds uniformly in proportion to the temperature, and therefore may be represented by a straight line inclined at some angle to another straight line divided into degrees of temperature. But the inertia of a balance of the common construction cannot be made to vary uniformly according to the temperature, but more rapidly in cold than heat; and consequently its rate of variation can only be represented by a curve, and the curve can only be made to coincide with the straight line representing the rate of variation of the spring, in two points, whether two extremes or two means, or one extreme and one mean point. The same thing may be shown mathematically, as follows: let r be the distance of the compensation weights *b*, *b*, in fig. 22 (which we may assume for convenience to be the whole mass M of the balance) from the centre at some mean temperature, and let dr be their increase of distance due to a decrease of some given number of degree of heat, under the action of the compensation bars. Then the new moment of inertia will be $M(r^2+2r\,dr+dr^2)$, and the ratio of the new to the old will be $1+\frac{2dr}{r}+\left(\frac{dr}{r}\right)^2$; and the term $\left(\frac{dr}{r}\right)^2$ is now too large to be disregarded, as it might be in pendulums, where, as we saw, the compensation $\frac{dl}{l}$ is only required to be about $\frac{1}{20}$th of the $\frac{dr}{r}$ in a balance. It is found that an equal increase of temperature will produce an equal (or perhaps a less) motion ($-dr$) of the weights towards the centre, and therefore the ratio of the decreased moment of inertia to the original one will be $1-\frac{2dr}{r}+\left(\frac{dr}{r}\right)^2$; so that the increase and the decrease from the mean amount differ by twice $\left(\frac{dr}{r}\right)^2$: in other words, the moment of inertia of the balance varies less in passing from mean to hot temperatures than from mean to cold, and consequently if it is adjusted for mean and cold, it will not have decreased enough at an equal increase from mean to hot, or the chronometer will lose; and if adjusted for the two extremes it will gain at mean temperatures.

Clock and Watch Work.

The correction of this error is called the *secondary compensation;* and it has lately been the subject of a rather warm controversy, carried on in memorials to the Admiralty, published by parliament, and subsequently in the *Journal of the Society of Arts* for the year 1853, arising from a repeated claim by Mr Loseby, a chronometer-maker of great reputation, to be rewarded by the government for an invention of this kind, which he asserted to be superior to the many others for the same purpose, some earlier and some later than his own. The Astronomer Royal has four times reported against Mr Loseby's claim, though admitting the general excellence of his chronometers; and it appears, from other examinations of the reports of the annual trials at Greenwich, in the above papers and journal, that when proper means are taken to distinguish the errors of compensation from the general errors which have nothing to do with temperature, Mr Loseby's apparent superiority vanishes altogether. It is obvious that the mere fact of one chronometer going better than another for a certain time proves nothing as to the value of any particular invention it contains, unless some means are taken to distinguish the effects of the error which that invention is designed to correct. We shall give a short description of the principal classes of inventions for this purpose, as several of them are exactly the same in principle.

Eiffe's compensation balance.

The first which was disclosed was Mr Eiffe's, who communicated several methods for effecting this object to the Astronomer Royal in 1835. They were afterwards described in a paper edited by Mr Airy for the Admiralty, and they, or some of them, were sufficiently successful to obtain for Mr Eiffe a reward of L.300 as being the first inventor, and having disclosed his invention without a patent. In one of them a compensation curb was used; and though for the reasons we gave before this will not answer for the primary compensation, it possibly may for the secondary, where the motion required is very much smaller. In another the primary compensation bar, or a screw in it, was made to reach a spring set within it with a small weight attached, at some mean temperature, and as it bent further in it carried

Clock and Watch Work.

this secondary compensation weight along with it. The obvious objection to this is (as Mr Loseby remarks), that it is discontinuous; but still the whole motion is so small, not more than the thickness of a piece of paper, that this and other compensations on the same principle appear to have been on some occasions quite as successful as his own. Mr Eiffe seems to have made some improvements since that time, but the nature of them is not disclosed in any of the papers we have referred to. Shortly after this Mr Molyneux took a patent for a secondary compensation exactly the same as this of Mr Eiffe's, then before the Astronomer Royal.

Dent's compensation balance.

Another large class of balances, all more or less alike, may be represented by Mr Dent's, which came the next in order of time after the two we have mentioned. He also described several forms of his invention in a pamphlet which he published; and it should be observed, that the one which he there specified as the best of them is not the one which Mr Loseby afterwards selected and described as "Dent's balance," for the purposes of his memorial to the Admiralty. The following is the proper description:—

In fig. 23, the flat cross-bar is itself a compensation bar which bends upwards under increased heat; so that if the weights were merely set upon upright stems rising from the ends of the cross-bar, they would, of course, approach the axis when that bar bends upwards. But instead of the stems rising from the cross-bar, they rise from the two secondary compensation pieces *s t u* in the form of staples, which are set on the cross-bar; and as these secondary pieces themselves also bend upwards, they make the weights approach the axis more rapidly as the heat increases; and by a proper adjustment of the height of the weights on the stems, the moment of inertia of the balance can be made to vary in the proper ratio to the variation of the intensity of the spring. The cylindrical spring stands above the cross-bar and between the staples.

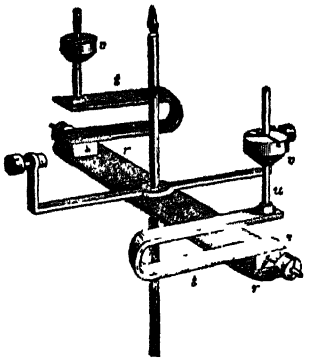


Fig. 23.

Loseby's mercurial balance.

Fig. 24 represents Mr Loseby's mercurial compensation balance. Besides the weights D set near the end of the primary compensation bars B, there are small bent tubes FE with mercury in them, like a thermometer, the bulb being at F. As the heat increases, not only do the primary weights D and the bulbs F approach the centre of the balance, but some of the mercury is driven along the tube, thus carrying some more of the weight towards the centre, at a ratio increasing more rapidly than the temperature. The tubes are sealed at the thin end, with a little air included. The action is here equally continuous with Mr Dent's, and the adjustments for primary and secondary compensation are apparently more independent of each other; and this modification of Le Roy's use of mercury for compensated balances (which does not appear to have answered), is certainly very elegant and ingenious. Nevertheless, it is clear, from the analysis of the Greenwich lists for the last 7 years before referred to, that the advantages of this method over the others is more theoretical than practical; for it appears, that if the six months of trial are divided into three periods, one containing all the coldest weeks, another the hottest, and the third those of moderate temperature only, and whether the division is arbitrarily made into equal periods of eight weeks, or into periods of six weeks of the most extreme temperatures and twelve of the mean, or is made just where the printed register of the temperature shows the greatest breaks to have occurred in each year, still the result is the same, that Dent's compensation has been the most successful in three years out of the seven, and Loseby's in only one. We observe also, that Mr Loseby, in his numerous letters and memorials to the Admiralty and the Society of Arts, does not answer the objection to his claim, that the high place which his chronometers have frequently obtained in the Greenwich lists, not being borne out in that particular respect for which his invention is designed, must be attributed to his personal care and skill in getting up a chronometer for trial in each year; which, however creditable to him, is evidently an argument against the value of his invention rather than in favour of it; and makes it probable that the same care and skill bestowed upon some of the other inventions for secondary compensation would have rendered them still more successful. It is remarkable also, that it has never been adopted by any other chronometer-maker; for although he has recently included it in a patent, it was well known and open to the adoption of everybody for several years before: whereas the principles both of Mr Eiffe's and Mr Dent's methods have been adopted by several other makers.

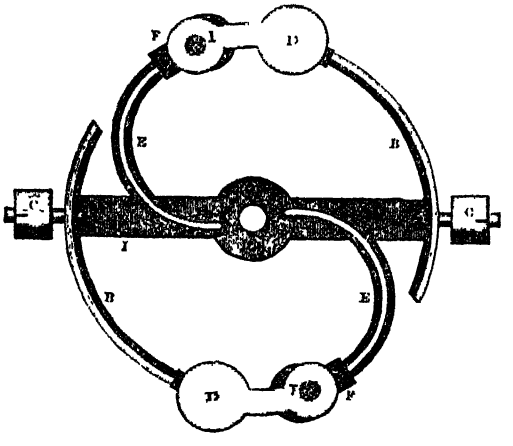


Fig. 24.

Clock and Watch Work.

Chronometers have been made with glass balance-springs, and the published rate of one which was tried some years ago at the Royal Observatory was very good. They have the advantage of requiring very little primary and no secondary compensation, on account of the very small variation in their elasticity, compared with springs of steel or any other metal. We cannot ascertain any good reason why the use of them has not been extended, except that it is said the workmen resisted their introduction, as they often do resist any improvement involving a material departure from the established modes of construction. It was also stated on a late occasion at the Society of Arts, that glass springs change their rate after a few months; but so do steel springs: it is expressly stated in Mr Eiffe's pamphlet before referred to, that chronometers always gain after a few months' working. But whatever is the cause, very few of these glass spring chronometers appear to have been made even by Mr Dent, who was the author of the one whose rate we have mentioned.

Dent's prismatic balance.

But about a year before his death he invented a very different method of effecting the primary and secondary compensation at once, and without any additional appendage to the balance or addition to the cost. He called it the *prismatic balance*, from the shape of the steel rim, of which the section is shown in fig. 25, BC being the brass, and the dark triangle within it the section of the steel part of the rim. A prism of cast-steel will bend more easily from the edge than the other way, and consequently the motion is greater

Clock and Watch Work.

when it is being curved by heat than when it is pulled straighter by cold; which is exactly what is wanted. It is

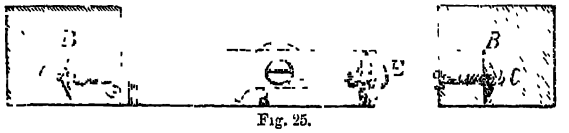


Fig. 25.

true that the difference is not quite so great as it ought to be for complete compensation for a very wide range of temperature (above 90°), such as the present Astronomer Royal has for the last few years subjected all the chronometers which are sent for public trial; a practice which seems not unlikely to withdraw the attention of the makers from points of greater practical importance, and confine it to this one of secondary compensation for variations of temperature which not one in a hundred of them will have to undergo in real use. It is remarkable that when the chronometer rates were sent to Greenwich after a late arctic expedition, the Astronomer Royal had to report to the Admiralty that the chronometers had all been kept so *warm* that they did not afford the means of arriving at any conclusion as to the relative merits of the different kinds of secondary compensation; in other words, that it had not come into action, even in an arctic voyage, to any sensible extent. But, although it would be of no use to send a chronometer of this kind to be tried against others in artificial changes of temperature from 21° to 115°, the present Mr Dent (of the Strand) says he has found them quite near enough to the requisite compensation for all ordinary variations of temperature, and also more than usually steady in their rate; for even in the best chronometers there appear every now and then quite capricious variations, which show that there is yet ample room for improvement in other things besides compensation for an excessive range of temperature.

WATCH ESCAPEMENTS.

There is a greater variety of escapements in use in watches than in clocks. In the Austrian department of the Great Exhibition there was a large watch movement to which thirteen different escapements could be fitted for the purpose of illustration—not that anything like all this number can be said to be in use. The only ones that can be so described are (1.) the old *vertical* escapement, now almost disused; (2.) the *lever*, very much the most common in English watches; (3.) the *horizontal* or *cylinder*, which is equally common in foreign watches, though of English invention; (4.) the *duplex*, which used to be more in fashion for first-rate watches than it is now; and (5.) the *detached* or *chronometer* escapement, so called because it is always used in marine chronometers. Of course every watch is in one sense a chronometer; but the term is conventionally applied only to marine chronometers, and to watches of the same construction, which are thence called pocket chronometers. Besides these five standard movements, we have already mentioned that Macdowall's single-pin escapement (fig. 7) has lately been applied to watches, and that it is in some respects superior to the lever; but it is more expensive on account of the two additional wheels in the train; and that, like the *virgule* or *comma* escapement (which is described in most of the French treatises on watches), can hardly be added to the list of escapements in general use, though it is entitled to stand above many others of the thirteen before alluded to.

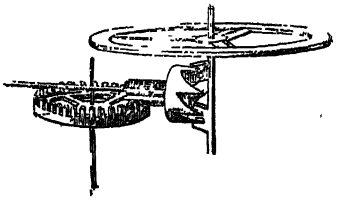


Fig. 26.

Vertical escapement.

The vertical escapement is simply the original clock escapement of fig. 3 adapted to the position of the wheels in a watch and the balance, in the manner here exhibited in fig. 26. It is, as we saw before, a recoil escapement, and the only one of those we have mentioned which is; and besides that, it requires considerable thickness in the watch to hold the wheel which stands vertically when all the others are horizontal. It is also inferior in going to all the others, and very little cheaper than the lever escapement can now be made; and for these reasons it is no wonder that it is almost disused.

Clock and Watch Work.

The lever escapement, as it is now universally made, was invented by Thomas Mudge, a London watchmaker, to whom (or to his son for him), in 1793, a committee of the House of Commons, in opposition to the opinion of the Board of Longitude, and apparently not understanding the evidence they took, gave a reward of L.3000 for inventing a remontoire escapement for chronometers, not worth a farthing, and indeed, as it turned out, worth a good deal less than nothing to his son, who proceeded to make the chronometers. However, if the reward is considered as given for the invention of the lever escapement, which is now used in all the best watches in the world (except chronometers), it may be said to have been well deserved. It is strange that Graham, the inventor of the dead escapement in clocks, did not hit upon this application of it to watches; an application, too, which avoids the great defect of that escapement in clocks, viz., the dead friction, or the friction on the dead faces of the pallets beyond what is necessary for the locking course the position of the lever with reference to the pallets is immaterial in principle, and is only a question of convenience in the arrangement; but it is generally such as we have given it. If you turn back to fig. 5, the dead escapement in clocks, you will see that this is just the same as if the pallets there vibrated no farther with the pendulum than just enough to let the teeth escape, and left the pendulum free during all the rest of its swing or "excursion" beyond the angle of escape. The reason why that cannot be done with a pendulum is, that its arc of vibration is so small that the requisite depth of intersection cannot be got between the two circles described by the end S of the lever and any pin in the pendulum which would work into it; whereas in a watch the pin P, which is set in a cylinder on the verge of the balance, does not generally slip out of the nick in the end of the lever until the balance has got 15° past its middle position. The pallets are under-cut a little, as it is called, *i.e.*, the dead faces are so sloped as to give a little recoil the wrong way, or slightly to resist the unlocking; because otherwise there would be a risk that a shake of the watch would let a tooth escape while the pin is disengaged from the lever. There is also a further provision added for safety. In the cylinder, which carries the impulse pin P, there is a notch just in front of P into which the other pin S on the lever fits as they pass; but when the notch has got past the cylinder, it would prevent the lever from returning, because the safety pin S cannot pass except through the notch, which is only in the position for letting it pass at the same time that the impulse pin is engaged in the lever. The pallets in a lever escapement (except bad and cheap ones) are always jewelled, and the scape-wheel is of brass. The staff of the lever also has jewelled pivot holes in expensive watches, and the scape-wheel has in all good ones. The holes for the balance pivots are now always

Fig. 27 shows its action; of Lever escapement

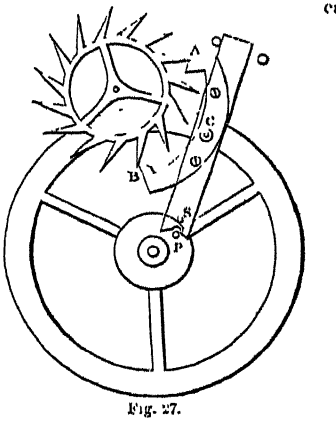


Fig. 27.

Clock and Watch Work.

jewelled, if nothing else is. The scape-wheel in this and most of the watch escapements generally beats five times in a second; in large chronometers four times; and the wheel next to the scape-wheel carries the seconds-hand. Macdowall's single-pin escapement is adapted to watches exactly as the dead escapement of clocks is turned into the lever escapement in watches.

Horizontal escapement.

Fig. 28 is a plan of the *horizontal* or *cylinder* escapement, cutting through the cylinder which is on the verge of the balance at the level of the tops of the teeth of the scape-wheel; for the triangular pieces A B are not flat projections in the same plane as the teeth, but are raised on short stems above the plane of the wheel; and still more of the cylinder than the portion shown at ACD is cut away where the wheel itself has to pass. The author of this escapement was Graham, and it resembles the dead escapement in clocks in principle more than the lever escapement does, though much less in appearance; because in this escapement there is the dead friction of the teeth against the cylinder, first on the outside, as here represented, and then on the inside, as shown by the dotted lines, during the whole vibration of the balance, except that portion which belongs to the impulse, whereas in the lever escapement there is not the dead friction, as we explained just now. The impulse is given by the oblique outside edges A *a*, B *b*, of the teeth against the edges AD of the cylinder alternately. The portion of the cylinder which is cut away at the point of action is about 30° less than the semicircle. The cylinder itself is made either of steel or ruby, and from the small quantity of it which is left at the level of the wheel, it is evidently a very delicate affair; and probably this has been the main reason why, although it is an English invention, it has been almost entirely abandoned by the English watchmakers in favour of the lever, which was originally a French invention, though very much improved, as we have seen, by Mudge; for before his invention the lever had a rack or portion of a toothed wheel on its end working into a pinion on the balance verge, and consequently it was affected by the dead friction, and that of this wheel and pinion besides. This used to be called the rack lever, and Mudge's the detached lever, but the rack lever being now quite obsolete, the word "detached" has become detached from the lever escapement and confined to the chronometer, to which it is more appropriate, as will be seen presently. The Swiss watches have almost universally the horizontal escapement. It is found that—for some reason which is apparently unknown, as the rule certainly does not hold in cases apparently analogous—a steel scape-wheel acts better in this escapement than a brass one, although in some other cases steel upon steel, or even upon a ruby, very soon throws off a film of rust unless they are kept well oiled, while brass and steel or stone will act with scarcely any oil at all, and in some cases with none.

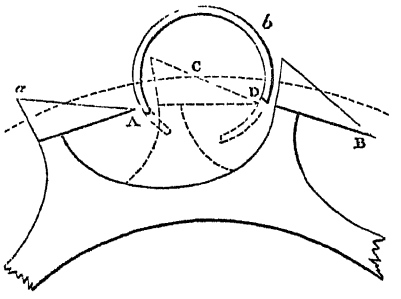


Fig. 28.

Duplex escapement.

The *duplex* escapement (fig. 29) is probably so called because there is a double set of teeth in the scape-wheel—the long ones (like those of the lever escapement in shape) for locking only, and short ones (or rather upright pins on the rim of the wheel) for giving the impulse to the pallet P on the verge of the balance. The action of this escapement is very peculiar, and requires some attention to understand it. It is a single-beat escapement, *i.e.* the balance only receives the impulse one way, or at every alternate beat, as in the chronometer escapement, and in a few clock escapements which we have not described, because they have never come into use. When the balance is turning in the direction marked by the arrow, and arrives at the position in which the dotted tooth *b* has its point against the triangular notch V, the tooth end slips into the notch, and as the verge turns farther round, the tooth goes on with it till at last it escapes when the tooth has got into the position A; and by that time the long tooth or pallet which projects from the verge has moved from *p* to P, and just come in front of the pin T, which stands on the rim of the scape-wheel, and which now begins to push against P, and so gives the impulse until it also escapes when it has arrived at *t*; and the wheel is then stopped by the next tooth B having got into the position *b*, with its point resting against the verge, and there is evidently what we have called dead friction between them; but as the verge is smaller than the cylinder of the horizontal escapement, and is also made of a jewel, the friction does not seriously affect the motion of the balance. The impulse is also given very directly across the line of centres, and therefore with very little friction, as in the three-legged dead escapement for clocks before described, and in the chronometer escapement which will be next described. A little impulse is also received from the long teeth on the notch; but the greatest part of that motion is wasted. As the balance turns back, the nick V goes past the end of the tooth *b*, and, in consequence of its smallness, it passes without visibly affecting the motion of the scape-wheel, though of course it does produce a very slight shake in passing. It is evident that if it did not pass, the tooth could not get into the nick for the next escape. The objection to this escapement is, that it requires very great delicacy of adjustment, and the watch also requires to be worn carefully; for if by accident the balance is once stopped from swinging back far enough to carry the nick V past the tooth end, it will stop altogether, as it will lose still more of its vibration the next time from receiving no impulse. The performance of this escapement, when well made, and its independence of oil, are nearly equal to that of the detached escapement, but not quite; and as lever watches are now made sufficiently good for all but astronomical purposes, for which chronometers are used, and they are cheaper both to make and to mend than duplex ones, the manufacture of duplex watches has decreased a good deal of late.

Clock and Watch Work.

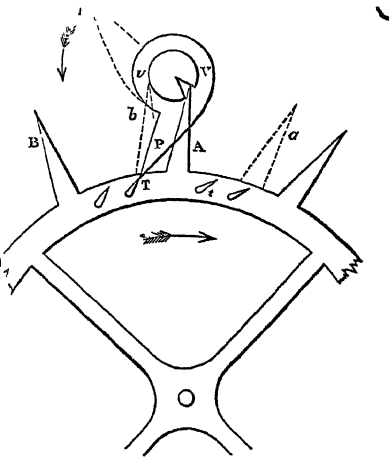


Fig. 29.

Detached, or chronometer escapement.

The chronometer or detached escapement is shown at fig. 30 in the form to which it was brought by Earnshaw nearly eighty years ago, and in which it has remained ever since, with the very slight difference that the pallet P, on which the impulse is given (corresponding exactly to the pallet P in the duplex escapement), is now generally set in a radial direction from the verge, whereas Earnshaw made it sloped backward or undercut, like the scape-wheel teeth. The early history of escapements on this principle does not seem to be very clear. They appear to have originated in France; but there is no doubt that they were considerably improved by the first Arnold, who died in 1799; (the second, who died in 1842, owed his reputation to his father in the first instance, and afterwards to his partner, the late Mr Dent.) He re-

Clock and Watch Work.

ceived several government rewards for improvements in chronometers, though it cannot be said that he deserved them all; for the last and largest of them he got solely through the influence of his friend Sir Joseph Banks, who, after failing to persuade the Board of Longitude to disregard the certificates of the Astronomer Royal, and the further evidence taken by themselves in consequence of Banks's opposition to the grant to Earnshaw, at last, by the help of the First Lord of the Admiralty, Lord Melville, extorted from a majority of the board a further grant of L.1680 to Arnold, for no further invention whatever, but simply to make him equal with Earnshaw, because he had been voted L.3000 for the improvements which enabled his ordinary and cheap chronometers to beat the picked ones of Arnold and the other makers. For among the other proofs of Earnshaw's genius it may be mentioned that he boldly set at defiance the common and stupid prejudice for what is called "high finish," *i.e.* the polishing up of surfaces which have no action, and therefore no friction on them. In this we are sorry to find that he has not been followed, in chronometers at least, by any body; and Mr Dent, who has adopted the same system in turret clockwork, has on that account met with the same obloquy, on grounds still more absurd; for nothing can be a more ridiculous waste of money than polishing non-acting surfaces, which are never seen after they leave the shop, and besides that, necessarily lose their polish by dirt, oil, and sometimes rust, in the course of a few months. But it is time we should describe the detached escapement, as it has been made ever since the time of Earnshaw, with the slight difference in the shape of the pallet, before alluded to.

Earnshaw's chronometers.

In fig. 30 the small tooth or cam V on the verge of the balance is just on the point of unlocking the detent D T from the tooth T of the scape-wheel; and the tooth A will immediately begin to give the impulse on the pallet P, which in good chronometers is always a jewel set in the cylinder; and the tooth V is also a jewel. This part of the action is so evident as to require no further notice. When the balance returns, the tooth V has to get past the end of the detent, without disturbing it; for as soon as it has been unlocked it falls against the banking pin E, and is ready to receive the next tooth B, and must stay there until it is again unlocked. It ends, or rather begins, in a stiffish spring which is screwed to the block D on the watch frame, so that it moves without any friction of pivots like a pendulum. The passing is done by means of another spring T V, called the passing spring, which can be pushed away from the body of the detent towards the left, but cannot be pushed the other way without carrying the detent with it. In the back vibration therefore, as in the duplex escapement, the balance receives no impulse, and it has to overcome the slight resistance of the passing spring besides; but it has no other friction, and is entirely *detached* from the scape-wheel the whole time, except when receiving the impulse. That is also the case in the lever escapement; but the impulse in that escapement is given obliquely, and consequently with a good deal of friction; and besides, the scape-wheel only acts on the balance through the intervention of the lever, which has the friction of its own pivots and of the impulse pin. The locking pallet T is under-cut a little for safety, and is also a jewel in the best chronometers, and the passing spring of gold, as steel will rust. In the duplex and the detached escapements, the timing of the action of the different parts requires great care, *i.e.* the adjusting them so that each may be ready to act exactly at the right time; and it is curious that the arrangement which would be geometrically correct, or suitable for a very slow motion of the balance, will not do for the real motion. If the pallet P were really set so as just to point to the tooth A in both escapements at the moment of unlocking (as we have drawn it, because otherwise it would look as if it could not act at all), it would run away some distance before the tooth could catch it; because in the duplex escapement the scape-wheel is then only moving slowly, and in the detached it is not moving at all, and has to start from rest. The pallet P is therefore in fact set a little further back, so that it may arrive at the tooth A just at the time when A is ready for it, without wasting time and force in running after it. The detached escapement has also been made on the duplex plan, of having long teeth for the locking, and short ones or pins nearer the centre for the impulse; but the advantages do not appear to be worth the additional trouble, and the force required for unlocking is not sensibly diminished by the arrangement, as the spring D must in any case be pretty stiff, to provide against the watch being held in the position in which the weight of the detent helps to unlock it.

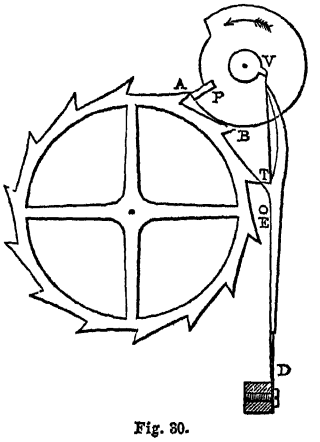


Fig. 30.

Clock and Watch Work.

There have been several contrivances for remontoire escapements, some of them certainly far better than Mudge's parliamentary reward escapement; but there are defects in all of them, and there is, after all, not the same advantage to be obtained by giving the impulse to a watch-balance by means of some other spring instead of the mainspring, as there is in turret-clocks, where the force of the train is liable to very much greater variations than in chronometers or small clocks. We are, however, far from pronouncing, as some persons have done, on the very insufficient ground of these inventions having failed hitherto, that no remontoire escapement for watches can ever succeed. It was predicted with equal confidence, that it could never succeed in turret-clocks; whereas we now see, that both a train remontoire and a remontoire escapement have succeeded perfectly, and make the clocks keep better time than had ever been known before.

Repeaters.

Among the pieces of watch-work which have gone very much out of fashion may be mentioned repeating watches, *i.e.* watches which strike the hours and quarters on pushing in the handle. They are now scarcely ever made in England, and with very good reason; for it is almost impossible to crowd into the space of even a large-sized watch the quantity of wheels and other things required for the repeating work, without unduly interfering with the going part; and besides that, the striking work itself is very liable to get out of order. We have therefore thought it better in this edition to omit the descriptions of the various inventions of this kind, and to devote the space to matters of more practical importance.

Keyless watches.

The winding of watches without a key is an object for which there have been several inventions, and it possesses a considerable advantage besides the mere convenience of being independent of a key; for as there is then no occasion to open it, the case may be made to fit more closely, and the air is more completely excluded, and consequently the watch will go longer without cleaning; and it also saves the thickness and the cost of a double back to the case. The first plan of the kind was that of pulling out the knob of the handle, which went into the watch, and had a gathering click attached to it which wound up the fusee, or the barrel, by means of a ratchet. But this was not found to answer; it was liable to get out of order, and moreover, at every time of winding you pumped fresh air into the watch, which soon produced injurious effects. A far better plan is that which is noticed in the horological report of the Great

Clock and Watch Work.

Exhibition as exhibited by Mr. Dent, as the proprietor, though not the author of the invention. It combines the two objects of winding and setting the hands by means of the handle, in the manner we shall now describe. In fig. 31, *d* is a wheel on the barrel with bevelled teeth, and there is another small bevelled wheel on a spindle *b* which ends in a milled head *a* within the handle or *pendant;* these two wheels cannot conveniently be arranged so as to work into each other without the intervention of a third between them, which is marked *e* in the left hand of the three figures 31. It is easy to see that turning the milled head will wind up the barrel. The same arrangement might of course be applied to the fusee, though it would increase the size; but in fact these watches are made without one, and we know from those who have worn them for some years that the absence of a fusee could certainly not be discovered from any defect in their performance; on this point we have expressed our own opinion some pages back. The winding wheel *d* is also made with the well-known contrivance of Breguet, known here by the name of the "tipsy key," when applied to a common winding key; which enables you to turn the handle the wrong way without doing anything except moving a ratchet-wheel over its click, and consequently without straining the watch in attempting to wind it the wrong way. The same handle and wheels are also

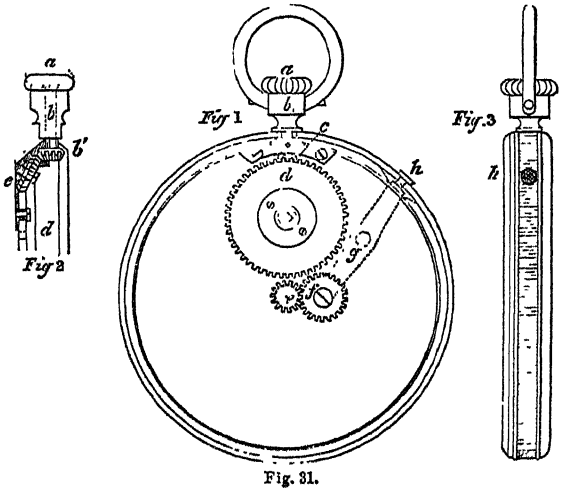


Fig. 31.

made use of to set the hands thus: There is a small wheel *f* which turns on a stud at the end of the lever *f g h*, and as the lever turns on a pivot at *g*, when its end *h*, which just projects through the rim of the watch, is pushed on one side, the wheel *f* will then be thrown into gear with the winding wheel *d* and the hour pinion in the middle of the watch; and consequently if the handle is then turned it will alter the hands, just as they are usually altered from the back by a key in foreign watches, so that the face need never be opened. Of course, while this is doing, you do at the same time wind up the watch a little if the handle has to be turned the way for winding; but that is of no consequence, except that you cannot put the hands forward immediately after you have completely wound up the watch. (The arrangement of the lever and the wheel *f* is not quite the same in Mr Dent's later watches as that given above, and taken from one of his pamphlets; but the principle being the same, we have not thought it worth while to alter the drawing.)

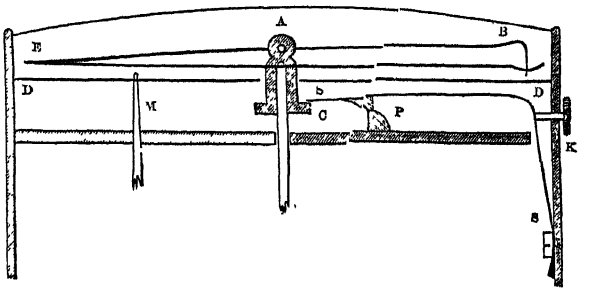
The emperor Napoleon I. had a watch which wound itself up by means of a weighted lever, which at every step he took rose and fell, and, having a gathering click to it, wound up a ratchet attached to the barrel, if it was not then fully wound up. The instrument called the *pedometer* is on the same principle, though its object is different, being merely to count the number of steps you take while the instrument is in your pocket. It is capable of adjustment

Pedometer.

according to the number of steps which the wearer usually takes in a mile, which he must first count, and set the instrument accordingly, and then it will indicate the distance walked; but without such adjustment it affords no measure of distance at all, and it is on the whole of very little use.

Clock and Watch Work.

There is a very elegant invention of M. Redier of Paris (to whom a prize medal was awarded in the Great Exhibition), for enabling you to mark the exact time of any observation, without immediately looking off the object, and without the trouble of counting the beats by ear from the watch. In fig. 32, DD is the dial of a large watch (not intended for the pocket, though not so large as a box chronometer). The seconds-hand arbor is in the middle, so as to get the usual space of a minute for the seconds on the dial, and the spaces may be still further divided if necessary. The watch should not have a duplex or a detached escapement, because in them the hand only moves at every other beat, and the quicker the balance beats the more accurate the observations may be. Very perfect going is not necessary for it, any more than for what is called in observatories a *journeyman clock, i.e.* a clock made for very loud beats (which is not generally consistent with very good going), and only set a-going from another clock a short time before it is wanted. The seconds hand is double, the lower one ending in a little cup at B with a small hole in the



Redier's dial-marking watch.

Fig. 32.

bottom; and the upper one EAB is a spring fixed to the other at E, and the end B a point just going through the hole in the cup. A drop of thick ink is put in the cup, and it is evident that when the upper hand is pulled down its point will make a mark on the dial. The pulling down is done thus:—At A there is a kind of link hung to the marking hand, moving very freely on the arbor of the main seconds hand, and ending in a ring C very near the end of the spring S S, which is fixed to the watch case, and can be pushed in by a knob K from the outside. It would be difficult to exhibit in a drawing the precise form of the pin P and the inclined plane which passes over it; but it is such that as soon as the knob is pushed in far enough the inclined plane drops over the end of P, and then the spring strikes down the ring C, and so pulls down the marking hand, and then the inclined plane is brought back sideways past P, so as to be thrown out of the ring immediately, and to leave only a momentary contact with the dial; it is in fact so momentary that the ink spot is never *run* the least, but is always a distinct and small speck, which gives the time of pushing in the knob within the nearest beat of the balance; and for the minute, the minute-hand M must be looked at, either a little before or a little after the observation.

Watches have also been made with what are called *split seconds*-hands; the two hands being in their ordinary state together and appearing as one; but when you push in a knob, one of them is stopped, while the other goes on: the time shown by the stopped one is of course the time of the observation. Sometimes this is done by merely connecting the hands by a very slight spiral spring, which will allow itself to be untwisted one or two coils without stopping the watch; and as it cannot be of much use to stop the seconds-

Clock and Watch Work.

hand longer than a minute, this seems to be all that is wanted. There is however another plan, in which these two hands, or at least the socket of one and the arbor of the other are connected by a pair of discs set obliquely on the arbor and the socket respectively, so that whenever the spring which keeps them together is allowed to act, it brings the loose hand up to the hand fixed on the arbor; and it does not signify how long it may be stopped by throwing the discs out of contact.

TEETH OF WHEELS.

The important subject of the *teeth of wheels* is the only one we have now room to notice; and though it belongs to all machines involving wheels, there is none in which it is of so much consequence as in clock-work, because there is none in which friction forms so large an ingredient in all calculations respecting its effects. At the same time we are not going to write a treatise or even an article on all the branches of that important subject, but assuming a knowledge of the general principles of it, to apply them to the points chiefly involved in clock-making. The most comprehensive mathematical view of it is perhaps to be found in a paper by the present Astronomer Royal in the *Cambridge Transactions* many years ago, which is further expanded in Professor Willis's *Principles of Mechanism*. Respecting the latter book, however, we should advise the reader to be content with the *mathematical* rules there given, which are very simple, without attending much to those of the *odontograph*, which seem to us to give not less but more trouble than the mathematical, and are only approximate after all, and also do not explain themselves, or convey any knowledge of the principle to those who use them.

For all wheels that are to work together, the first thing to do is to fix the *geometrical*, or *primitive*, or *pitch circles* of the two wheels, *i.e.* the two circles which, if they rolled perfectly together, would give the velocity-ratio you want. Draw a straight line joining the two centres; then the action which takes place between any two teeth as they are approaching that line is said to be before the line of centres; and the action while they are separating is said to be after the line of centres. Now, with a view to reduce the friction, it is essential to have as little action before the line of centres as you can; for if you make any rude sketch, on a large scale, of a pair of wheels acting together, and *serrate* the edges of the teeth (which is an exaggeration of the roughness which produces friction), you will see that the further the contact begins before the line of centres, the more the serration will interfere with the motion, and that at a certain distance no force whatever could drive the wheels, but would only jam the teeth faster; and you will see also that this cannot happen after the line of centres. But with pinions of the numbers generally used in clocks, you cannot always get rid of action before the line of centres; for it may be proved (but the proof is too long to give here) that if a pinion has less than 11 leaves, no wheel of any number of teeth can drive it without some action before the line of centres. And generally (using the word in its mathematical sense, of universally) it may be stated that the greater the number of teeth the less friction there will be; as indeed is evident enough from considering that if the teeth were infinite in number, and infinitesimal in size, there would be no friction at all, but simple rolling of one pitch circle on the other. And since in clock-work the wheels always drive the pinions, except the hour pinion in the dial work, and the winding pinions in large clocks, it has long been recognised as important to have high numbered pinions, except where there is some remontoire escapement or apparatus to obviate that necessity.

Lantern pinions.

And with regard to this matter, the art of clock-making has positively retrograded, and the pinions which are now almost universally used in English and French clocks are of a worse form than those of several centuries ago, to which we have several times alluded under the name of *lantern* pinions, so called from their resembling a lantern with upright ribs. A sketch of one, with a cross section on a large scale, is given at fig. 34 (post). Now, it is a property of these pinions, that when they are driven, the action begins just when the centre of the pin is on the line of centres, however few the pins may be; and thus the action of a lantern pinion of 6 is about equal to that of a leaved pinion of 10; and indeed, for some reason or other, it appears in practice to be even better, possibly from the teeth of the wheel not requiring to be cut so accurately, and from the pinion never getting clogged with dirt. Certainly the running of the American clocks, which all have these pinions, is remarkably smooth, and they require a much smaller going weight than English clocks; and it is evident that this cannot be due to any high finishing of the wheels and pinions, for these clocks are remarkable for the absence of all such finish; which the ignorance of most English mechanics leads them to think the great merit of a piece of clock-work, though requiring less mind than any other part of their work. Mr Dent has for some years used these pinions in the going part of his turret-clocks, and he has lately been applying them to some smaller work for the Astronomer Royal at Greenwich, and to regulators with Mr Denison's escapement. It should be understood, however, that as the action upon these pinions is all after the line of centres when they are driven, it will be all before the line of centres if they drive, and therefore they are not suitable for that purpose. In some of the French clocks in the Exhibition they were wrongly used, not only for the train, but for winding pinions; and some of them also had the pins not fixed in the lantern, but rolling: a very useless refinement, and considerably diminishing the strength of the pinion. For it is one of the advantages of these pinions that they are very strong, and there is no risk of their being broken in hardening, as there is with common pinions.

The fundamental rule for the tracing of teeth, though one of great simplicity, is, we suspect, not so well known as it ought to be, and therefore we will give it: premising that so much of a tooth as lies within the pitch circle of the wheel is called its *root* or *flank*; and the part beyond the pitch circle is called the *point*, or the *curve*, or the *addendum*; and moreover, that before the line of centres the action is always between the flanks of the driver and the points of the driven wheel or *runner* (as it may be called, more appropriately than the usual term *follower*); and after the line of centres, the action is always between the points of the driver and the flanks of the runner. Consequently, if there is no action before the line of centres, no points are required for the teeth of the runner.

In fig. 33, let AQX be the pitch circle of the runner, and ARY that of the driver; and let GAP be any curve whatever of smaller curvature than AQX (of course, a circle is always the kind of curve used); and QP the curve which is traced out by any point P in the generating circle GAP, as it rolls *in* the pitch circle AQX: and again, let RP be the curve traced by the point P, as the generating circle GAP is rolled *on* the pitch circle ARY: then RP will be the form of the point of a tooth on the driver ARY, which will drive with uniform and proper motion the flank QP of the runner; though not without some friction, because that can only be done with *involute* teeth, which are traced in a different way, and are subject to other conditions, rendering them practi-

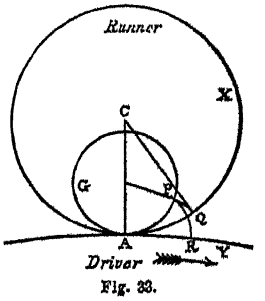


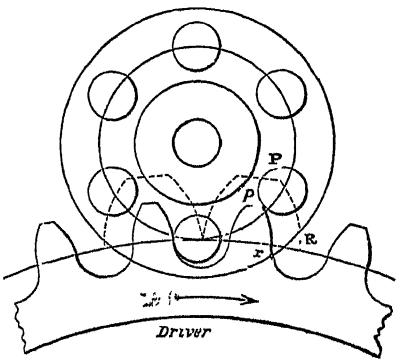
Fig. 33.

Clock and Watch Work.

cally useless for machinery, as may be seen in Professor Willis's book. If the motion is reversed, so that the runner becomes the driver, then the flank QP is of the proper form to drive the point RP, if any action has to take place before the line of centres.

And again, any generating curve or circle, not even necessarily the same as before, may be used to trace the flanks of the driver ARY, by being rolled within that pitch circle, and on the outside of the runner AQX.

Now then, to apply this rule to particular cases. Suppose the generating circle is the same as the pitch circle of the driven pinion itself; it evidently cannot roll at all, and the tooth of the pinion is represented by the mere point P on the circumference of the pitch circle; and the tooth to drive it will be simply an *epicycloid* traced by rolling the pitch circle of the pinion on that of the wheel. And we know that in that case there is no action before the line of centres, and no necessity for any flanks on the teeth of the driver. But inasmuch as the pins of a lantern pinion must have some thickness, and cannot be mere lines, a further process is necessary to get the exact form of the teeth; thus if RP, fig. 34, is the tooth that would drive a pinion with pins of no sensible thickness, the tooth to drive a pin of the thickness 2 P*p* must have the width P*p* or R*r* gauged off it all round. This in fact brings it very nearly to a smaller tooth traced with the same generating circle; and therefore in practice this mode of construction is not much adhered to, and the teeth are made of the same shape, only thinner, as if the pins of the pinion had no thickness.



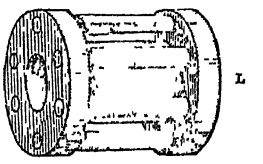


Fig. 34.

Lantern pinions.

Of course they should be thin enough to allow a little shake, for freedom of action in case of any impediment; and in clock-work the backs of the teeth never come in contact at all.

Next, suppose the generating circle to be half the size of the pitch circle of the pinion. The curve, or *hypocycloid*, traced by rolling this within the pinion, is no other than the diameter of the pinion, and consequently the flanks of the pinion teeth will be merely radii of it, and such teeth or leaves are called radial teeth; and they are far the most common; indeed no others are ever made (except lanterns) for clock-work. The corresponding epicycloidal points of the teeth of the driver are more curved, or a less pointed arch, than those required for a lantern pinion of the same size and number. The teeth in fig. 35 are made of a different form on the opposite sides of the line of centres CA in order to show the difference between driving and driven or running teeth, where the number of the pinion happens to be as much as 12, so that no points are required to its teeth when driven, since with that number all the action may be after the line of centres. The great Westminster clock affords a very good illustration of this. In both the striking parts the great wheel of the train and the great winding wheel on the other end of the barrel are the same, and so are their pinions, except that in the train the wheel drives and in winding the pinion drives; and the same is again the case with the second wheel of the train and the second winding wheel. And therefore in the train the pinion teeth have their points cut off, and wheel teeth have their points on, as on the right side of fig. 35; and in the winding wheels the converse, as on the left side; and thus in both cases the action is made to take place in the way in which there is the least friction. Professor Willis gives the following table, "derived organically" (*i.e.* by actual trial with large models), of the least numbers which will work together without any action before the line of centres, provided there are no points to the teeth of the runner, assuming them to be radial teeth as usual:—

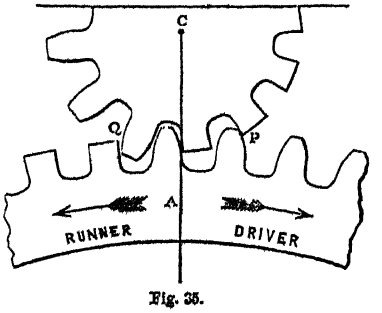


Fig. 35.

Clock and Watch Work.

Driver	54	30	24	20	17	15	14	13	12	11	10	9	8	7	6
Runner.....	11	12	13	14	15	16	17	18	19	21	23	27	35	32	176

In practice it is hardly safe to leave the driven teeth without points, unless the numbers slightly exceed these; because if there is any irregularity in them, the square edges of those teeth would not work smoothly with the teeth of the driver. Sometimes it happens that the same wheel has to drive two pinions of different numbers. It is evident that, if both are lanterns or both pinions with radial teeth, they cannot properly be driven by the same wheel, because they would require teeth of a different shape. It is true that on account of the greater indifference of lantern pinions to the accuracy of the teeth which are to drive them, the same wheel will drive two pinions of that kind differing in the numbers in the ratio of even 2 to 1, with hardly any sensible shake; but that would not be so with radial pinions, and of course it is not correct. Accordingly in clocks with Mr Denison's spring remontoire, as in fig. 17, where the scape-wheel or remontoire pinion is double the size of the fly pinion, the larger one is made with radial teeth and the smaller a lantern, which makes the same wheel teeth exactly right for both. In clocks of the construction in fig. 18 there is a case of a different kind, which cannot be so accommodated; for there the great wheel has to drive the second wheel's pinion of 10 and the hour-wheel of 40; the teeth of the great wheel are therefore made to suit the lantern pinion of 10, and those of the hour-wheel (*i.e.* their flanks) then depend on those of the great wheel, and they are accordingly traced by rolling a generating circle of the size of the lantern pinion on the inside of the pitch circle of the hour-wheel; the result is a tooth thicker at the bottom than usual. These are by no means unnecessary refinements; for if the teeth of a set of wheels are not properly shaped so as to work smoothly and regularly into each other, it increases their tendency to wear out in proportion to their inaccuracy, besides increasing the inequalities of force in the train. Sometimes turret clocks are worn out in a few years from the defects in their teeth.

Striking cams.

In describing the striking work of a turret clock, fig. 18, we referred to this part of the article for the rule for constructing the cams which raise the hammer. The condition which it is most important for them to satisfy is that the action should begin at the greatest advantage and therefore at the end of the lever; and that when it ceases the face of the lever should be a tangent to the cam at both their points, so that in no part of the motion should the end of the lever scrape on the cam. In the common construction of clocks the first condition is deviated from as far as possible, by the striking pins (which are used by nearly all the clock-makers) beginning to act some distance from the end of the lever; and consequently at the time when the most force is required to lift the hammer there is the least given, and a great deal is

Clodius Pulcher || Clonmel.

wasted afterwards. The following is a simple rule for constructing the cams. In fig. 36 let CA be a radius of the wheel, and L in the same straight line the centre of the lever; AB the space of one cam on the pitch circle of the cams; AP the arc of the lever. Draw a tangent to the two circles at A, and a tangent to the cam circle at B; then T, their point of intersection, will be the centre of the circle which is the face of the cam BP; and TB also = TA; which is a convenient test of the tangents being rightly drawn. The action begins at the point of the lever, and advances a little way up it, but recedes again to the point, and ends with the lever as a tangent to the cam at P. The backs of the cams must be cut out rather deeper than the circle AP, to allow enough for clearance and drop, in order that the lever may not fall at once on to the next cam, but against some fixed stop or banking on the clock frame. The point of the lever must not be left quite sharp, for, if it is, it will in time cut off the points of the cast-iron cams.

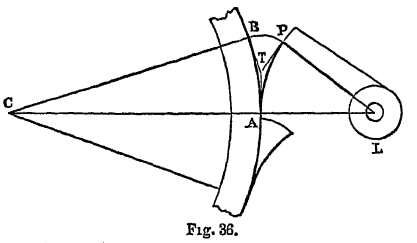


Fig. 36.

We will add a few words on the subject of oil. Olive-oil is most commonly used, sometimes purified in various ways, and sometimes not purified at all. We believe, however, that animal oil is better than any of the vegetable oils, as some of them are too thin, while others soon get thick and viscid. For turret clocks and common house clocks, good sperm oil is fine enough, and is probably the best. For finer work the oil requires some purification. Even common neat's foot oil may be made extremely fine and clear by the following method:—mix it with about the same quantity of water and shake it in a large bottle, not full, until it becomes like a white soup; then let it stand till fine oil appears at the top which may be skimmed off: it will take several months before it has all separated into water at the bottom, dirt in the middle, and fine oil at the top. And it should not be done in hot weather, because heat makes some oil come out as fine, which in cold would remain among the dirty oil in the middle, and in cold weather that fine oil of hot weather will become muddy. There are various vegetable oils sold at tool shops as oil for watches, including some for which a prize medal was awarded in the Exhibition, but not by any of the mechanical juries; we have no information as to the test which was applied to it, and none but actual use for a considerable time would be of much value. We have heard of 5 per cent. in power being saved in a manufactory by the use of sperm, instead of sweet oil, to small spindles requiring constant lubrication. See DIPLEIDOSCOPE. (E. B. D.)

Close || Cloud.

CLODIUS PULCHER, PUBLIUS, the son of Appius Claudius Pulcher, one of the most worthless Romans of the latter days of the republic. After a life of almost uninterrupted turbulence and crime he was slain in a scuffle by his old rival Milo, who had exerted himself in behalf of his friend CICERO when in exile. Milo was arraigned for murder, and though defended with all the brilliant eloquence of Cicero, he found it necessary to retire from Rome for a time. See CICERO, and ROMAN HISTORY.

CLOGHER, a decayed episcopal city, and formerly a parliamentary borough of Ireland, county of Tyrone, 15 miles S.S.E. of Omagh, and 98 from Dublin. Besides its cathedral, a plain cruciform building, it has an episcopal palace, free school, bridewell, workhouse, and savings-bank. Pop. (1851) 558, exclusive of 442 in workhouse.

CLOISTER, literally a place inclosed with walls; commonly applied to a monastery or nunnery. In a more limited sense, cloister denotes the principal part of a regular monastery, consisting of a square inclosing a court, which is ordinarily between the church, the chapter-house, and the refectory, and over which is the dormitory. The cloisters served for several purposes in the ancient monasteries. The proper use of the cloister is for the monks to meet in for conversation at certain hours of the day. The form of the cloister is square; and received its Latin name *claustrum* from *clausus*, the participle of *claudo*, to shut or close; as being inclosed on its four sides with buildings. Hence, in architecture, a building is said to be in the form of a cloister when there are buildings on each of the four sides of the court.

CLONMEL, a parliamentary and municipal borough of Ireland, partly in the south riding of Tipperary and partly in Waterford county, 104 miles S.W. from Dublin. It is built on both sides of the Suir, and on Moore and Long Islands, which are connected with the mainland by 3 bridges. The principal buildings are, the parish church, 3 Roman Catholic chapels, 2 convents, endowed school, model school under the national board, mechanics' institute, court-house and prison, fever hospital and dispensary, lunatic asylum, market-house, barracks, savings-bank, and workhouse. Till the Union the woollen manufacture was extensively carried on here. The town contains a brewery, distillery, flour-mills, a cotton factory, and has a considerable export trade in grain, cattle, butter, and provisions. The river is navigable for barges of 50 tons to Waterford. Clonmel is a station on the Waterford and Limerick railway, and the centre of a system for the conveyance of travellers on light cars, extending over a great part of Leinster, Munster, and Connaught. It is governed by a corporation, consisting of a mayor, free burgesses, and a commonalty, and returns one member to parliament. Electors (1853) 328. Pop. (1851) 15,203. Market-days, Tuesday and Saturday. Two newspapers are published here, each twice a-week.

CLOSE, in *Heraldry* (opposed to *volant* or flying), is when a bird is drawn with its wings closed, and in a standing posture.

CLOTH. See WOOLLEN MANUFACTURE.

CLOTHO, one of the three Parcæ or Fates, daughters of Jupiter and Themis, or of Erebus and Nox. Clotho held the distaff, and spun the thread of life, whence her name from κλώθειν, *to spin*. She was represented as wearing a crown with seven stars, and a variegated robe. See PARCÆ.

CLOUD, a collection of vapours suspended in the atmosphere.

Cause of the formation of clouds uncertain.

That the clouds are formed from the aqueous vapours, which before were so closely united with the atmosphere as to be invisible, is universally allowed; but it is no easy matter to account for the long continuance of some very opaque clouds without dissolving, or to give a reason why the vapours, when they have once begun to condense, do not continue to do so till they at last fall to the ground in the form of rain, snow, &c. The general cause of the formation of clouds, it has been supposed, is a separation of the latent heat from the water of which the vapour is composed. The consequence of this separation must be the condensation of that vapour, in some degree at least. In such case it will first appear as a smoke, mist, or fog, which, if interposed between the sun and earth, will form a cloud; and the same causes continuing to act, the cloud will produce rain or snow. But though the separation of this latent heat in a certain degree is the immediate cause of the formation of clouds, the remote cause, or the changes produced in the atmosphere, by which such a separation may be induced, are much more difficult to be discovered. In common observation, we see that vapour is most powerfully condensed by cold substances, such as metals, water, and the

Cloud. like. But cold alone cannot in all cases cause the condensation of the atmospherical vapours, otherwise the nights would be always foggy or cloudy, owing to the vapours raised during the day by the heat of the sun being condensed by the superior coldness of the night. Great rains may happen in very warm weather, when the union of the vapours with the atmosphere ought rather to be promoted than dissolved, if cold were the only agent in their condensation. The serenity of the atmosphere, also, in the most severe frosts, abundantly shows that some other cause besides mere heat or cold is concerned in the formation of clouds and the condensation of the atmospherical vapours.

The electric fluid is now so generally admitted as an agent in all the great operations of nature, that it is no wonder to find the formation of clouds attributed to it. This has accordingly been stated by Beccaria as the cause of the formation of all clouds whatsoever, whether of thunder, rain, hail, or snow. The first, he thinks, are produced by a very great power of electricity, and the others by one more moderate. But though it is certain that all clouds, or even fogs and rain, are electrified in some degree, it still remains a question whether the clouds are formed in consequence of the vapour of which they are composed being first electrified, or whether they become electrified in consequence of its being first separated from the atmosphere, and in some measure condensed. This has not yet, as far as we know, been ascertained by the experiments of Beccaria, or of any other person; and indeed, notwithstanding the multitude of electrical discoveries which have been made, there seems to be little or no foundation for ascertaining it. Electricity is known to be in many cases a promoter of evaporation; but no experiments have as yet been brought to prove that electrified air parts with its moisture more readily than air that is not electrified: and hence, until the properties of electrified air be further investigated, it is impossible to lay down any rational theory of the formation of clouds upon this principle.

But whether the clouds are produced, or, in other words, the invisible vapours floating in the atmosphere condensed so as to become visible, by means of electricity, or not, it is certain that they do contain the electric fluid in very great quantities, and that many terrible and destructive phenomena have been occasioned by clouds highly electrified. Perhaps the most extraordinary instance of this kind on record happened in the island of Java in August 1772. On the 11th of that month, at midnight, a bright cloud was observed covering a mountain in the district called Cheribon, and at the same time several reports like those of a gun were heard. The people who dwelt upon the upper parts of the mountain not being able to fly fast enough, a great part of the cloud, almost three leagues in circumference, detached itself under them, and was seen at a distance rising and falling like the waves of the sea, and emitting globes of fire so luminous that the night became as clear as day. The effects of this phenomenon were astonishing. Every thing was destroyed for seven leagues round; the houses were demolished, plantations were buried in the earth, and 2140 people were killed, besides 1500 head of cattle, and a vast number of horses, goats, and other animals.

Another instance of a very destructive cloud is related by Brydone, in his *Tour through Malta*. It appeared on the 29th of October 1757. About three-quarters of an hour after midnight, there was seen to the S.W. of the city of Melita, a great black cloud, which, as it approached, changed its colour, till at last it became like a flame of fire mixed with black smoke. On its approach a dreadful noise was heard, which alarmed the whole city. It passed over the port, and came first on an English ship, which in an instant was torn in pieces, and nothing left but the hulk: part of the masts, sails, and cordage, were carried to a considerable distance along with the cloud. The small boats and feluccas that fell in its way were all shattered and sunk. The noise increased and became more frightful. A sentinel, terrified at its approach, ran into his box, but it was lifted up and carried into the sea, where he perished. It then traversed a considerable part of the city, and laid in ruins almost everything that stood in its way. Several houses were levelled; and it did not leave a steeple standing in its passage. The bells of some of them, together with the spires, were carried to a considerable distance; the roofs of the churches were demolished or beat down. It went off at the N.E. point of the city, and demolishing the lighthouse, is said to have mounted up into the air with a frightful noise, and passed over the sea to Sicily, where it tore up some trees, and did other damage, but nothing considerable, as its fury had been mostly spent at Malta. The number of killed and wounded amounted to nearly two hundred; and the loss of shipping, &c., was very considerable. Cloud.

The effects of thunder-storms, and the vast quantity of electricity collected in the clouds which produce these storms, are so well known that it is superfluous to mention them. It appears, however, that even the clouds are not so highly electrified as to produce fatal effects on those who are immersed in them. It is only the discharge of part of their electricity upon such bodies as are either not electrified at all, or not so highly electified as the cloud, that does mischief. We have, however, only the following instance on record, of a person immersed in the body of a thunder-cloud. Saussure and young M. Jalabert, when travelling over one of the high Alps, were caught among clouds of this kind; and, to their astonishment, found their bodies so full of electrical fire, that spontaneous flashes darted from their fingers with a crackling noise, and the same kind of sensation as when strongly electrified by art.

Height of the clouds. The height of clouds in general is not great; the summits of very high mountains being commonly quite free from them, as Brydone experienced in his journey up Mount Ætna. But those which are most highly electrified descend lowest, their height being often not more than seven or eight hundred yards above the ground; nay, sometimes thunder-clouds appear actually to touch the ground with one of their edges; yet the generality of clouds are suspended at the height of a mile, or little more, above the earth. Some, however, have imagined that clouds rise to a most incredible and extravagant height. Maginan of Toulouse, in his Treatise of Perspective, gives an account of an exceedingly bright little cloud that appeared at midnight, in the month of August, and spread itself almost as high as the zenith. He says that the same thing was also observed at Rome; and thence concludes that the cloud was a collection of vapours raised beyond the projection of the earth's shadow, and consequently illuminated by means of the sun. This, however, can by no means be credited; and it is much more probable that this cloud owed its splendour to electricity, than to the reflection of the solar beams. Humboldt, however, when on Chimborazo, saw white *cirrhi*, or detached hair-like small clouds, still far above him.

Their curious colours. In the evenings after sunset, and the mornings before sunrise, we often observe the clouds tinged with beautiful colours. They are mostly red, sometimes orange, yellow, or purple, more rarely bluish, and still more seldom green. The reason of this variety of colours, according to Sir Isaac Newton, is the different size of the globules into which the vapours are condensed. But this is controverted by Mr Melville, who thinks that the clouds reflect the sun's light precisely as it is transmitted to them through the atmosphere; which reflects the most refrangible rays in the greatest quantity, and therefore ought to transmit the least refrangible ones, red, orange, and yellow, to the clouds, which accordingly appear most commonly of these colours. In this opinion he was greatly confirmed by observing while he was in Switzerland, that the snowy summits of the Alps turned more and more roseate after sunset, in the same man-

Cloud.

ner as the clouds; and he imagines that the semi-transparency of the clouds, and the obliquity of their situation, tend to make the colours in them much richer and more copious than those on the tops of snowy mountains.

Of the motions of clouds.

The motions of the clouds, though sometimes directed by the wind, are not always so, especially when thunder is about to ensue. In this case they seem to move very slowly, and often to be absolutely stationary for some time. The reason of this most probably is, that they are impelled by two opposite streams of air nearly of equal strength, by which means their velocity is greatly retarded. In such cases both the aërial currents seem to ascend to a very considerable height; for Messrs Charles and Roberts, when endeavouring to avoid a thunder-cloud in one of their aerial voyages, could find no alteration in the course of the current, although they ascended to the height of four thousand feet above the surface of the earth. In some cases the motions of the clouds evidently depend on their electricity, independently of any current of air whatever. Thus, in a calm and warm day, we often see small clouds meeting each other in opposite directions, and setting out from such short distances that we cannot suppose any opposite winds to be the cause of such motions. These clouds when they meet, instead of forming a larger one, become much less, and sometimes vanish altogether; a circumstance undoubtedly owing to the discharge of opposite electricities into each other. This serves also to throw some light on the true cause of the formation of clouds; for if two clouds electrified, the one positively and the other negatively, destroy each other in contact, it follows, that any quantity of vapour suspended in the atmosphere, while it retains its natural quantity of electricity, remains invisible, but becomes a cloud when electrified either *plus* or *minus*. A difficulty, however, still occurs, namely, in what manner a small quantity of vapour surrounded by an immense ocean of the same kind of matter can acquire either more or less electricity than that which surrounds it; and this indeed we seem as yet not to have any data to solve in a satisfactory manner.

Their shapes.

The shapes of the clouds are likewise undoubtedly owing to their electricity; for in those seasons in which a great commotion has been excited in the atmospherical electricity, we shall perceive the clouds assuming strange and fantastical shapes, which vary almost every moment. This, as well as the meeting of small clouds in the air, and then vanishing upon contact, is an almost infallible sign of thunder.

Connection of the clouds with wind.

Besides the phenomena of thunder and rain, the clouds are intimately connected with those of wind, and always assume a particular shape when a strong continued wind is about to ensue; though it is remarkable, that in the strongest winds we often observe them stationary. Sometimes also, on the approach of a cloud, we find a sudden and violent gust of wind arise; while at others, the wind, though violent before, ceases on the approach of a cloud, and recovers its strength as soon as the cloud is past. This connection of the clouds with wind is most remarkable in mountainous countries, where the peaks are sufficiently high to have their tops involved in clouds. This is very remarkable on the Table mountain at the Cape of Good Hope, from the clouded top of which the winds sometimes issue forth of a sudden and with great violence, as if they had been confined in a bag; and something similar has been observed of mountains in other parts of the world.

Their uses.

The uses of the clouds are evident, as from them proceed the rain and dews which refresh the earth, and without which, according to the present system of nature, the whole surface of the earth must be a mere desert. They are likewise of great use as a screen interposed between the earth and the scorching rays of the sun, which are often so powerful as to destroy the grass and other tender vegetables. In the more secret operations of nature, also, where the electrical fluid is concerned, the clouds bear a principal share, and serve especially as a medium for conveying that fluid from the atmosphere into the earth, and from the earth into the atmosphere; but in doing this, when electrified to a great degree, they sometimes produce terrible effects. This subject is further treated in the articles METEOROLOGY and PHYSICAL GEOGRAPHY.

Cloud ‖ Clusium.

CLOUD, *St*, a town of France, department of Seine-et-Oise, on the left bank of the Seine, and on the Paris and Versailles railway, 5 miles W. of Paris. Pop. 3051. It is celebrated for its park and palace, and is much resorted to by visitors from Paris. The palace consists of a front and two wings, inclosing three sides of a square, the fourth side being formed by a terrace and balustrade, commanding a magnificent view. The interior is handsomely furnished, and contains marble statues, vases, and paintings. The finest apartment is the Salon de Mars. The orangery is remarkable as being the place where the Council of the Five Hundred held their sittings when expelled by Napoleon and his armed grenadiers in 1799. The park is of great extent, and beautifully adorned with cascades and waterworks, which play on the first and third Sunday of every month. The *Grand Jet d'Eau* ejects a column of water to the height of more than 100 feet, and discharges 5000 gallons per minute. A fair held here, beginning on the 7th September and lasting for three weeks, is one of the most celebrated and frequented of all the fêtes near Paris. St Cloud is a favourite summer residence of the French court.

CLOUDBERRY, *Rubus chamæmorus*, a well known alpine plant, found in boggy ground on our loftiest mountains. It is a low shrub with a yellowish berry resembling a brambleberry.

CLOVER. See AGRICULTURE, vol. ii. p. 322.

CLOVES. See AMBOYNA, vol. ii. p. 660; and BOTANY.

CLOVIO, GIORGIO GIULIO (1498-1578), a historical and portrait painter, was born in Sclavonia. At the age of eighteen he went to Rome, where he spent three years in the study of drawing and miniature painting. His knowledge of colouring was derived from the instructions of Giulio Romano, and his taste in composition and design was formed by a close study of the works of Michael Angelo Buonarotti. With the assistance of these he attained such excellence in portrait as well as in historical painting, that he was accounted nearly equal to Titian in the former, and in the latter only inferior to Buonarotti himself. His principal works are the *Corpus Christi* at Rome and the *Descent from the Cross* at Milan.

CLOVIS I. (467-511), the founder of the French monarchy. See FRANCE.

CLOYNE, a market-town, formerly an episcopal city of Ireland, 15 miles E. by S. of Cork. A church was built and a bishopric erected here by St Colman, who died in 604; and an abbey was founded in 707. In 1430 the bishopric was united to that of Cork. In 1678 it was again governed by its own prelates, one of whom was the celebrated Berkeley; but in 1835 the episcopate was again merged in that of Cork. The cathedral is a large old cruciform building, with some good monuments; and near it stands an ancient round tower 92 feet in height. The old episcopal palace is now a private residence. Pop. (1851) 1713.

CLUNY, or CLUGNI, a town of France, department of Seine-et-Loire, on the left bank of the Grône, here crossed by a stone bridge, 12 miles N.W. of Mâcon. Pop. 4000. Its celebrated Benedictine abbey, of which the church was 656 feet long by 130 wide, was almost totally destroyed during the revolution of 1789. Cluny has manufactures of woollens, linens, paper, earthenware, and gloves; and a trade in corn, wine, timber, and cattle.

CLUPEA, the genus to which the herring belongs. See ICHTHYOLOGY.

CLUSIUM, now CHIUSI, a city of Etruria, and one of twelve that composed the Etruscan confederation. It was

Clusius || Cluvier.

situated on the slope of a hill on the right bank of the river Clanis, and at a short distance from the Palus Clusina, about 100 miles from Rome, in a district still celebrated for its fertility. It was regarded by the ancients themselves as a place of great antiquity, and was by them believed to have been built by the Umbrians. Its original name was Camars or Camers, which it exchanged for that of Clusium when it fell into the hands of the Tuscans. In allusion to its antiquity, Virgil mentions it among the cities which sided with Æneas against Turnus. Clusium first appears in history as a place of importance under the reign of its king Porsena, whose abilities and magnanimity were acknowledged by the Romans themselves. The noble qualities of this prince were the theme of many an ancient song and legend; and his expedition against Rome has furnished Mr Macaulay with the subject of one of his most spirited Lays. As Clusium rose under Porsena, so after his death it relapsed into its original obscurity, and its name does not occur again in history till the invasion of the Galli Senones, B.C. 391. These barbarians, being foiled in their first attempts to take the town, suddenly broke up their camp before the walls and marched off to Rome, which they destroyed and burned to the ground, except the capitol. In B.C. 295 they once more suddenly crossed the Apennines, and, rushing down upon Clusium, cut to pieces the Roman legion posted there. In what year Clusium acknowledged the supremacy of Rome is unknown; but it is found in the second Punic war taking part with the Romans against Hannibal. In the wars of Marius and Sulla, the Clusians espoused the cause of the former, and were twice defeated. Under the empire, Clusium is found greatly fallen from its high estate, and existing as a small municipal town. In the numerous excavations that have been recently effected in the neighbourhood of Chiusi, large numbers of Etruscan vases, urns, &c. have been discovered. One of the most interesting objects in the vicinity of the ancient Clusium was the famous labyrinthine tomb of Porsena. It is supposed by some authorities that the Poggio Cajella (2½ miles from Chiusi), which has been recently excavated and discovered to have been an ancient cemetery, is no other than this renowned sepulchre of which so many traditions are still extant. This subject will be found fully discussed in Dennis's *Cities and Cemeteries of Etruria*. The present population of Chiusi is about 1700.

CLUSIUS, or ECLUSE, CHARLES D', a celebrated botanist, born at Arras, Feb. 18, 1526. He had been intended for the profession of the law, but disliking this study, he went to Montpellier, where he became the pupil of the naturalist Rondelet, and took the degree of M.D. From France he travelled into different parts of Europe, and on his return to Antwerp began to publish his botanical researches. The Emperor Maximilian II. appointed him to the direction of the botanical garden at Vienna; and there he remained until a court cabal drove him from his situation in 1587, and obliged him to seek an obscure retreat at Frankfort-on-the-Maine. Thence he was called in 1593 to occupy the chair of botany at Leyden. The life of Clusius was one of much bodily suffering. In a botanical excursion in early life he had the misfortune to dislocate his ankle and hip joint, and to fracture his thigh, which rendered him lame. In after years he became dropsical, and had vesical disease, which occasioned him much bodily suffering; yet his mental activity was undiminished, and he continued to teach and write till within a short period of his death, which took place at Leyden April 4, 1609. His botanical works are remarkable for the time he flourished; and he translated several from the Latin into French and Spanish.

CLUVIER, PHILIP (1580-1623), a celebrated geographer, was born at Dantzic, and was educated for the bar. During a visit to Leyden he was induced by Joseph Scaliger to devote himself to the study of geography; and for this purpose he visited the majority of the European states. He gained considerable reputation as a linguist, and taught at Leyden for several years with great applause. He wrote, 1. *De tribus Rheni alveis atque ostiis, et de quinque populis quondam accolis*, inserted in the *Recueil des Antiquités de la Germanie Inférieure*, Leyden, 1611, 4to; 2. *Germaniæ Antiquæ libri tres, necnon Vindelicia et Noricum*, Leyden, 1616, 2 vols. fol.; 3. *Siciliæ Antiquæ libri duo, Sardinia ac Corsica Antiquæ*, Leyden, 1619, fol.; 4. *Italia Antiqua*, Leyden, 1624, two vols. in one, fol.; 5. *Introductionis in Universam Geographiam tam veterem quam novam, libri sex*, Leyden, 1629, 12mo. The best edition of this last work is that of Amsterdam, 1729, in quarto, with notes by Bunon, Hekel, and De la Martinière.

Cluyd || Cnossus.

CLUYD. See DENBIGHSHIRE.

CLYDE, the most important river of Scotland, and the third in point of magnitude, celebrated for the romantic beauty of its scenery. It has its origin from numerous small streams rising in the mountains which separate Lanarkshire from the counties of Peebles and Dumfries, and flows first in a northerly direction, with a slight inclination eastward as far as Biggar. After its junction with the Douglas near Harperfield, it takes a N.W. course, passing Lanark, Hamilton, and Glasgow, and falls into the Firth of Clyde below Dumbarton. From its source to Dumbarton it is about 73 miles in length, but in a direct line only about 52. Its principal tributaries are the Douglas, Nethan, Avon, Mouse, Kelvin, Cart, and Leven. Of the celebrated falls of Clyde, two are above and two below Lanark: the uppermost is Bonnington Linn, the height of which is about 30 feet; the second is Corra Linn, where the water dashes over the rock in three distinct leaps. Dundaff Fall is 10 feet high; and at Stonebyres there are three distinct falls, together measuring 76 feet in height. At high water the Clyde is navigable for the largest class of merchant vessels. See GLASGOW.

CLYTEMNESTRA. See AGAMEMNON.

CNIDUS, in *Ancient Geography*, a city of Caria, at the extremity of a long peninsula forming the southern boundary of the Ceramicus Sinus. It was built partly on the mainland and partly on an island about 7 stadia in circuit, and connected with the mainland by a causeway forming two harbours. It was celebrated for the worship of Venus. A narrow sandy isthmus now unites the island to the mainland. The remains of two moles which inclosed the southern or larger port are still visible. The ruins of this city are still considerable, exhibiting specimens of different kinds of Greek architecture, both Doric and Ionic. The city walls are still very perfect, and there are remains of two theatres, one of which had a diameter of 400 feet.

CNOSSUS or GNOSSUS, or (as the name was originally written) CNOSUS or GNOSUS, the most important city of Crete, on the left bank of the Cæratus, a small stream which falls into the sea on the north side of the island. The city was situated at a considerable distance from the coast, and, according to the old traditions, was founded by Minos, the mythical king of Crete. The locality was associated with a number of the most interesting legends of the Grecian mythology, particularly those which related to Jupiter. It was in the vicinity of Cnossus that the most powerful of the gods is said to have been born, to have been married, and to have been buried. Cnossus is always assigned as the *locale* of the fabled labyrinth in which the Minotaur was confined. As it was originally peopled by Dorians, the manners, customs, and political institutions of its inhabitants were all Dorian in their caste. Along with Gortyna and Cidonia, it held for many years the supremacy over the whole of Crete, and always took a prominent part in the civil wars which from time to time desolated the island. When the Romans began to extend their arms southwards, Cnossus fell under their domination, and became a Roman colony. Ænesidemus, the sceptic philo-

Coa Vestis ‖ Coach.

sopher, and Chersiphron, the architect of the temple of Diana at Ephesus, were natives of Cnossus.

COA VESTIS, *in Antiquity*, a fine transparent textile fabric, probably of silk, for which the island of Cos was celebrated. It appears to have been of a gorgeous description, sometimes dyed purple, and enriched with golden stripes.

COACH, a close vehicle for commodious travelling, borne on four wheels, and supported by springs upon a framework to which the wheels are attached.

The learned Beckmann, in his *History of Inventions*, has given an interesting account of coaches from the earliest times. The Roman *arcera*, mentioned in the Twelve Tables, was a covered carriage used by the sick and infirm, and is supposed to have been so called from its resemblance to an *arca* or chest. This was succeeded by the *carpentum*, a two-wheeled car with an arched covering. The *carrucæ* were of later invention, but their construction is a matter of surmise, though it seems probable they had four wheels. These vehicles were sometimes very splendidly ornamented with gold and precious stones; and covered carriages seem more and more to have become appendages of Roman pomp and magnificence. On the introduction of the feudal system the use of carriages was for some time prohibited, as tending to render the vassals less fit for military service. Men of all grades and professions rode on horses or mules, and sometimes the monks and women on she-asses. Horseback was the general mode of travelling; and hence the members of the council who at the diet, and on other occasions, were employed as ambassadors, were called *rittmeister*. In this manner also great lords made their public entries into cities. When on state occasions the pope mounted his horse or mule, emperors and kings, if present, were obliged to hold his stirrup and to lead the horse. Bishops made their public entrance on horses or asses richly decorated.

Covered carriages were known in the beginning of the sixteenth century, but their use was confined to ladies of the first rank; and as it was accounted disgraceful for men to ride in them, the electors and princes sometimes availed themselves of this prejudice to excuse their non-attendance at meetings of the state, by informing the emperor that their health would not permit them to ride on horseback. Covered carriages were for a long time forbidden even to women; but about the end of the fifteenth century they began to be employed by the emperor, kings, and princes, in journeys, and afterwards on state occasions. In 1474 the Emperor Frederic III. visited Francfort in a close carriage, and again in the following year in a very magnificent covered carriage. Shortly afterwards carriages began to be splendidly decorated; as for instance that of the Electress of Brandenburg at the tournament held at Ruppin in 1509, which was gilded all over; and that of the Duchess of Mecklenburg, which was hung with red satin. At the marriage of the Emperor Frederic II. with a princess of Bavaria, "the bride rode with her sisters in a splendid carriage studded with gold, her maids of honour in carriages hung with black satin, and the rest of the ladies in neat leather carriages." When Cardinal Dietrichstein made his entrance into Vienna in 1611, forty carriages went to meet him; and in the same year the consort of the Emperor Matthias made her public entrance on her marriage in a carriage covered with perfumed leather. The wedding carriage of the first wife of the Emperor Leopold, who was a Spanish princess, cost, together with the harness, 38,000 florins. Those of the emperor are thus described:—"In the imperial coaches no great magnificence was to be seen; they were covered over with red cloth and black nails. The harness was black, and in the whole work there was no gold. The pannels were of glass, and on this account they were called the imperial glass coaches. On festivals the harness was ornamented with red silk fringes. The imperial coaches were distinguished only by their having leather traces; but the ladies in the imperial suite were obliged to be contented with carriages the traces of which were made of ropes." At the magnificent court of Duke Ernest Augustus at Hanover, in 1681, there were fifty gilt coaches with six horses each. The first time that ambassadors appeared in coaches on a public solemnity was at the imperial commission held at Erfurth in 1613. Soon after this time coaches became common all over Germany, notwithstanding various orders and admonitions to deter vassals from using them. These vehicles appear to have been of very rude construction. Beckmann mentions, that when he visited Bremen in 1785, he saw on the wall of the senate-house a view of the city painted in oil colours by John Landwehr in 1661; and in it there was represented a long quadrangular carriage, apparently not suspended by straps, and covered with a canopy supported by four pillars, but without curtains. In the side there was a small door, and in front a low seat, or perhaps a box; the coachman sat upon the horses; and the dress of the persons within proved them to be burgomasters. At Paris in the fourteenth, fifteenth, and even sixteenth centuries, the French monarchs rode commonly on horses, the servants of the court on mules, and the princesses and principal ladies sometimes on asses. Persons even of the highest rank sometimes sat behind their equerry on the same horse. Carriages, however, were used at a very early period in France; for there is still extant an ordinance of Philip the Fair, issued in 1294, by which citizens' wives are prohibited from using them. It appears, however, that about 1550 there were only three carriages at Paris; one belonging to the queen, another to Diana of Poictiers, and the third to René de Laval, a very corpulent nobleman who was unable to ride on horseback. The coaches used in the time of Henri IV. were not suspended by straps (an improvement referred to the time of Louis XIV.) though they were provided with a canopy supported by four ornamental pillars, and with curtains of stuff or leather. When Richard II. of England, towards the end of the fourteenth century, was obliged to fly before his rebellious subjects, he and all his followers were on horseback, while his mother alone used a carriage. The oldest carriages used by the ladies in England were called by the now forgotten name of *whirlicotes*; but these became less fashionable when Ann the wife of Richard II. showed the English ladies how gracefully she could ride on the side-saddle. Coaches, properly so called, were first known in England about the year 1580, and were introduced, according to Stow, from Germany, by the Earl of Arundel. About 1605 they began to be in common use. The celebrated Duke of Buckingham was the first who rode in a coach with six horses; and to ridicule this pomp the Duke of Northumberland used eight.

Coach.

Hackney coaches were first introduced in France about the year 1650, by one Nicolas Sauvage, who lived in a house called the *Hôtel S. Fiacre;* from which circumstance all hired carriages came to be called *fiacres;* though eventually the name was restricted to such as were stationed for hire in the streets. It should be observed, however, that in ancient Rome there were carriages let out for hire, which Suetonius calls *rheda meritoria*, and *meritoria vehicula* (i. 57; iv. 39).

The prototype of the modern omnibus was a carriage which at stated hours carried passengers from one quarter of Paris to another. Coaches to be let out for hire were first established at London in 1625. In 1637 there were in London and Westminster no fewer than 50; in 1652 they had increased to 200; and two years later there were 300, employing 600 horses. In 1694 the number of hackney coaches was limited to 700; and in 1715 to 800.

Hackney coaches were first established at Edinburgh in

Coach. 1673; but from 20, their original number, they had fallen in 1752 to 14, and in 1778 to 9, while the number of sedans increased.

At Amsterdam in 1663, coaches with wheels were prohibited, in order to save the pavement of the streets; and accordingly they were placed on sledges—a fashion that is not yet extinct. (Beckmann's *Hist. of Inventions*, vol. i.)

Duties on Carriages.—It is long since duties were imposed on carriages, and these have varied considerably at different periods.

The following table exhibits the rates of duty on carriages as fixed by the 16th and 17th Vict., cap. 90 (1853):—

Carriages with four wheels, drawn by two or more horses or mlues	L.	3	10 0
Do drawn by one horse or mule		2	0 0
Carriages with four wheels, each of less diameter than 30 inches, and drawn by two or more ponies or mules, not exceeding 13 hands in height		1	15 0
Do. drawn by one such pony or mule		1	0 0
Carriage with less than four wheels, drawn by two or more horses or mules		2	0 0
Do drawn by one horse or mule		0	15 0
Do. drawn by one pony or mule not exceeding 13 hands in height		0	10 0
Carriages kept solely for being let for hire, one-half the above duties respectively.			
Carriage with four wheels, used by a common carrier, chiefly for the carriage of goods		2	6 8
Do. with less than four wheels		1	6 8

Exemptions.—Licensed hackney and stage carriages. Carriages kept for being let on hire with a horse or horses by a person licensed to let horses for hire. Waggon, van, or cart used solely in trade or husbandry, on which the name, surname, and place of abode of the owner are legibly painted, and which on no occasion is used for any purpose of pleasure, except for conveying the owner or his family to or from church.

Hackney Coaches are coaches stationed in the streets or other public places, and bound to carry those who require them at certain fixed rates of hire, according to the distance travelled. By act 16th and 17th Vict., cap. 127, the former duties on hackney carriages in the metropolis were abolished, and the following instituted instead:—For every license to keep and let to hire a hackney carriage, 20s. For every such carriage authorized to be used every day in the week, the weekly sum of 7s.; but if for every day except Sunday, the weekly sum of 6s.

Stage Coaches are defined as carriages or vehicles used, employed, or let out for the purpose of carrying passengers for hire, and travelling at the rate of three or more miles in the hour, without regard to the number of wheels, horses, or passengers, or whether the same be open or close, provided each passenger be charged a separate and distinct fare. Carriages used wholly on a railway or impelled by steam are excepted from this definition. By act 16th and 17th Vict., cap. 88, the following are the license duties imposed on postmasters:—

	£		
For 1 horse or 1 carriage	£	7	10
Not exceeding 2 horses or 2 carriages		12	10
... 4 ... or 3 ...		20	0
... 8 ... or 6 ...		30	0
... 12 ... or 9 ...		40	0
... 16 ... or 12 ...		50	0
.. 20 ... or 15 ...		60	0
Exceeding 15 carriages		70	0
Exceeding 20 horses—then for every additional number of 10 horses, and for any additional number less than 10 over and above 20, or any other multiple of 10 horses, the further additional duty of		10	0

The various regulations relating both to stage and hackney coaches may be found in M'Culloch's *Commercial Dictionary* (1854), pp. 293–5, and 645–6. See Carrier.

Mail Coaches are stage coaches of a particular construction, which, for a certain consideration, carry her Majesty's mails, are protected by a guard, and are subject to the regulations of the post-office. In most instances these have been superseded by the railways.

Coach-making ‖ Coahuila.

Coach-making is such a combination of crafts as rarely are united in one trade. The technical names of those composing the different branches are, body-makers, carriage-makers, wheelers, spring-makers, axle-makers, smiths, trimmers, &c. Painting is an important part of the business; and those professing it are divided into body, carriage, and heraldry or ornamental painters. These classes of workmen have each their own department in the construction of a coach. Under the general head of coach-making a great variety of different kinds of vehicles are produced, such as close coaches, landaus, landaulets, chariots, phaetons, britzskas, gigs, &c.; and of the three kinds last named there are almost infinite varieties, both with regard to construction and the manner of finishing. The fashion with respect to these is almost as fluctuating and mutable as that of dress. The smaller the body of a carriage of course the lighter, and consequently the easier drawn; but it has been proved that shortness in the carriage makes it not only less easy, but also harder on the axles and springs, thus rendering them more apt to break.

The principal part of the coach-making business depends chiefly on the selection of materials. Ash is the kind of wood commonly used in the framework both of body and carriage; and the quality best suited for body wood is that of a mild and free nature, while for the carriage the wood cannot be too strong or robust. Full-grown wood of course is best suited for both purposes, and the planks must be allowed to lie until they are properly seasoned.

After the framework is made, the lower part of the body is pannelled up with the softest bay mahogany. The kinds of wood generally applied to coach-wheel making are elm for the naves, oak for the spokes, and ash for the felloes; but beech felloes are often used; and it has been found by experience, that beech, when cut into felloes from the log shortly after it is felled, and kept until they become dry before being put upon wheels, answers admirably for this purpose. Indeed, nothing but properly-seasoned wood can be applied to any purpose in the construction of a coach.

Formerly, in the making of coach-springs nothing was used but German steel, which from its hardness was more apt to snap than the English steel now employed for that purpose. The latter, with superior elasticity, combines a strength that enables the spring-maker to fabricate his springs at least one-third lighter, while they stand equal fatigue. The kinds of axles now chiefly used are the common or plain axle, the mail-coach patent, and the Collinge patent, which last, when properly executed, is found to be the best for retaining the oil; as it is generally found to be in good order in this respect after a journey of 500 or 600 miles. The iron mounting of coach-work requires the skill of experienced smiths; for, besides solidity, some degree of taste is requisite to form the shapes and sets of the different parts. No branch of coach-making contributes more to the elegance of the vehicle than that of the painter. His colours must be of the best quality, in order to stand exposure in all weathers. The varnish used is copal, of which there are two kinds; the finest for finishing the body, and the second for finishing the carriage. Heraldry painting requires some knowledge of heraldry, combined with considerable practice. The business of the trimmer is to make and put in the linings, mount the coachman's seat, steps, &c., and put on the leather work, beading, &c. Coaches built in London are reputed the most perfect of their kind; and Edinburgh has latterly become noted for the excellence of its carriages.

Coach, or Couch, is also an apartment in a large ship of war near the stern, the floor of which is formed by the aftmost part of the quarter-deck, and the roof by the poop.

COAHUILA, a state of Mexico. See Mexico.

Coak ‖ Coal-Trade.

COAK, or COKE, charred pitcoal, prepared for the smelting of iron ore by igniting the coals piled up in long ridges in the open air, and closing in the cinders with earth, when brought to a glowing red heat. For the use of the manufacturers, the method hitherto most in practice has been to burn the small or screened coal in conical ovens, built of firestone or brick, the floor being generally about 6 feet in diameter, and the oven 8 feet high, while an aperture of 18 inches diameter is left at top. The small coal is thrown in to the depth of 15 inches or more, and then ignited. The oven door is at first kept open, and the hole at the top left uncovered till the mass is red hot. The door is then closed, and by degrees the hole at the top is covered over by two large flat stones, gradually approaching each other, when the whole is left to cool. When sufficiently cooled, it is drawn out with long iron rakes, and the mass is found to have assumed a rude columnar arrangement. The oven is immediately charged again with small coal, which the heat remaining in the floor is found sufficient to ignite, and so the operation goes on. In both the above ways good coaks are made, but the volatile products are lost. To save these, Lord Dundonald proposed to burn the coals in a close furnace, to which he adapted an apparatus for conveying the coal-tar, with the ammoniacal products, into proper recipients. About the same time, Baron Von Haak, a German, constructed works in the neighbourhood of Newcastle, for distilling the small coal in large cast-iron cylinders, upon the plan which has since been adopted in the gas-works; except that the soot from the furnace fires is, at Newcastle, during a certain period of the combustion, before any gray ashes have begun to arise, conveyed into a chamber contrived for the purpose, and collected for lamp-black. See IRON MAKING.

COAL. See COLLIERY.

COAL TRADE. It is estimated that not less than forty million tons of coals are raised annually from the various mines in the United Kingdom.[1] Of these the greater part is either used in the immediate neighbourhood of the mines, or sent by inland navigation or land carriage to different parts of the kingdom. In 1852, 12,709,771 tons of coals, cinders, and culm were shipped from ports in the United Kingdom; of these, 9,069,577 tons were sent coastwise to other ports of the kingdom, being, coals 8,805,934 tons, cinders 43,376 tons, culm 220,267 tons. The quantities of coals, cinders, and culm shipped coastwise from the different ports of the United Kingdom in 1851 and 1852, were—

	1851. Tons.	1852. Tons.
ENGLAND—		
Portsmouth	6,103	6,644
Bristol	1,562	1,085
Gloucester	85,963	88,801
Cardiff	501,002	462,243
Newport	451,491	451,770
Swansea	352,247	375,182
Llanelly	219,460	214,735
Milford	49,573	50,102
Chester	101,044	85,772
Liverpool	115,904	105,932
Preston	42,257	37,918
Fleetwood	9,898	9,349
Lancaster	5,337	4,838
Whitehaven	226,266	222,208
Workington	95,703	85,014
Maryport	201,676	230,012
Carlisle	15,153	17,851
Newcastle	2,067,112	2,175,857
Shields	214,829	168,172
Sunderland	1,899,160	1,978,611
Stockton	388,646	336,821
Hartlepool	1,137,989	1,340,876
Gainsborough	9,577	7,605
Hull	12,735	10,113
Goole	104,336	96,083
Other ports	4,252	3,934
SCOTLAND—		
Leith	9,091	8,358
Borrowstounness	36,359	31,550
Grangemouth	6,521	2,943
Alloa	23,015	18,266
Kirkcaldy	37,035	29,504
Glasgow	86,893	81,966
Irvine	224,193	250,847
Ayr	72,569	77,888
Other ports	430	2,091
IRELAND—		
Ross	476	179
Total	8,816,538	9,069,577

Coal Trade.

In 1852 the exports from the United Kingdom to foreign countries including British settlements, were as follows:—coals 3,479,282 tons, of the value of L.1,287,626; cinders 159,040 tons, of the value of L.83,832; culm 1872 tons, of the value of L.656; total, 3,640,194 tons, of the declared value of L.1,372,114.

The principal foreign countries to which coals, cinders, and culm were exported from the United Kingdom in 1851 and 1852, were the following—

Countries.	Quantities Exported. 1851	1852.
Russia	Tons 215,221	188,041
Denmark	295,153	313,689
Prussia	216,603	211,513
Hanseatic towns	343,065	350,499
Holland	132,258	117,540
France	602,808	663,261
Spain and Canaries	191,355	203,371
Italy	152,919	171,367
Turkey	98,235	72,782
British East Indies	97,738	91,304
British West Indies	82,147	99,449
United States, N.A.	83,516	122,285

The quantities of coal brought coastwise and by inland navigation into the port of London were—

	Coastwise.	Inland Navigation and Land Carriage.	Total.
1851	Tons 3,236,542	254,421	3,490,963
1852	„ 3,330,428	414,917	3,745,345

During the six months ending 30th June 1852, 179,386 tons of coal were imported into London by railway, and 19,637 tons by canal: for the corresponding period of 1853 the imports by railway were 296,361 tons, and by canal 10,322; showing a decrease by canal, but a very considerable increase by railway.

The coal trade was long subjected to very heavy and oppressive duties. A duty of 17s. per chaldron on large, and 4s. 6d. per chaldron on small coals, was levied on all coal exported to foreign countries. In 1831 these duties were considerably modified, and in 1835 they were repealed, with the exception of an *ad valorem* duty of 10s. per cent. on coal exported in British vessels, or in those of foreign countries entitled to the privileges conferred by treaties of reciprocity, while in other foreign vessels it was subject to a duty of 4s. a ton. These duties were, in 1840, altered to 10s. 6d. per cent., and 4s. $2\frac{8}{9}$d. per ton respectively. In 1842, duties of 2s. per ton on large, and 1s. per ton on small coal and culm were imposed, and on all coal exported in foreign vessels not entitled to the privileges conferred by treaties of reciprocity a duty of 4s. per ton. The two former were abolished on 12th March 1845, but the last continued in force till 14th August 1850.

In the reign of William III., a duty of 5s. per chaldron was laid upon coal carried coastwise from one part of the kingdom to another. During the last war this was raised to 9s. 4d., but in 1824 it was reduced to 6s., and in 1831 was wholly repealed. This tax pressed very unequally on different parts of the empire, for while it amounted to 6s. a chaldron, or 4s. a ton in the metropolis, and all the south of England, it was only 1s. $7\frac{1}{4}$d. a ton on coal carried by sea to Ireland, and 1s. 8d. on that to Wales; while Scotland was for many years entirely exempted from this duty.

[1] Since the above was written, Mr Robert Hunt has published a work on the "Mineral Statistics of the United Kingdom of Great Britain and Ireland for 1853 and 1854," in which the quantity raised in 1854 is given at 64,661,401 tons, as ascertained by means of circular letters addressed to the various owners or lessees of collieries, and by personal inquiries.

Coamings || Coasting Trade.

Though these duties are now abolished, the coal trade is still in some places burdened with heavy local duties. Thus a duty of 1s. 1d. per ton is chargeable upon all coal brought into the port of London. By act 1st and 2d William IV., cap. 76, several oppressive acts were repealed, and the duties payable to the corporation of the city of London were commuted for a duty of 1s. 1d. per ton; and by 8th and 9th Vict., cap. 101, a like duty was imposed on coal brought into London by railway, canal, or other inland carriage. Of this duty 8d. per ton is carried to the London Bridge Approaches Fund, for effecting street improvements in the metropolis; 4d. per ton is the property of the corporation of the city of London, and after defraying certain charges is carried to the general account of the corporation; and 1d. per ton is payable to her Majesty's commissioners of works, to be applied by them in effecting public improvements in the metropolis, authorized by several acts of parliament. The produce of these duties, with the drawbacks allowed upon coal exported, was in 1852,

	Gross Duty.	Drawback.	Nett Duty.
8d. per ton to 5th January 1853 ..	L.123,657	L.10,098	L 113,559
4d per ton to 31st Dec. 1852 . .	62,640	5,049	57,591
1d. per ton to ditto	15,560	1,262	14,298
Total.	L.201,857	L 16,409	L.185,448

In 1851 the gross amount of duty was, on sea-borne coal L.175,840, on coal brought landwise L.12,151. The 4d. per ton duty, in 1851, amounted to L.54,104, of which L.215 were salaries in relation to collection; L.3009 drawback allowed upon coal exported; L.7607 retiring allowances paid to deputy sea-coal meters and others, upon the abolition of their offices in consequence of Act 1st and 2d Will. IV., cap. 76, and which had gradually decreased from L.16,820 in 1836; and L.20,000 an annual charge for making a new street in the line of Canon Street, and other improvements. The attention of government is at present directed to these unjust local imposts, by which our home trade is unnecessarily burdened, and the merchant and shipowner made to pay for improvements which ought properly to be charged against the landlords or inhabitants; and it is expected that they will speedily be abolished.

COAMINGS, in ship-building, the raised border round the hatches, to prevent water from going down into the hold.

COANZA, a river of Congo, West Africa, forming in the lower part of its course the S. boundary of Angola, and falling into the Atlantic in S. Lat. 9. 10., E. Long. 14. 22. It is supposed to have a course of about 500 miles.

COAST CASTLE, Cape, or *Cabo Corso*, a town of Africa, capital of the British settlements on the Gold Coast, in N. Lat. 5. 6., W. Long. 1. 12. It was first colonized in 1610 by the Portuguese, but they were dislodged a few years afterwards by the Dutch, who were in their turn ejected by the British in 1661. Since that date the colony has remained in the possession of the English. The castle is situated upon a granite rock about 50 feet high, projecting into the sea, and near it are the outposts of Fort William and Fort Victoria. The town is dirty and irregularly built, but the English residences are generally handsome. Population about 10,000. The climate is moist and unhealthy. The exports are palm oil, gold dust, ivory, maize, tortoise shell, &c.

COASTING Trade, trade or intercourse carried on by sea between ports or places of the same country. This is regulated in different countries by particular laws; and it has generally been the custom to exclude foreigners from all participation in the coasting trade. This policy was adopted in England in the reign of Elizabeth, or perhaps earlier; was perfected by the navigation acts of 1651 and 1660; and these again were succeeded by a vast number of regulations at different times, which have all been much simplified by act 16th and 17th Vict., cap. 107. (See M'Culloch's *Commercial Dictionary*).

Coat || Cobbett.

COAT, or Coat of Arms, in *Heraldry*, a habit worn by the ancient knights over their arms, and still borne by heralds-at-arms. It was a kind of surcoat, reaching as low as the navel, open at the sides, with short sleeves, upon which were applied the armouries of the knights embroidered in gold and silver, and enamelled with beaten tin, coloured black, green, red, and blue. The coats of arms were frequently open, and diversified with bands and fillets of several colours, placed alternately, and called devices, as being divided and composed of several pieces sewed together. The representation of these is still called a coat of arms. See Heraldry.

Coat of Mail, a kind of armour made in form of a shirt, consisting of iron rings interwoven netwise; or of small laminæ or plates laid over each other like the scales of a fish, and fastened to a strong linen or leathern jacket.

COBALT, a metal of a reddish-gray colour, rather brittle, and very infusible. It is never found in a pure state, but occurs usually as an oxide, or in combination with arsenic or its acid, with nickel, sulphur, iron, &c. The oxide yields a rich blue colour, on which account it is extensively employed in the arts. The impure oxide is called *zaffre;* but by fusion with two or three parts of fine siliceous sand and an alkaline flux it is converted into a blue glass, which, when reduced to powder, is called *smalt.* This is largely employed to colour glass, porcelain, and stoneware, and also to give a blue tint to writing-paper. The word cobalt is derived from *kobold*, a *goblin*—the name applied to it by the German miners, who regarded its occurrence as unfavourable to the presence of more valuable metals. See Chemistry; Mineralogy; Smalt.

COBBETT, William, one of the most remarkable political agitators of his time, was the son of a farmer at Farnham in Surrey, where he was born in 1762. In a tract published by himself in 1796, under the title of the "Life and Adventures of Peter Porcupine," he gives an account of his self education, carried on with extraordinary ardour and perseverance, under circumstances of great difficulty and discouragement. His early years were spent in the labours of the farm; but in the autumn of 1782, happening to visit Portsmouth, the sight of the sea, the ships, and the sailors, excited in his youthful mind aspirations after martial glory and foreign adventures, and he offered to serve on board a man of war, but was not accepted. Shortly afterwards he went to London, where he was employed as a copying-clerk by an attorney. Tiring of this employment, he next enlisted in a regiment of foot, which was stationed at Chatham for nearly a year. During this time he applied himself with amazing assiduity to study the English grammar, writing the book over twice or thrice, committing it to memory, and repeating it to himself while standing sentry. The regiment was next ordered to Nova Scotia, where, by his good conduct and diligent application to his duties, he was advanced to the rank of sergeant-major. In 1791 he returned to England, procured his discharge, and married the daughter of a sergeant-major of artillery. One of his first acts after his return was to bring charges of peculation against four officers of his late regiment. A court-martial was appointed to try them, but, on the day of trial, to the astonishment of all, Cobbett was not to be found; he had crossed over to France. From France he sailed for New York, where he arrived in October 1792. There he published an abusive pamphlet against Priestley. This was followed by a number of other anti-republican tracts of a violent and reckless character, which involved him in several prosecutions for libel, and ultimately induced him to remove from America to England. On his arrival in London in 1800, he commenced a daily paper, entitled "The Porcupine," which however was soon discontinued, and followed

Cobija ‖ Coblentz.

by the "Weekly Register." For the first two years he advocated Tory principles, and was a decided supporter of the government; but about 1803 the "Register" completely changed its politics. From that time it was violently democratic and anti-ministerial; and as the work had a very large circulation, and was written in a bold nervous style, its influence was extensive. Cobbett was repeatedly tried for libel, and subjected to heavy damages; and, in 1810, for a libel in his observations on a case of flogging in the army, he was subjected to a fine of L.1000 and two years' imprisonment. In 1817 he again visited America; but in two years he returned home, bringing with him the bones of Thomas Paine. All this time the "Register" continued to be published, and he was twice again involved in actions for libel, in one of which he was cast in damages of L.1000.

In 1832 he attained the great object of his ambition by being elected member of parliament for Oldham; but he disappointed the expectations of his admirers. Parliament was not his proper sphere; his unscrupulous charges and inaccurate assertions were too immediately detected and exposed. The late hours consequent upon his parliamentary duties affected his health, and after a short illness he died, June 18, 1835.

His writings are very voluminous. Amongst the best of these are his English and French Grammars, Cottage Economy, and Advice to Young Men. He is a striking example of the benefit of industry, perseverance, and an economical improvement of time. He went to bed punctually at nine o'clock, and rose at four, and was thus enabled to complete the greater part of the writing which he apportioned to himself before others had commenced their daily occupations.

Cobbett was a man of proud, overbearing temper; but his writings, though often coarse, dogmatical, and offensively personal, bear the stamp of vigour, and, with occasional slips, furnish a good example of the severe and simple English style.

COBIJA, or Puerto La Mar, a seaport of Bolivia. See Bolivia, vol. iv. p. 827, &c.

COBLE, a small kind of fishing boat.

COBLENTZ (German *Coblenz*), a strongly fortified city, capital of the Prussian province of the Rhine, and of a government of its own name, is pleasantly situated on the left bank of the Rhine, at its confluence with the Moselle. From this circumstance it derived its ancient name of *Confluentes*, of which Coblentz is a corruption. The fortifications are very extensive, connecting the works on the left bank of the Rhine with the very strong fortress of Ehrenbreitstein, standing on a high rock on the opposite bank; and thus render Coblentz the bulwark of Prussia and Germany on the side of France. They form a fortified camp capable of containing 100,000 men, and are constructed on the combined systems of Carnot and Montalembert. Several detached forts command the various approaches to the city. The Rhine is here crossed by a bridge of boats 485 yards long, and the Moselle by a Gothic freestone bridge of 14 arches, and 1100 feet in length, erected in the fourteenth century. The streets of Coblentz are mostly regular, and many of the public buildings are handsome. Among these may be noticed the modern electoral palace, erected in 1778-86, now used as a court-house; the old castle of the electors, built in 1280, now converted into a factory of japan-ware; the church of St Castor, built in 836, and surmounted by four towers, notable as the place where in 843 the grandsons of Charlemagne met to apportion the empire. In front of the church of St Castor is a fountain, erected by the French in 1812, with an inscription to commemorate their invasion of Russia. To this St Priest, the Russian commandant of the city in 1814, added "vu et approuvé." It has also a gymnasium, hospital, orphan asylum, theatre, public library, picture gallery, musical institute, medical school, &c. The manufactures consist chiefly of linens, cottons, japan-ware, and tobacco

Coblentz is a free port, and carries on an active trade by means of the Rhine, Moselle, and Lahn, in colonial produce, wines, mineral waters, corn, iron, volcanic products, potter's clay, stoneware, bark, &c. Pop. (1849) 25,318, including 1652 military. Prince Metternich was born here in 1772. The government of Coblentz has an area of 2320 square miles, with 25 cities, 35 market towns, 1092 villages, and (in 1849) 502,984 inhabitants, of whom 334,548 were Catholics, 159,716 Protestants, and 8475 Jews.

Coburg ‖ Cochin.

COBURG. See Saxe-Coburg.

Coburg, the capital of the duchy or province of the same name, forming part of the duchy of Saxe-Coburg-Gotha, is pleasantly situated on the left bank of the Itz, an affluent of the Regen, 40 miles S.S.E. of Gotha. The ducal palace of Ehrenburg, a fine Gothic edifice erected in 1549, is a favourite summer-residence of the reigning duke, and has several apartments very tastefully fitted up, a library of 26,000 volumes, and a collection of specimens in natural history, minerals, coins, and paintings. Coburg has a theatre, arsenal, five churches, a gymnasium founded in 1604, a normal school, observatory, two public libraries, and a cabinet of natural history. The ancient castle of the dukes of Coburg is situated on a commanding eminence in the vicinity. It was for some time the residence of Luther; and the bedstead on which he slept, and the pulpit from which he preached in the old chapel, are still shown. Coburg has manufactures of linen, woollen, and cotton goods, gold and silver articles, and dye-works; and carries on an active trade. In the vicinity are the castles of Callenberg and Lauterberg. Pop. (1846) 10,092.

COCA, a stimulant narcotic largely used as a masticatory by the Peruvians, is the dried leaf of *Erythroxylon coca*, in combination with a certain alkaline substance called *llipta*. The habitual indulgence in this drug is attended with remarkable effects on the human system, which are said to be not very dissimilar to those produced by the excessive use of opium. See Bolivia, vol. iv. p. 824.

COCCEIUS, John, (1603-1699) an eminent Hebrew scholar, was born at Bremen. He taught theology at Leyden, and wrote commentaries on the Bible and other works. From his peculiar views in regard to a visible reign of Christ on earth, he gave rise to a sect who assumed the name of Cocceians.

COCCOLITE. See Mineralogy.

COCCOLOBA, a genus of West Indian plants, the best known of which is *C. uvifera* or sea-grape of Jamaica. Its juice, which is very astringent, yields a sort of kino, and the wood is used as a dye.

COCHABAMBA, a department of Bolivia, in South America. The climate is mild and the soil productive. Cochabamba is also the name of a province and town in this department. The town is situated at an elevation of 8418 feet above the level of the sea, and is considered one of the most healthy and agreeable places in Bolivia. Pop. of the department, 488,947; of town, about 30,000. See Bolivia, vol. iv. pp. 828, &c.

COCHIN, one of the native states of Hindustan, situate on the coast of Malabar. Its boundaries are the British district of Malabar on the N. and N.E., Travancore on the S. and E., and the sea on the S.W. It lies between Lat. 9. 48. to 10. 50., Long. 76. 5. to 76. 58., and contains an area of 1988 sq. miles. A portion of this territory extends over the mountainous range termed the Western Ghauts, and has an elevation of from 4000 to 5000 feet above the sea. The remainder consists for the most part of low hills, intersected by narrow fertile valleys, finely wooded and extremely well watered by small perennial streams. Rice is the chief cereal grown. The other vegetable productions are pepper, cardamoms, ginger, betel-nut, and arrow-root. The gardens and orchards produce in abundance the bread-fruit, jackfruit, mango, plantain, lime, pine-apple, guava,

Cochin. tamarind, and other fruits. Groves of palms and other trees skirt the bottom of the hills. Above these are woods of forest trees which, though not equal in size to those in Chittagong, are very fine, and free from rattans and other climbers. Among the principal trees may be noticed the teak, which is said to be inferior to that found in Malabar and Travancore; the jackwood, much in demand for cabinet work; the peon, probably a sort of pine, which furnishes excellent masts. There are also the angeli, blackwood, and bastard cedar. Among the remarkable features of the country are the Cochin backwaters or shallow lakes, occasioned by the overflowing of the rivers during the S.W. monsoon, and affording the means of inland navigation from stream to stream and estuary to estuary, in a direction parallel to the shore. Of these waters the most important is that of Chowgaut, 20 miles in length and 8 in breadth, studded with numerous islands, and characterized by Dr Buchanan as "one of the finest inland navigations imaginable." In this province are many Nazarene or Christian villages, which, for Indian towns, are well built and cleanly, and the inhabitants of which are a very orderly and industrious people, living chiefly by trade or agriculture. The Christians are of two denominations—the Syrian or Jacobite Christians, who refer their conversion and the foundation of their religious establishment to St Thomas the Apostle, and acknowledge as their spiritual head the Patriarch of Antioch; and the disciples of the Church of Rome, being either descendants of the Portuguese or their converts. Jews also are numerous. These consist of two separate classes; the black Jews from time immemorial settled in the country, and the white Jews, affording evidence in their fairer complexions of the recent emigration of their race from more temperate climes.

The Cochin rajah maintained his independence to a much later period than most of the other Hindu chiefs. When Hyder invaded his country in 1776, he quietly submitted to pay tribute; which was continued to his son Tippoo, and is now paid to the British government. The earliest political relations of England with that government occurred in 1791, when a treaty was concluded between the rajah and the East India Company. This was followed by another in 1809, by the conditions of which the friends and enemies of each of the contracting parties were declared the friends and enemies of both. Cochin is under the protection of the British, and pays an annual tribute of L.24,000. Under the influence of the protecting powers many important benefits have been conferred upon the country, which is represented as steadily advancing in all the elements of prosperity. An additional stimulus to the productive powers of the territory has been recently afforded by placing its trade as regards the United Kingdom on the same footing, with certain specified exceptions, as that of the British possessions in India.

Cochin, a seaport and town which, though giving name to the above native state, belongs to the British government, and is included within the district of Malabar, under the presidency of Madras. The city is of a semicircular form, and is about a mile and a half in circumference. It has three gates; and the streets are wide and commodious. A fort was built at this place by Albuquerque in 1503, and was the first possessed by the Portuguese in India. Cochin continued to increase and to flourish under their rule; and, besides other buildings, was adorned by a noble cathedral. In 1663 the town was captured by the Dutch. During the period of their rule it was a place of extensive commerce, and was inhabited not only by all sects of Christians, but by Hindus, Mohammedans, and Jews, who traded with Arabia, Persia, and the whole coast of India. The trade carried on with Surat, Bombay, the coasts of Malabar and Canara, and also with Arabia and the islands in the Eastern Seas, is still extensive. The imports consist chiefly of British manufactures, cotton, wool, opium, and spices; the exports are pepper, cardamoms, teak-wood, and other timber, cocoa nuts, coir, and cassia. The harbour is on the north side of the town, which stands on an island at the mouth of the Cali Caytang river. At this port also ship-building is carried on to a considerable extent, and vessels are constructed on the best European models. Cochin was taken by the British in 1795, when war commenced with Holland. Its fortifications were subsequently blown up with gunpowder; and the town was finally ceded to the British by the European treaty of 1814. Distant S.W. from Madras 350 miles. Lat. 76. 18., Long. 9. 57.

Cochin China.

COCHIN CHINA. This extensive kingdom is situated in the southern extremity of Asia, and forms part of the peninsula between China and Hindustan. It is not separated, however, by any distinct boundary from the neighbouring countries; and its limits have been greatly extended by conquest beyond those of Cochin China proper, which is merely a strip of land between the China Sea and the mountains, and is not above 60 or 70 miles broad. The empire of Cochin China, which took its present form in the beginning of this century, comprehends Cochin China proper, Tonquin, the principal part of Cambodia, and the little state of Chiampa. This state, as it has been aggrandized by conquest, extends from the point of Cambodia, in about 8. 30. N. Lat., to the northern confines of Tonquin, which reach within a very few miles of the tropic of Cancer, and from the longitude of 102. to about 109. E. It is bounded on the N. by the Chinese Quangsi or Kiangsi and Yunan; on the W. by the kingdoms of Laos and Siam; while the Gulfs of Siam, Tonquin, and the China Sea bound it on the S.W., E., and N.E. Its area is estimated at about 98,000 square miles; and its population at from 12,000,000 to 16,000,000. This great country is divided by long ranges of mountains, which run nearly N. and S., and in almost parallel chains, forming it into separate provinces, divided by physical boundaries, and inhabited by distinct tribes and nations, although subject to the same sovereign. By these mountainous ridges Tonquin and Cochin China proper are separated from Lactho, Laos, and Cambodia. Another chain separates the three latter states from Siam and China, and gradually diminishes in height as it approaches the south, terminating at the southern extremity of Cambodia.

1. Tonquin is mountainous on the N., and of the same general character as the adjacent Chinese provinces. On the W., the chain which separates Cochin China proper from the interior of the peninsula constitutes the boundary towards the Laos country. The E. is nearly level, terminating towards the sea in an alluvial plain. On the southern frontier, towards Cochin China, a wall extends from the mountain to the sea; but the wall is now useless, as both countries are under one sovereign. Next to Korea and Japan, Tonquin has most completely maintained its exclusive system against foreigners; and after all that has been written on the country, it is still almost unknown. Towards the N., as far as the Song-ka, or Rankao river, Tonquin extends from 103. 50. E. Long. to about 109. 48. E. Long.; but from this latter point it is hemmed in by the great Yunan ridge, which runs parallel with the sea; 17. 36. is its southern limit, and the northern is 22. 55. It is generally fertile, and contains a large industrious population. Most of the rivers flow in a south-easterly direction. The largest is the great river Song-ka, formed by the union of the Le-teen, a stream which constitutes the boundary between China and the Laos country, and the Song-shai, which rises in the latter country, and passes through a mountain defile not far from the principal city in Tuyen-kwang district. The sand of these rivers contains many particles of gold, and thousands of people are engaged in collecting it. The river then runs S.E., having the capital of Tonquin —Kecho or Hanoi—on its right bank; it makes a sudden bend at Heën, and then turning northward forms a delta, in which Domea, the port for foreign shipping in former times, is situated. It has three mouths, the northernmost of which

Cochin China.

has the deepest water; the southern is nearly inaccessible to vessels drawing above 10 feet on account of the banks and shallows. This river, by its periodical overflowing, fertilizes the rice-fields. It is not much larger than the Oder; but it has numerous tributaries, and several branches are joined together by canals, both for irrigation and commerce. South-east of the mouth of the Song-ka there are seven streams, all of which flow into the sea. The intervening country consists of swamps and a few rice-fields, and is frequently under water. It is the residence of numerous fishermen, who also hunt the alligator, which is used as food, the flesh being sold in the shambles. The produce of these fisheries is immense; it supplies the poorer classes in the interior who seldom taste any meat, and still leaves a large surplus for exportation to China.

2. Cochin China proper, a small strip of land, extends from the southern frontiers of Tonquin to about 12. S., where it borders on Tsiampa. This country is bounded on the west by naked mountains, which have only a scanty vegetation; and for ten miles inland it is a complete desert. The most important river is that on which the capital is situated; but the Songve and Songdalang are larger. Having traversed the regions inhabited by the Annam race, the traveller comes to lofty mountains, which present a dreary waste. No European has yet visited them.

3. Chiampa, or Tsiampa, is a narrow strip of land extending to about 11. 35. N. Lat. It is inhabited by a peculiar race, more resembling the Malay than the Annam. It has one great river, the Song-luong. Since the incorporation of this country with Cochin China, the aborigines, at one time bold navigators of the Indian archipelago, have retired to the mountains, a forlorn and persecuted race, and a few thousand Cochin Chinese have taken possession of the coast.

4. The part of Cambodia which belongs to Cochin China presents a continued flat; a rich alluvial soil, full of navigable rivers, one of which the Mekom, or Cambodia, is among the largest rivers in Southern Asia. This river, which flows through a rich and varied valley, takes its rise in Yun-nan, on the frontiers of Sefan, in 27. 20. N. Lat., where at first it has the name of Lan-tsan; but towards the south, and before it enters the Laos country, it is called Kew-lung-keang, or Nine-dragon river. The volume of water which it receives in its course from the stupendous mountains through which it makes its way, renders it a mighty stream. In the Chinese territory it runs a considerable distance through a magnificent valley. In 16. N. Lat. it bends more to the E., and enters Cambodia, after having received a large tributary: it then drains the whole length of that country, and falls by three embouchures into the sea in about 9. 34. N. Lat. In many places the river is very deep; in others there are rocks and cataracts, shifting banks and shallows, all which impede the navigation. Like all great rivers, it has some outlets which are only accessible at high water. The river is navigable in Yun-nan, and there are many flourishing cities upon it. In Laos many thriving villages adorn the banks; and in Cambodia the principal population is near it. We may conceive what a mighty stream that must be which traverses 18 degrees of latitude, and forms at its mouth an alluvial deposit only second to that of the Yang-tsze and Hwangho. North-east of Penompeng (Kalumpé), the present capital of Cambodia, is a large lake, the Bienho, in Cochin Chinese—in Cambodian, Tanle-sap (fresh-water lake); from which a broad stream flows into the Mekom. The Saigun river, which all our maps represent as only being 20 miles long, is nevertheless a very deep river, easy of access for ships of the greatest burthen, being six fathoms over the bar at the principal entrance, and ten deep in mid-channel. It is joined to the Mekom near its mouth by two channels; and probably it is really one of the outlets of that mighty stream. Cambodia is a land of rivers. The natural fertility of the soil is very great; but the inhabitants are still behind in agriculture. Cambodia is nevertheless the granary of Cochin China, and is rich in all kinds of productions.

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The soil in Cochin China, especially in the low lands, is fertile, and its products are very valuable. Of these rice, as being the general food of the people, is the staple commodity; and after supplying the wants of the people, about 100,000 peculs remain annually for exportation. The cultivation of the sugar cane, as well as the preparation of sugar, has of late years much increased; and the annual exportation of sugar is considered to be not less than 70,000 peculs. Cotton of the best quality is produced on the coast; and of this probably about 60,000 peculs are exported. Though raw silk is produced, it is principally for home consumption. Cinnamon ranks high among its productions, and has always been celebrated in China. In the southern parts the cocoa-nut grows very luxuriantly, and hence there is a large exportation of oil. Pepper of a good quality, but in small quantity and of a high price, is produced in the central provinces of Cochin China; but the quantity is inadequate to the demand which the Chinese trade creates for its exportation. It grows among the central mountains of Cochin China, whence it is exported to Cambodia and Tonquin, but principally to China, where it is much more highly valued than any other quality of this aromatic. Another exclusive product of the central parts of the kingdom, which is extensively cultivated and sent to the neighbouring provinces, is tea, which is very coarse and only used by the poorer classes. The other productions of the country are gamboge, gum, cardamoms, eagle-wood, areca-palm, betel-nut, ivory, sticklac; hides, consisting of deer-skins, buffalo, elephants', and rhinoceros' hides; peltry, consisting of tiger, leopard, otter, and cat skins; feathers, salt fish, horns and bones, dyewoods, and woods for ship-building and for domestic purposes. Valuable timber is only found in Cambodia, and a small quantity of teak wood is found in the forests; also ebony cedars, mimosas, walnuts, iron-wood, and poon, and most of the other trees found in the woods of India. The wood used for ship-building and for domestic purposes is strong and durable, and is carried to the capital in large quantities. There is a hard black wood extensively used in cabinet-work, and of large dimensions, which takes a fine polish, and might form an article of exportation. Cambodia also produces the Portuguese rosewood, which the Chinese export as they do from Siam; also sandal-wood and other scented woods. Among the products of Tonquin is a species of vegetable root, a cheap material, which forms the dead-weight of all the Chinese cargoes exported from Tonquin, and is used extensively both throughout Cochin China and the adjacent countries, and also in China, as the material of a red dye. Edible bird-nests, the sea-slug usually called biche-de-mer, or *Sipunculus edulis*, and various marine production of a gelatinous quality, form standing articles of trade with China, and are always in demand.

The geological formation of Cochin China is primitive; the mountains are chiefly composed of granite and syenite. Mica slate and primary limestone here and there occur; while several hills consist of quartz rock. Among the mountains of Tonquin is the only portion of the Cochin Chinese empire which produces iron, gold, and silver. The iron received from these mines, which is as cheap as that from Siam, supplies the whole kingdom, with the exception of Saigun, which is furnished from the latter country. Gold dust is found in many of the rivers; and there are immense rocks of marble situated on the banks of the river Faifo, on a kind of sandy plain, of which large quantities have been exported. This remarkable range of limestone rocks rises almost perpendicularly from the low sand hills, to a height of from 300 to 400 feet, without a hill or mountain near them.

The foreign trade of the Cochin Chinese is almost exclusively with China; the trade carried on with Siam being in-

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considerable, and that with European nations still smaller. But there is no indisposition to trade, though among the European nations the notion has been propagated by travellers that the resort of European traders is in a great measure interdicted in this kingdom, on the same principle as in Japan and China. In 1818, a new tariff was imposed on foreign vessels, by which the high duties imposed on all foreign vessels prior to 1818 were repealed, and equal duties substituted in their stead. By this regulation all vessels pay a rated measurement duty, moderate in its amount; and are exempted from all import duties payable previous to 1818. Vessels that are driven into the ports of Cochin China by stress of weather, or that visit them for the purpose of commercial inquiries, are free from all charges. Besides the exports above mentioned are cardamoms, betel-nut, eagle-wood, dye-woods, stick-lac, gamboge, ivory, elephants' hides and bones, and rhinoceros' bones. The imports are silk goods of various kinds, the coarser kinds of teas, coarse chinaware, paper, cotton and woollen stuffs, iron, opium, cutlery, &c. Of the internal trade of the country, though considerable, little is known. The trade with China is chiefly conducted with Cachao in Tonquin, Saigun in Cambodia, and Faifo and Hué in Cochin China. There is also some inconsiderable intercourse with other parts of the empire.

Cochin China, from its central situation, its navigable rivers, and its many excellent harbours, possesses extraordinary advantages for commerce. Few countries are so amply provided with harbours, there being within the 6½ degrees of latitude which intervene between Cape St James and the Bay of Turon, no less than nine of the finest harbours in the world, accessible in every wind, quite safe to approach, and affording the most complete protection. The Bay of Turon, situated in Lat. 16. 7. N., is equalled by few in the eastern world, and surpassed by none for the security and convenience which it affords.

The principal town is Hué, the capital, situated 70 or 80 miles N.W. of Turon, on a river navigable for vessels of moderate burden. It is fortified; and in the arsenal everything is in a style of neatness, magnitude, and perfection, which denotes a bold and warlike people. The other towns are Cachao in Tonquin; Saigun in Cambodia, a mercantile town of considerable size, on a branch of the Saigun river; and Taifo or Faifo, situated about 15 miles from the entrance of the river, and now in ruins; Turon also, formerly the chief mart of trade between China and Japan, now surrounded with marks of ruin.

Cochin China, until within a few centuries after the Christian era, formed a part of the Chinese empire; and in the general features of the natives, many of their customs, their written language, and their religious opinions and ceremonies, it is easy to trace their Chinese origin. The Cochin Chinese, for example, resemble, according to Barrow, their Chinese progenitors in the ceremonies and processions observed at marriages and funerals, in the greater part of their religious superstitions, in the offerings presented to idols, in the consultation of oracles, and in the universal desire of inquiring into futurity by the casting of lots; in charming away diseases, in their diet and cookery, in their public entertainments, in their instruments of music, in games of chance, in cock-fighting, quail-fighting, and the devices of their fire-works. Their language, however, though originally Chinese, has now deviated so much from its standard as to be wholly unintelligible to a Chinese. But the Cochin Chinese have effectually preserved the written character of the Chinese language; and when the country was visited by Barrow he found no difficulty in communicating with them by means of the Chinese priests who accompanied him.

Cambodia enjoys a delightful temperature, although the weather throughout the rainy season (May to September) is often very sultry: the dry monsoon during the remaining part of the year is clear and the heat very moderate, seldom exceeding 90°, and ordinarily being only about 80°. Cochin China presents the very reverse of the seasons to Tonquin and Cambodia, on account of the ridge of mountains which breaks the clouds. From October up to January the weather is very boisterous, and typhoons are by no means uncommon—when in the former the wet seasons reign, the latter is dry, and *vice versa*. The thermometer never rises there above 103°, nor sinks below 53°, and the climate throughout is healthy and agreeable. Tonquin in this respect resembles Bengal, but participates likewise in the oppressive heat and very [illegible] cold of China.

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In external appearance the Cochin Chinese are the most diminutive of the Mogul race. They are short and squat. They want the broad face of the Malay, the cylindrical cranium and expanded lower jaw remarked in the Siamese, and the oblique eyes of the Chinese. Their heads and countenances are round; and they possess, according to Mr Finlayson, an expression of sprightliness, intelligence, and good humour, not to be found either in the Chinese or Siamese. Morals in Cochin China, as in every part of Asia, are at a very low ebb; and the women especially are in a very degraded state, and are permitted to indulge in every species of licentiousness. Neither parents nor husbands in any rank scruple for a moment to prostitute for gain either their wives or daughters. The females in general have but slender pretensions to beauty; yet this want is compensated by a lively and cheerful temper, totally different from the morose character of the Chinese. They are doomed by the men to labour from morning to night in the most toilsome occupations. All the labours and the various employments connected with agriculture fall to their share; and in some places they superintend all the details of commerce. They even assist in constructing and keeping in repair their mud-built cottages; they manufacture coarse earthenware vessels; navigate boats on rivers and in harbours; bear articles to market; draw the cotton-wool from the pod, spin it and weave it into cloth, dye it, and make it up into dresses for their families. By the system of the government, every male belongs to the king, and must either enlist in the army or work one-third if not one-half of the year for the sovereign without pay; by which the people are taken away from agricultural and mechanical pursuits, and [illegible] idle and unprofitable habits. When not so employed they engage occasionally in fishing, in collecting swallows' nests and sea-slug in the neighbouring islands, and in various other occupations. But they have always leisure for their amusements; while the women are condemned to unremitting toil, being considered by the lower classes much in the light of beasts of burden fitted for use, and by the higher classes as the slaves of their pleasures. These latter are arrogant in the extreme, and offensively coarse in their manners; while their inferiors are described as mild and inoffensive, lively and good humoured, affable and polite to strangers, but, under this exterior, as cunning, deceitful, impudent, conceited, and tyrannical, where they can be so with impunity. These vices are traced to the nature of the government, which is completely despotic, the sovereign being the supreme disposer both of the lives and properties of his subjects. "The bamboo," says a traveller, "which is perpetually at work, is the universal reformer of manners throughout Cochin China;" and the moral character of the people corresponds entirely to this illiberal and despotic system under which it has been formed. It is owing to the same cause, namely the insecurity of property, which prevails all over Asia, that the arts and manufactures make no progressive improvement, and that agriculture also is in such a backward state. The country exhibits nowhere the marks of industrious cultivation; and the inhabitants are generally poor, and living in miserable cottages, with little furniture. The only branch

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of the arts in which they particularly excel is naval architecture; for which, however, they are not a little indebted to the size and quality of the timber employed for that purpose. Their row-galleys for pleasure are remarkably fine vessels, being from fifty to eighty feet in length, and composed of fine single planks, each extending from one extremity to the other. They employ various descriptions of vessels in the coasting trade, in fishing, and in collecting the biche-de-mer or sea-slug, and the swallows' nests among the cluster of islands called the *Paracels*. Many of them are covered with sheds of matting, under which a whole family constantly reside; and others resemble the common prows of the Malays, both in their hulls and rigging. Their foreign traders are built on the plan of the Chinese junks.

The religion of the Cochin Chinese is a modification of the widely extended system of Buddha, to whom they offer the firstlings of their flocks and the first fruits of their fields. They have temples filled with the idolatrous images of this deity, and the natives are extremely superstitious. Besides voluntary offerings, which are made by individuals, a yearly contribution is levied by the government, in order to support a certain number of monasteries, in which the priests invoke the deity for the public welfare.

The ancient history of Cochin China, like that of most of the other eastern countries, is very little known; and it is only from the year 1774 that there are any authentic accounts. The reigning family was at that time expelled from Quinong, the capital, by three brothers, who divided the country among them. At the time the revolt took place, the young prince Caung Shung, with the queen and his family, escaped by the assistance of a French missionary named Adran, into a forest; whence the king was compelled to fly, first to Putowai, a desert island in the Gulf of Siam, and afterwards to Siam, which he was obliged to quit. The son was carried by Adran to France, where he endeavoured to procure assistance; but the revolution breaking out, all these schemes were frustrated. Caung Shung, after remaining in the woods, sustaining many hardships, landed in his own country in 1790, and succeeded in expelling the successors of the usurpers; and in 1802 he effected the conquest of Tonquin, and established an extensive empire on a solid basis, which has flourished ever since that time. He was greatly aided by the missionary Adran, who had acquired the most perfect mastery over the language, and compiled a code of laws and a book of instructions for the government of the country. The king, after his death, evinced his gratitude for his services by erecting a monument to his memory, with an inscription in gold characters—an honour confined to the royal family.

Several attempts have been made to open an amicable intercourse with the Cochin Chinese; one in 1778 by Mr Hastings, and one in 1804 by an envoy from Canton; but both proved unsuccessful, through the intrigues of Frenchmen, by whom the sovereign Caung Shung was completely surrounded. In 1822 Mr Craufurd was sent by the East India Company as an envoy to Siam and Cochin China. He was not well received at the Cochin Chinese court, and does not appear to have obtained any peculiar advantages for commerce. It is to him that we are indebted for the best description of the country.

COCHINEAL, *Coccus cacti*, an insect used as a dye, is found on several species of cactus, but particularly on one, which is thence called *Cactus cochinellifer*. This plant is cultivated largely for the purpose in Mexico and in Honduras; and also on a small scale in Teneriffe, Java, &c. The insects are scraped off the plants into bags; and killed either in hot air ovens or by immersion in boiling water; then dried in the sun, and put up for exportation in *serons* (skin bags).

The cochineal yields a brilliant crimson dye, which is highly esteemed and extensively used in this country. The methods of preparing the different tints are described under DYEING. The English market is almost entirely supplied from Honduras, Mexico, and Teneriffe. Honduras produces the best, Mexico that of least value. The insect, as imported, resembles in bulk and shape a full-sized grain of barley. There are two varieties, distinguished in commerce as "silvers" and "blacks." Of these, the black is the more valuable—the finer kind usually exceeding the silver in price by 1s., and the inferior by a few pence per lb. respectively. The silver kind, said to be the female insect, constitutes fully two-thirds of the imports into Britain. Its back presents a rugose or ribbed appearance, and is covered over with a fine dust of a bright silvery hue. The most esteemed are large, plump, and dry. They are less prized when dull or dark-coloured; and still less valuable when they have the bad qualities of being small, of a pink tint, clammy, or adulterated by the admixture of paste.

The black kind, said to be the male insect, is either dark brown or gray, and about the same size as the silver. The finest exhibit a shelly appearance, have a dark shining lustre, and are large, but at the same time light.

On its arrival in this country, cochineal is usually taken out of the *serons* and "garbled" (sifted) in order to separate the dust, &c. It is afterwards repacked in linen or cotton bags, instead of in the *serons*.

Granilla, a very inferior kind of cochineal, consists of small insects collected from wild uncultivated plants. According to Humboldt (*Essai Polit.* on N. Spain), the plants on which the two kinds of cochineal live are essentially different, and the species of insect is probably also different.

About a century ago, cochineal and silver bullion were often classed together as articles of equal value. Extended cultivation, however, in Honduras and elsewhere, more especially in Mexico, has wrought a wonderful change in the value of cochineal. This once precious article of commerce has of late years fluctuated in value between 3s. and 6s. per lb., its average price being from about 4s. to 5s. In 1814 the price rose to 36s. and 39s.; but afterwards it gradually declined, till in 1852, when the imports greatly exceeded the average quantity (having amounted to no less than 22,042 cwts.), the price of silver cochineal fell below 3s. a lb. The duty on cochineal was abolished in 1845.

COCHLEARY, COCHLEOUS (Lat. *cochlea*, a screw, a snail-shell), spiral, in the form of a screw. Cochlea is the name formerly given to the screw, one of the mechanical powers.

COCK, the English name for the male of gallinaceous birds, but more especially used for the common domestic cock. See ORNITHOLOGY.

Cochleary ‖ Cock-Pit.

COCK-PIT, a name given to the theatre or area appropriated to the fighting of game-cocks armed with sharp-pointed spurs of steel or silver. Cock-fighting was practised by the ancient Greeks and Romans. The islanders of Delos were especially addicted to this cruel sport; and Tanagra in Bœotia, the isle of Rhodes, Chalcis in Eubœa, and the country of Media, were famous for their high-bred chickens. There was probably included in the last the kingdom of Persia, whence this kind of poultry was first brought into Greece; and if one may judge of the rest from the fowls of Rhodes and Media, the excellence of the broods at that time consisted in their weight and largeness. The Greeks, moreover, had some method of preparing the birds for battle by feeding, as may be gathered from Columella.

It seems that cock-fighting was at first partly a religious and partly a political institution at Athens, and was continued there for the purpose of improving the seeds of valour in the minds of the youth; but it was afterwards perverted and debased both in Athens and in other parts of Greece into a common pastime.

The Romans, ever prone to imitate the Greeks, followed their example in this mode of diversion, and in the worst

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way; since, when the Romans adopted it, the Greeks had already perverted it to a low and unmeaning sport. It appears that they did not adopt this practice very early; and it may be gathered from Columella that the Romans did not use the sport in his time. This author styles cock-fighting a *Grecian diversion;* and speaks of it in terms of ignominy, as an expensive amusement, and often attended with the ruin of the parties that engaged in it. His words are—"Nos enim censemus instituere vectigal industrii patris familias, non rixosarum avium lanistæ, cujus plerumque totum patrimonium pignus aleæ, victor gallinaceus pyctes abstulit;" in which passage he describes the manners, not of the Romans, but of the Greeks, who in his time had converted the diversion of cock-fighting into a species of gaming, often to the total ruin of their families. It was not till the decline of the empire that the Romans gave in to the custom. The fixed antipathy between the brothers Caracalla and Geta, sons of the Emperor Septimius Severus, commenced, according to Herodian, about the fighting of their cocks; and if this was the first instance of it, it is probable that these princes had learned it in Greece, whither they had often accompanied their father. Quails, however, were the birds chiefly employed for this purpose by the Romans; though cock-fights at a later period were also common.

Cocks and quails pitted for the purpose of engaging one another *à l'outrance*, or to the last gasp, for diversion, are frequently compared, and with much propriety, to gladiators. Hence Pliny's expression, *gallorum, ceu gladiatorum;* and that of Columella, *rixosarum avium lanistæ; lanista* being the proper term for the master of the gladiators. It might naturally have been supposed, that when the bloody scenes of the amphitheatre were discarded, as happened soon after Christianity became the established religion of the empire, the ὀρτυγομανία and the ἀλεκτρυομανία would also have ceased. The fathers of the church continually inveighed against the spectacles of the arena, upbraiding their adversaries with these, which, indeed, were more unnatural and shocking than a main of cocks; but the latter had a similar tendency towards infusing ferocity into the dispositions of men. This ungenerous diversion too, has been in fact the bane and destruction of thousands in more recent times, as well as of those *lanistæ avium*, "cock-feeders," mentioned by Columella, who thus dissipated their patrimonial fortunes.

It is unknown when the practice of cock-fighting was introduced into England, but it was probably brought hither by the Romans. This bird existed here before Cæsar's arrival, but no notice of his fighting occurs earlier than the time of William Fitz-Stephen, who wrote the life of Archbishop A Becket, in the reign of Henry II., and describes cocking as a sport of school-boys on Shrove Tuesday. From this time at least it was common. It was disapproved and prohibited by the 39th Edward III.; also in the reign of Henry VIII., though that prince erected the cock-pit in Whitehall. It may here be noticed that the room in Westminster in which her Majesty's privy-council hold their sittings is called the *cock-pit*, from its being the site of what was formerly the cock-pit belonging to the palace of Whitehall. Cock-fighting was again prohibited under Elizabeth, in 1569. It was a favourite amusement of James I., in whose time there were cock-pits in St James's Park, in Drury Lane, in Tufton Street, in Shoe Lane, and in Jewin Street. Cromwell issued an ordinance to suppress the practice, which bears date March 31, 1654. What were called *the battle-royal* and *the Welsh-main* were the two favourite modes of cock-fighting usually exhibited. In the first, an unlimited number of fowls were pitted, and the single surviving bird was esteemed the victor, and carried away the prize. The Welsh-main consisted, we shall suppose, of sixteen pairs of cocks; of these, the sixteen conquerors were pitted a second time; the eight conquerors of these were pitted a third time; the four conquerors the fourth time; and, lastly, the two conquerors of these were pitted the fifth time; so that thirty-one cocks were slaughtered for the amusement of spectators. Cock-fighting is now forbidden and punishable by law.

Cock-Pit ‖ Cocker-mouth.

For further information on this subject, the reader may consult the very learned paper of Mr Pegge, in the *Archæologia*, iii. 132; Beckmann's *Hist. of Inventions and Discoveries*, vol. ii. Among ancient writers, Columella and Varro have written about the breeding and education of these birds.

Cock-Pit of a ship of war, the apartment of the surgeon and his mates appropriated to the use of the wounded in time of action. It is situated under the lower deck, below the water-line.

COCKATRICE. See Basilisk.

COCKBURN, Henry Dundas, a lawyer, orator, and author, was born in Edinburgh, October 26, 1779. His father was Archibald Cockburn, a baron of the court of exchequer in Scotland. His mother, a daughter of Captain Rannie, was a sister of the wife of Henry Dundas, Lord Melville. It was from this connection that he was christened with the names Henry Dundas, and it was naturally expected that he would devote his brilliant powers to that triumphant party in which the statesman whose name he bore was, according to the political notions of the day, bound by the strongest obligations to advance him. Making his own selection, however, on his own principles, the young lawyer, who entered the faculty of advocates in the year 1800, attached himself to the Whig or Liberal party, at a time when it held out few inducements to men ambitious of vulgar success in life; and he adhered to his political choice with a single-hearted steadiness of purpose rivalled only by the constancy of his personal friendships. He possessed many remarkable faculties, through which he might have acquired distinction in several departments of intellectual exertion. His forensic eloquence, peculiar for its clearness, earnest pathos, and striking simplicity, was the qualification which the world first perceived, and was chiefly accustomed to associate with his name. His conversational powers were unrivalled among his contemporaries for fertility of fancy, corrected by soundness of taste. The extent of his literary ability became known after he had passed his seventieth year, by his beautiful biography of his beloved friend Jeffrey, published in 1852. It is understood that he has left behind him manuscripts which, when they are published, may have some chance of conveying to future generations a notion of the brilliant intellectual resources by which he delighted the contemporary circle privileged by the enjoyment of his familiar society. On the accession of Earl Grey's ministry in 1830, he became solicitor-general for Scotland. In 1834 he was raised to the bench, and (after the usual custom in Scotland) he took the title of Lord Cockburn. He died on the 26th of April 1854, in his mansion of Bonaly on the slope of the Pentland Hills, where he had long derived the purest enjoyment from improvements calculated to aid the natural beauty of the scenery.

COCKERMOUTH, a parliamentary borough and market-town of England, county of Cumberland, 25 miles S.W. of Carlisle, at the confluence of the Derwent and Cocker, each of which is here crossed by a bridge. The borough had, in 1851, 7275 inhabitants, and 355 registered electors, who return two members to parliament. The town is irregularly built, but has recently been much improved. It has remains of an old castle built soon after the Conquest, and razed by the parliamentary forces in 1648; also a town-hall, free grammar-school, savings-bank, dispensary, house of correction; with manufactures of cotton, linen, and woollen goods, hats, hosiery, paper, and leather. In the neighbourhood are extensive coal mines Wordsworth the poet was born here in 1770.

Cockle || Cocoa.

COCKLE, a genus of shells. See MOLLUSCA, genus CARDIUM.

COCKNEY, a very ancient nickname for a citizen of London. Ray interprets it to mean a young person coaxed or cockered, made a wanton or nestle-cock, and delicately bred and nurtured, so as when arrived at man's estate to be unable to bear the least hardship. According to another writer, it signifies a person ignorant of country economy. The origin of the term has been accounted for as follows: A young citizen having called the neighing of a horse laughing, was told that it was called neighing,—and next morning on hearing a cock crow, being anxious to show that he had benefited by instruction, he exclaimed, How that cock neighs! from which circumstance the citizens of London were thenceforward called cockneighs or cockneys. But whatever may be the origin of the term, we learn from the following verses, attributed to Hugh Bagot, earl of Norfolk, that it was in use in the time of Henry II.

> Was I in my castle at Bungay,
> Fast by the river Wavenay,
> I would ne care for the king of Cockeney.

The king of the cockney occurs among the regulations for the sports and shows formerly held in the Middle Temple on Childermas day, when he had his officers, a marshal, constable, butler, and others. See Dugdale's *Origines Juridicales*, p. 247.

COCKROACH. See ENTOMOLOGY.

COCKSWAIN (pronounced *coxen*), an officer on board of a man of war, who has the care of a boat or sloop, and who must be always ready with his gang or crew. He sits in the stern of the boat, which he steers, and has a whistle to summon his men.

COCLES, HORATIUS, a famous Roman, who defended the Sublician bridge against the army of Porsenna. See ROMAN HISTORY.

COCOA OR CACAO, the seed or kernel of the *Theobroma Cacao*, a tree extensively cultivated in the West Indies, Brazil, and other districts of South America. These are contained in pods shaped like a cucumber; each pod producing from 10 to 30 nuts about the size of a large almond. The shell is dark-coloured, thin, and brittle; and the kernel throughout is of a brown colour. The nuts have a light agreeable smell, and an unctuous, bitterish, but not ungrateful taste. The principal use of the cocoa is to form the beverage called chocolate. See CHOCOLATE.

Cocoa has never been so extensively used in Great Britain as on the Continent. Humboldt estimated the quantity consumed in Europe in 1806 at 23,000,000 lb. Until a recent period, the consumption of cocoa in England had been comparatively small, probably owing to the heavy duties imposed on it; but since 1832, when the duty on cocoa from British possessions was reduced from 6d. to 2d. per lb., the consumption has greatly increased. The annual average quantity consumed for the three years ending 1831 was only 440,578 lb.; while that for the three years ending 1842 was 2,072,332 lb.

In 1842, this duty was further reduced to $1\frac{1}{20}$d. per lb.; but the duty on foreign cocoa continued at 6d. per lb. till 1846, when it was reduced to $2\frac{1}{10}$d. These duties were equalized and fixed at 1d. per lb. in 1853, when the duties on husks and shells were also fixed at $\frac{1}{2}$d. per lb., and on the paste or chocolate at 2d. per lb.

Quantities imported for consumption in Great Britain in 1851—

	Lb.	Rates of Duty.	Nett Revenue.
Cocoa, from British Pos.,	2,396,611	$1\frac{1}{20}$d. per lb.	
„ foreign,.....	581,733	$2\frac{1}{10}$ „	
„ Husks and shells,	640,303	$0\frac{1}{2}$ of Brit. Pos. / $1\frac{1}{20}$ of Foreign	L.18,911.
Chocolate & Cocoa Paste,	14,134	$2\frac{1}{10}$ of Brit. Pos. / $6\frac{3}{10}$ of Foreign	

The quantities of cocoa entered for home consumption during the 3 months ending 5th April in 1852, 1853, and 1854, were respectively 978,327, 1,178,754, and 1,380,123 lb.

Cocoa Nuts || Codeia.

COCOA NUTS, the fruit of the *Cocos nucifera* of Linnæus, a species of palm tree that is common within the tropics. This tree grows from 50 to 100 feet in height, has no branches, but produces at top a cluster of leaves from 12 to 14 feet in length. The cocoa nut is as large as a man's head, and a single tree generally yields about 100 of these, which are disposed in clusters near its top. The exterior rind is thin and tough; and underneath it there is a quantity of very tough fibrous matter of a brownish-red colour. Of this, which in its manufactured state is called *coir*, ropes and coarse sail-cloth are made. Beneath this fibrous material is the shell of the nut, which is extremely hard, susceptible of a high polish, and when sawed in two is employed as bowls for domestic use. The kernel is white, and somewhat hard, about half an inch in thickness, and filled with a milky fluid of a very agreeable flavour. When the nut is green, this cavity is quite filled with the milk. Besides the nut and its milk, this tree (one of the most valuable, perhaps, in the world), exudes, when the wood is bored, a mild beverage called mirra, which when new drawn is without acidity or powers of intoxication, but when kept above 24 hours becomes vinegar. Oil is expressed from the kernel. Several species of the palm produce the liquid called toddy, from which arrack is distilled. A kind of sugar is produced from the mirra. The leaves are used for thatching houses, and the wood is employed for the purposes of house and ship carpentry.

COCOON, the silky tissue or envelope which the larvæ of many insects spin as a protection for themselves while in the chrysalis state. See ENTOMOLOGY, and SILKWORM.

COCYTUS, a tributary of the Acheron, supposed like that river to be connected with the lower world, and which consequently came to be described as one of the rivers of hell. It derived its name from *κωκύειν, to wail* or *lament*. Hence Milton—

> Cocytus named, of lamentation loud
> Heard on the rueful stream.

COD and COD-FISHERY. See ICHTHYOLOGY, and FISHERIES.

CODE (*codex*), a collection of the laws and constitutions of the Roman emperors, made by order of Justinian. The word comes from the Latin *codex*, a book; so called *a codicibus vel caudicibus arborum*, the trunks of trees; the bark of which, when stripped off, was used by the ancients as material for writing upon.

The Code is accounted the second volume of the body of civil law, and contains twelve books; the matter of which is nearly the same with that of the Digest, especially the first eight books; but the style is neither so pure, nor the method so accurate, as that of the Digest; and it determines matters of daily use, whereas the Digest discusses the more abstruse and subtle questions of the law, and gives at the same time the opinions of the ancient jurisconsults. Although Justinian's collection is distinguished by the appellation of *Code*, by way of eminence, yet there were codes before his time: as, first, the Gregorian code and Hermogenian code, a collection of the Roman laws made by two famous lawyers, Gregorius and Hermogenes, and including the constitutions of the emperors from Hadrian to Diocletian and Maximinian; and, secondly, the Theodosian code, in sixteen books, formed out of the constitutions of the emperors from Constantine the Great to Theodosius the Younger, and observed almost all over the West, till it was superseded by the Justinian code. (See CIVIL LAW.) There are several modern systematic collections of laws called codes, the most celebrated of which is the *Code Napoléon*. See FRANCE, and NAPOLEON.

CODEIA, or CODEINE. See CHEMISTRY.

Codicil || Cœnobite.

CODICIL, a supplement appended to a will, for the purpose of explaining, altering, adding to, or subtracting from, the testator's former disposition.

CODLIN, a kind of baking apple. See HORTICULTURE.

CODOGNO, the capital of a district of Lombardy, delegation of Lodi, and 15 miles S.E. of the town of that name. It has a considerable trade, especially in Parmesan cheese, besides some manufactures of silk stuffs. Pop. 9000.

CODON (κώδων), in *Antiquity*, a little hemispherical bell, frequently attached to the trappings of horses.

CODRINGTON, CHRISTOPHER, a brave English officer, was born at Barbadoes in 1668, and educated at Oxford, where he held a fellowship. Having entered the army, he soon gained the favour of King William, and obtained a captaincy in the first regiment of foot guards. He was at the siege of Namur in 1695; and on the conclusion of the peace of Ryswick, he was made captain-general and governor-in-chief of the Leeward and Carribbee Islands. He died at Barbadoes April 7, 1710; but his remains were in 1716 brought over to England and interred in the chapel of All-Souls College, Oxford. He bequeathed his plantations in Barbadoes, and part of the island of Barbuda, to the Society for Propagating the Gospel in Foreign Parts; and left a noble legacy to All-Souls College. He was the author of some poems in the *Musæ Anglicanæ*, London, 1741.

CODRUS, the last king of Athens. See ATTICA, vol. iv., p. 193.

CO-EFFICIENT, in *Algebra*, a number or known quantity put before letters or quantities, known or unknown, and into which it is supposed to be multiplied. Thus, in $3x$, ax, or bx, 3, a, and b are the co-efficients of x. See ALGEBRA.

CŒLESYRIA (ἡ κοίλη Συρία, the *hollow* Syria). This name, which is Grecian, and originated in the times of the Seleucidæ, was first applied to the valley lying between the mountain-ranges of Libanus and Anti-Libanus. It was also used to denote the whole tract of country (with the exception of Judæa and Phœnicia) reaching from Seleucis to Arabia and the confines of Egypt. In the time of David, Cœlesyria was probably included in "Syria of Damascus," which was conquered by that monarch, but recovered from Solomon by Rezon the son of Eliadah. The possession of it was an object of many struggles between the Seleucidæ and the kings of Egypt. Bochart supposes that Syrophœnicia is the same as Cœlesyria. Scythopolis and Gadara are mentioned by Josephus as cities of Cœlesyria (*Antiq.* xiii. 13). The name frequently occurs in the Apocrypha. Under the Emperor Diocletian, Phœnice and Cœlesyria formed one province, called Phœnicia Libanica. Under the present Turkish government the western part of Cœlesyria is in the Pashalic of Saide, and the eastern in that of Damascus.

CŒLUS (Heaven), called Uranus by the Greeks, was the son of Æther and Dies, or Air and Day. According to Hesiod, he married Terra or the Earth, by whom he became the father of the Mountains, the Ocean, Saturn, &c. He imprisoned the Cyclops, who were likewise his children; and in consequence was dethroned and emasculated by Saturn, with the assistance of Terra.

COEMPTIO, one of three forms of marriage among the ancient Romans, in which the contracting parties delivered to each other a small piece of money, and repeated at the same time certain formulæ. The man asked the woman "an sibi mater familiæ esse vellet;" to which she replied, "se velle." A similar question was put by the woman to the man, and a similar answer received.

CŒNA (supper), the principal meal of the ancient Romans, usually taken at the ninth hour, *i. e.*, three o'clock, p.m., in summer, and at the tenth hour in winter.

CŒNOBITE (from κοινός *common*, and βίος *life*), one of a religious order who live in a convent, or in community; in opposition to an anchoret or hermit, who lives in solitude. Fleury refers the institution of cœnobites to the times of the apostles, making it a sort of imitation of the ordinary lives of the faithful at Jerusalem. But St Pachomius is ordinarily acknowledged as the institutor of the cœnobite life, as being the first who gave a rule to any community.

Coffea.

COFFEA ARABICA, the COFFEE-TREE, is a native of Ethiopia and Abyssinia; but it was in Arabia that it first became an object of interest and importance to the civilized world. The plant is an evergreen, and is accurately described by La Roque as follows:—

"The coffee-tree is from six to twelve feet high; the stem ten, twelve, and fifteen inches in circumference. When it is full grown, it much resembles in figure our apple-trees of eight or ten years' standing. The lower branches ordinarily bend when the tree begins to grow old, and extend themselves into a round form, somewhat like an umbrella; and the wood is so very limber and pliable, that the ends of the longest branches may be bent down within two or three feet of the earth. The bark is whitish, and somewhat rough; its leaf is much like that of the citron-tree. It continues green all the year, and the tree is never without leaves, which are ranged almost opposite on each side of the bough, and at small distances from each other. Nothing is more singular in its kind than its productions; for almost in all seasons of the year, blossoms, and green and ripe fruit, may be seen on the same tree at the same time. When the blossom falls off, there remains in its room, or rather springs from each blossom a small fruit, green at first, but which becomes red as it ripens, and is not unlike a large cherry, and is very good to eat. Under the flesh of this cherry, instead of the stone, is found the bean or berry we call coffee, wrapped round in a fine thin skin. The berry is then very soft, and of a disagreeable taste; but as the cherry ripens, the berry in the inside grows harder, and the dried up fruit being the flesh or pulp of it, which was before eatable, becomes a shell or pod of a deep brown colour. The berry is now solid, and of a clear transparent green. Each shell contains one berry, which splits into two equal parts. When the fruit is sufficiently ripe to be shaken from the tree, the husks are separated from the berries, and are used in Arabia by the natives; while the berries are exported for the European markets."

From Arabia the plant was taken by the Dutch about the year 1690 to Java, whence its culture spread slowly amongst the islands of the Indian archipelago. In the early part of the eighteenth century it found its way to the West India islands. The plant is now common in every botanical garden of Europe, and there are few private conservatories without good specimens of the tree. When cultivated with a view to trade, it is most productive on hills and mountains, where its root is almost always dry, and its head frequently watered with gentle showers. It prefers a westerly exposure and a loose gravelly soil, but freed from weeds and grass. The plants are inserted at distances of six or eight feet asunder, and in holes from twelve to eighteen inches deep.

If left to themselves they would rise to the height of sixteen or eighteen feet; but in extensive plantations the trees are topped and stunted to about five feet, for the convenience of having the fruit within reach of the gatherer. Thus dwarfed, they extend their branches until they cover the whole spot round about them. They begin to yield fruit the third year. By the fifth, sixth, or seventh year, according to the nature of the soil, they are at full bearing, and continue to bear for upwards of twenty years.

It has but recently come to the knowledge of Europeans that the leaves of the coffee-plant contain the same essential principle for which the berries are so much valued, and that in the Dutch island of Sumatra in the Indian archipelago the natives scarcely use anything else, and greatly prefer a beverage made from the leaf to the berry itself. The leaves undergo a process of curing similar to tea, and they possess all the virtues of either tea or coffee. This may be

Coffee. looked upon as the introduction of a new element amongst the innocent and beneficial necessaries of life; for whilst the culture of the coffee plant for the sake of its fruit is limited to particular soils and high temperatures, the tree produces leaves in abundance anywhere within the tropics where the soil is sufficiently fertile. This extensive habitat, added to its nutritive qualities and freedom from any deleterious principle, points out the coffee plant as the best adapted for general consumption of all the productions affording *caffeine*.

The COFFEE *Berry* (for which the plant has hitherto been chiefly cultivated), when ripe, is cured in the West Indies, in Java, Ceylon, the East Indies, and South America, by a process called pulping and washing. In Arabia, Persia, &c., it is neither pulped nor washed, but cured in the ancient fashion by the labour of the hands and the action of the sun. The pulping process is performed by machinery, which greatly expedite the work; but practical experienced West India planters admit, that this process is in some important respects inferior to the oriental mode. "A manifest preference," says one, "is given in the leading European markets to coffee which has gone through the pulping and washing process; but, strange to say, the consumers of this beverage are totally ignorant of the fact, that the produce which is cured in the pulp furnishes a stronger decoction than an equal quantity of the same coffee which has undergone the other process. The mucilaginous substance which is washed off by the pulping process is absorbed by the bean when cured in the pulp. This gives strength to the produce, and enhances its aromatic flavour." Before the berry is available for use, it undergoes a process called roasting. The valuable properties of coffee depend very much on the manner in which this process is performed. For the most recent and intelligent dissertation on this point, consult Dr Ure's *Dictionary of Arts, Manufactures, and Mines*, last edition, vol. i., p. 456.

COFFEE also denotes the drink which is made from the coffee berries. This beverage has been familiar in Europe for the last two hundred years. The first human beings who appear to have used the coffee berries were the half savage tribes of the higher Ethiopia. According to Bruce, the berries were first parched like any other grain, bruised into powder, and mixed up with any sort of grease into paste rolled into little balls. The same authority declares that two or three of these balls were sufficient to support a man for a whole day in a marauding excursion, or in active war against some neighbouring tribe. They merely preferred the coffee-berry to other grain, because it fed them as well, and cheered them more.

From Ethiopia, both the coffee plant and the use of its fruit were introduced into Persia and Arabia, and it is to the Arabs that we are indebted both for the first written account of it, and for the manner of using it in a liquid state. But though we derive the only authentic account of coffee from the Arabs, they admit that they were taught by the Persians; and it was in the city of Aden in Arabia about the middle of the fifteenth century, that the drinking of coffee first became general. The mufti of that city introduced the custom from Persia; his authority gave reputation to the practice—lawyers began to drink it—those who loved reading followed their example—artisans who were obliged to work in the night did the same thing, as well as travellers who journeyed in the night to avoid the heat of the day. In short, says M. Galland, "the whole inhabitants of Aden soon became drinkers of coffee, and not only at night to keep them awake, but even in the daytime for its other virtues."

From Aden, the taste for coffee found its way to Mecca, from Mecca to Cairo, from Cairo to Damascus, from Damascus to Aleppo, and from Aleppo to Constantinople; but it was not until 1615, that the use of coffee found its way from Constantinople to Venice. Coffee-Trade.

In 1644 it was introduced to Marseilles, in 1652 to London, and in 1669 to Paris.

The first English author who mentioned coffee was Burton, in his *Anatomy of Melancholy* (vol. i. p. 130), published in 1621, thirty years before the introduction of the drink into London. "The Turks," says he, "have a drink called coffee (for they use no wine), so named of a berry as black as soot and as bitter, which they sip up as warm as they can suffer, because they find by experience that that kind of drink so used helpeth digestion and procureth alacrity."

It would be an error to infer that the mode of making coffee in Europe and Asia is the same. In Europe, an infusion or a decoction of the roasted berry is all that is consumed; but this is a refinement in cookery not appreciated in Asia; there the custom is now, and always has been different.

A highly trustworthy traveller, Lamartine, in describing the ordinary khan in Palestine and Syria, says, "a charcoal fire is constantly burning on the hearth, and one or two copper coffee-pots are always full of *thick farinaceous coffee*, the habitual refreshment and only want of the Turks and Arabs."—*Travels in Syria and the East*, vol. i., p. 292.

A cup of well made coffee exhilarates, arouses, and keeps awake. It allays hunger to a certain extent, gives to the weary increased strength and vigour, and imparts a feeling of comfort and repose.

Its physiological effects upon the system, so far as they have been scientifically investigated, appear to be, that while it makes the brain more active, it soothes the body generally, makes the change and waste of matter much slower than usual, and the demand for food in consequence proportionately less.

All these effects are produced by the conjoined action of three ingredients, either identical with or similar to those contained in tea. There is a volatile oil produced during the roasting; a variety of tannic acid, which is also altered in some degree during the roasting; and the substance called theine or caffeine, which is common to both tea and coffee, and is found in the leaves of *Guarana officinalis*, and *Ilex paraguénsis*, both used by the aborigines of South America, as tea is in the Old Continent, a remarkable result of chemical investigation. The chemical constitution of caffeine is $C_{19} H_{10} N_4 O_4$.

COFFEE-TRADE. The extent to which the cultivation of coffee has been carried in the British possessions, the vast amount of capital embarked in plantations suited to its growth, the multitude of hands engaged in its culture, and the shipping necessarily employed in connection with that trade, invests the article, in a commercial point of view, with great importance; while as a beverage, the tendency of which is to wean the community from indulgence in intoxicating liquors, renders it second to no commodity in the British tariff.

The history of the coffee-trade prior to 1850 is only valuable now as an example of a commodity for which there is a universal craving amongst mankind, struggling successfully, and at last triumphantly, over fiscal restrictions, high duties, differential duties, and an endless mass of antiquated obstructions. In common with other important necessaries of life, it has now attained to the natural state of unrestricted competition, though it still pays a customs duty of threepence per pound.

The following is an estimate of the annual exports of coffee from the principal places where it is produced, during the last four years, and as nearly as can be ascertained of its annual consumption for the same period in those countries into which it is imported from abroad at the present time, viz.:—

Coffee.

Estimated Supplies of Coffee for Europe and United States.

	1850	1851.	1852.	1853
	Tons.	Tons	Tons.	Tons
Brazil, shipment from	80,000	142,000	133,000	126,000
Java	40,000	60,000	69,000	62,000
St Domingo...	20,000	18,000	25,000	20,000
Cuba	4,000	5,000	4,000	5,000
Porto Rico	6,000	5,500	9,500	9,500
La Guyra & Venezuela	12,000	10,500	12,000	12,000
Costa Rica	4,000	3,000	3,000	3,000
British West India	1,000	1,500	1,500	1,500
Ditto East India and Ceylon	18,000	16,000	21,000	16,000
French colonies and West Indies...	500	500	500	500
Dutch—West Indies	500	500	500	500
Manilla 600, Arabia 1400	2,000	2,000	2,000	2,000
	188,000	264,500	281,000	258,000
Deduct supplies directed to and retained in U. States	63,000	94,000	88,000	85,000
Supplies available for Europe	125,000	170,500	193,000	172,000
Estimated real consumption in Europe	155,000	176,500	191,400	193,000
Surplus			1,600	
Deficit	30,000	6,000		21,000

Estimated Consumption of Coffee.

	1850	1851.	1852.	1853.
	Tons.	Tons.	Tons.	Tons
Great Britain (official)	14,000	14,500	15,700	17,500
France do.	15,300	18,500	21,500	21,500
Belgium do.	16,500	17,500	20,700	20,000
Holland, estimated...	12,000	13,500	15,000	15,000
Germany, Zollverein, and the other States, included in the new Customs Union	49,000	56,000	58,000	58,000
Bohemia, Gallicia, and Hungary	4,500	6,000	6,000	6,000
Austria	9,000	10,500	11,000	11,000
Switzerland	5,700	6,500	7,000	7,000
Italy, Greece, Levant, and North Africa.	12,500	14,000	15,000	15,000
Spain and Portugal.	5,000	6,000	6,000	6,000
Sweden, Norway, and Denmark...	8,000	9,000	10,000	10,000
Russia, Finland, and Poland.....	3,500	4,500	5,500	6,000
Estimated consumption in Europe.....	155,000	176,500	191,400	193,000
Estimated consumption in U. States...	65,000	84,000	92,000	92,000
Total consumption	220,000	260,500	283,400	285,000
Estimated fresh supplies in the year...	188,000	264,500	281,000	258,000
Deficit	32,000		2,400	27,000
Surplus		4,000		

Quantity of Coffee imported into the United Kingdom for the same period, viz.:

	Tons.
1850	22,680
1851.....	20,870
1852	21,470
1853.....	21,400

The above quantities may be considered the nearest approximation to the truth which the present state of commercial statistics can supply; but any one familiar with the writings of modern travellers in the south of Europe and in Asia must be convinced that a very large quantity of coffee is consumed in Turkey, Syria, Palestine, Persia, Egypt, Abyssinia, &c., regarding which commerce takes no note, and of which no statistics have ever yet been collected. (W. L.)

Coffer ‖ Cognomen.

COFFER, in *Architecture*, a deep panel in a ceiling, or in each interval between the modillions of the Corinthian cornice, and ordinarily decorated with a pomegranate, a rose, or other ornament.

COFFER, in *Fortification*, a hollow lodgement across a dry moat, from 6 to 7 feet deep, and from 16 to 18 broad; the upper part made of pieces of timber raised two feet above the level of the moat. This little elevation is covered over with hurdles laden with earth, and serves as a parapet with embrasures.

COFFER-DAM, a water-tight inclosure formed in a river or other water by rows of piles, with bricks or clay between the rows, to prevent the entrance of water after it has been pumped out. Coffer-dams are employed in laying the foundations of piers for bridges in the beds of rivers. See MASONRY.

COFFIN (Gk. *κόφινος*, a basket, French *coffre*, a chest); the chest or box for the reception of a corpse. In the East, the body of a deceased person is carried to the grave on a [illegible]—a custom preserved from ancient times, and which obtains equally among the Jews, the Mohammedans, and the Christians. In this manner the son of the widow of Nain was carried forth to burial (Luke vii. 14). Neither does it appear that the body of our Lord was placed in a coffin; nor that of Elisha, whose bones were touched by the corpse that was afterwards let down into his sepulchre. (2 Kings xiii. 21). Coffins were the invention of the Egyptians, who generally formed them of pasteboard glued together and painted with hieroglyphics, sometimes of stone, and more rarely of sycamore wood—which last was reserved for persons of exalted rank. The sacred historian expressly observes of Joseph, that his body was embalmed and placed in a coffin (Gen. l. 26). There is good reason to believe also that the kings and other persons of distinction in ancient Palestine were buried in coffins of wood or stone, on which were placed the insignia of their several dignities. See BURIAL; BURYING-PLACES; FUNERAL RITES.

COGGLESHALL, GREAT, a market-town of England, county of Essex, 44 miles from London, picturesquely situated, partly at the base and partly on the acclivity of a hill on the N. side of the Blackwater river, here crossed by an ancient bridge of three arches. It was formerly celebrated for the manufacture of a white baize, known as "Coggleshall whites." The principal manufacture is now that of silk. The parish church is a spacious building in the perpendicular style, with a square tower. It has some remains of a Cistercian abbey, founded in 1142 by king Stephen. Pop. (1851) 3484.

COGNAC, a town of France, department of Charente, capital of a cognominal arrondissement, stands on the left bank of the Charente, 22 miles W. of Angoulême. It carries on an extensive trade in the celebrated brandy to which it gives name. The town is ill built, and has no remarkable buildings except an old castle, in the park of which is a bronze statue of Francis I., marking the spot where he was born in 1494. Pop. (1851) of town 5738; of arrondissement 57,959.

COGNATE, in Scotch law, any male relation by the mother's side.

COGNATION, in the civil law, that line of consanguinity which exists between males and females descended from the same father. Agnation, again, is the relationship between males only descended from the same stock.

COGNOMEN. See AGNOMEN.

COHESION.

Cohesion. THE corpuscular forces, on which the mechanical properties of the aggregates of matter depend, have been in some measure considered, as far as they relate to solids, in the articles BRIDGE and CARPENTRY. There are however other modifications of these forces, which are principally exemplified in the Cohesion of Fluids, and which afford us a series of phenomena, highly interesting to the mathematician, on account of the difficulty of investigating their laws, and of considerable importance to the natural philosopher, from the variety of forms in which they present themselves to his observation.

SECT. I.—*Fundamental Properties of the Cohesion of a Single Fluid.*

The three states of elastic fluidity, liquidity, and solidity, in all of which the greater number of simple bodies are capable of being exhibited at different temperatures, are not uncommonly conceived to depend on the different actions of heat only, giving a repulsive force to the particles of gases, and simply detaching those of liquids from that cohesion with the neighbouring particles which is supposed to constitute solidity. But these ideas, however universal, may be easily shown to be totally erroneous; and it will readily be found, that the immediate effect of heat alone is by no means adequate to the explanation of either of the changes of form in question.

There can never be rest without an equilibrium of force; and if two particles of matter attract each other, and yet remain without motion, it must be because there exists also a repulsive force, equal, at the given distance, to the attractive force. If we imagined the atoms of matter to be impenetrable spheres, only resisting when their surfaces came into actual contact, it would follow, that the degree of repulsive force exerted at the same distance must be capable of infinite variation, so as to counterbalance every possible modification of the attractive force that could operate between the particles. In this there would be no mathematical absurdity, and it may sometimes even be convenient to admit the hypothesis as an approximation; but we know, from physical considerations, that the actual fact is otherwise. The particles of matter are by no means incompressible; the repulsion varies indeed very rapidly when they approach near to each other; but the distance of the particles and the density of the substance must inevitably vary, in some finite degree, from the effect of every force that tends to produce either compression or expansion.

In elastic fluids, the law of the repulsive force of the particles is perfectly ascertained; and it has been shown to vary very accurately in the inverse ratio of their mutual distances. It is natural to inquire whether this repulsive force, continued according to the same law, would be capable of affording the resistance exhibited by the same bodies in a liquid or solid form, and holding the cohesive force in equilibrium; but in order to answer this question, it would be necessary to determine the law of the variation of the cohesive force with the variation of the density. Now if this force extended to all particles within a given distance of each other, whatever the density might be, the number of particles similarly situated within the sphere of action being as the density, and each one of this number being attracted by an equal number, the whole cohesion urging any two particles to approach each other would obviously, as Laplace has observed, be as the square of the density; but since this cohesive force would increase with the increase of density accompanying compression, more rapidly than any repulsive force like that of elastic fluids, there could never be an equilibrium between forces thus constituted: for, as Newton has justly remarked, the force of repulsion must be supposed to affect the particles immediately contiguous to each other only, their number not increasing with the density. Nor is there any reason to infer, from the phenomena of cohesion, that this force extends to a given minute distance, rather than to a given number of particles, as that of repulsion appears to do. It would indeed be possible to assign a law for the variation of cohesion, which would reduce the repulsion of liquids and of elastic fluids to the action of the same force, without any other modification than that which depends on the mutual distance of the particles; but this law is in itself so improbable that it cannot be considered as affording an admissible explanation of the phenomena, for it would be required that the force of cohesion should diminish, instead of increasing, with every increase of density, and with a rapidity nineteen times as great as the repulsion increased. For the height of the modulus of elasticity of all kinds of gaseous substances remaining unaltered by pressure, that of steam would still be only one twentieth as high as the modulus of elasticity of water, even if the steam were compressed by 1200 atmospheres; and the resistance to any minute change of dimensions would be twenty times as great in water as in steam of equal density, and the variation of the repulsion would be in the same proportion. It is therefore simplest to suppose the repulsion itself to be also twenty times as great, and the cohesion little or not at all altered by the effect of a slight compression or extension; and we shall have no difficulty in imagining this abrupt change in the magnitude of the repulsive force to depend on an increase of the number of particles to which it extends; supposing that when cohesion begins to affect them, this number becomes four or five times as great as before, and that it is not further increased by a greater increase of density; although, like the distance to which the force of cohesion itself extends, it may be liable to some modification from the effects of a change of temperature. Thus it is probable that the number of particles co-operating, both in repulsion and in cohesion, is diminished by the effect of heat; for the diminution of the elasticity of a spring is much more than proportional to the expansion of its substance, although the primitive repulsive force of the single particles may very possibly be as much augmented by an elevation of temperature in this case as in that of an elastic fluid: the cohesive powers of liquids are also diminished by heat, and indeed in a considerably greater degree than the stiffness of springs, although there can be no doubt that there is a considerable analogy in these changes. However this may be, it appears that the force of cohesion cannot be supposed to vary much with the density, and it is therefore allowable to consider it as constant, at all distances, as far as its action extends; while that of repulsion, though it may operate in some degree at distances somewhat greater, may still be considered, on account of its greater intensity at smaller distances, as equivalent to a resistance terminating at a more minute interval than that to which the action of cohesion extends.

Cohesion.

The distance at which cohesion commences between the particles of gaseous fluids appears to depend entirely on the temperature, and for any one fluid it is generally reduced to one half by an elevation of about 100° of Fah-

Cohesion. renheit. In whatever way the particles are caused to approach nearer than this distance to each other, they become subject to the action of this force, and rush together with violence, and with a great extrication of heat, until the increased repulsion affords a sufficient resistance to the cohesion, and the gas is converted into a liquid. Superficial observers have sometimes imagined that liquids possessed little or no cohesion; and it has generally been supposed that their cohesive powers are far inferior to those of solids. But that all liquids are more or less cohesive, is sufficiently shown by their remaining attached, in small portions, to every substance capable of coming into intimate contact with them, in opposition to the effect of gravitation, or of any other force; and the cohesion of mercury is still more fully exemplified by the well-known experiment of a column, standing at a height much exceeding that of the barometer, when it has been brought, by strong agitation or otherwise, into perfect contact with the summit of the tube, and is then raised into a vertical position; the summit of the tube supporting, or rather suspending, the upper parts, and each stratum the stratum immediately below it, with a force determined by the excess of its height above that of the column equivalent to the atmospherical pressure. The perfect equality of the cohesion of a given substance in the states of solidity and liquidity appears, however, only to have been asserted in very modern times; and the assertion has only been confirmed by a single observation of the sound produced by a piece of ice, compared with the elasticity exhibited in Canton's experiments on the compressibility of water; the results demonstrating that the resistance is either accurately or very nearly equal in both cases.

The real criterion of solidity is the lateral adhesion, which prevents that change of internal arrangement, by which a fluid can alter its external dimensions without any sensible difference in the mutual distances of its particles taken collectively, and consequently without any sensible resistance from the force of cohesion. It is probable that this lateral adhesion depends upon some symmetrical arrangement of the constituent parts of the substance, while fluidity requires a total independence of these particles, and an irregularity of situation, affording a facility of sliding over each other with little or no friction. The symmetry of arrangement, when continued uniformly to a sensible extent, is readily discoverable by the appearance of crystallization; but there are several reasons for supposing it to exist, though with perpetual interruptions, in more uniform masses, or in amorphous solids. It is obvious that the lateral adhesion, confining the particles so as to prevent their sliding away, performs an office like that of the tube of a barometer to which the mercury adheres, or like that of the vessels employed by Canton and Zimmerman for confining water which is compressed; and enables the cohesive and repulsive powers of the substances to be exhibited in their full extent. Nor can we obtain any direct estimate of these powers, from the slight cohesion exhibited, in some circumstances, by liquids in contact with the surface of a solid which is gradually raised, and carries with it a certain portion of the liquid; an experiment which had been often made, with a view of determining the mutual attractions of solids and fluids, but which was first correctly explained, as Laplace observes, by our countryman Dr Thomas Young, from its analogy with the phenomena of capillary tubes.

There are, however, still some difficulties in deducing these phenomena from the elementary actions of the forces concerned, whatever suppositions we may make respecting their primitive nature. The intermediate general principle of a hydrostatic force or pressure, proportional to the curvature of the surface, had been employed long ago by Segner, and had been considered by him as the result of corpuscular powers extending to an insensible distance only. But Segner's reasoning on this point is by no means conclusive, and he has very unaccountably committed a great error, in neglecting the consideration of the effects of a double curvature. There is also an oversight in some of the steps of the demonstration attempted by Dr Young in his *Lectures*, which has been pointed out by an anonymous writer in Nicholson's *Journal*; and M. Laplace's final equation for determining the angle of contact of a solid and a liquid, which Dr Young had first shown to be constant, has been considered as completely inaccurate, and as involving an impossibility so manifest as to destroy all confidence in the theory from which it was deduced. A demonstration which appears to be less exceptionable was lately published in the *Philosophical Magazine*; and it may serve, with some further illustrations, for the present purpose. Cohesion

It is only necessary to consider the actions of such of the particles of the liquid as are situated at a distance from the surface shorter than that to which the cohesive force extends; for all those which are more internal must be urged equally in all directions by the actions of the surrounding particles. Now it will readily be perceived, that the first or outermost stratum of particles will cohere very weakly with the stratum below it, having only its own attraction to bind it down; that the second will be urged by a force nearly twice as great; and that the cohesion will gradually augment by increments continually diminishing, until we arrive at the depth of the whole interval to which the force extends; and below this it will remain constant, the number of particles within the given distance not undergoing any further change. It has been observed by M. Laplace, that this partial diminution of the density of the surface is likely to be concerned in facilitating the process of evaporation; and it has been cursorily suggested in another quarter, that the polarisation of light by oblique reflection may be in some measure influenced by this gradation of density. But its more immediate effect must be to produce that uniform tension of the surface which constitutes so important a principle in the phenomena of capillary action; for since the cohesion in the direction of the surface is the undiminished result of the attractions of the whole number of particles constituting the stratum, acting as they would do in any other part of the substance, it follows that a small cubical portion of the liquid, situated in any part of the space which we are considering, will be pressed laterally by the whole force of cohesion, but above and below by that part only which is derived from the action of the strata above it, so that this minute portion must necessarily tend to extend itself upwards and downwards, and to thicken the superficial film, and at the same time to become thinner in the direction of the surface, and to shorten it in all its dimensions, unless this alteration be prevented by some equivalent tension acting in a contrary direction; and this tension must be always the same in the same liquid, whatever its form may be, the thickness of the whole stratum being always extremely minute in comparison with any sensible radius of curvature.

Upon these grounds we may proceed to determine the actual magnitude of the contractile force derived from a given cohesion extending to a given distance. Supposing the corpuscular attraction equable throughout the whole sphere of its action, the aggregate cohesion of the successive parts of the stratum will be represented by the ordinates of a parabolic curve; for at any distance x from the surface, the whole interval being a, the fluxion of the force will be as $dx\,(a - x)$, since a number of particles proportional to dx will be drawn downwards by a number proportional to a, and upwards by a number proportional to x, and

Cohesion. the whole cohesion, at the given point, will be expressed by $ax - \frac{1}{2}x^2$; and this at last becomes $\frac{1}{2}a^2$, which must be equal to the undiminished cohesion in the direction of the surface; consequently the difference of the forces acting on the sides of the elementary cube will everywhere be as $\frac{1}{2}a^2 - ax + \frac{1}{2}x^2$, and the fluxion of the whole contractile force will be $dx\,(\frac{1}{2}a^2 - ax + \frac{1}{2}x^2)$, the fluent of which, when $x = a$, becomes $\frac{1}{6}a^3$, which is one third of $a \times \frac{1}{2}a^2$, the whole undiminished cohesion of the stratum.

We may therefore conclude in general, that *the contractile force is one third of the whole cohesive force of a stratum of particles, equal in thickness to the interval to which the primitive equable cohesion extends;* and if the cohesive force be not equable, we may take the interval which represents its *mean* extent as affording a result almost equally accurate. In the case of water, the tension of each inch of the surface is somewhat less than three grains, consequently we may consider the whole cohesive and repulsive force of the superficial stratum as equal to about nine grains. Now since there is reason to suppose the corpuscular forces of a section of a square inch of water to be equivalent to the weight of a column about 750,000 feet high, at least if we allow the cohesion to be independent of the density, their magnitude will be expressed by 252·5 × 750,000 × 12 grains, which is to 9 as 252·5 × 1,000,000 to 1; consequently the extent of the cohesive force must be limited to about the 250 millionth of an inch; nor is it very probable that any error in the suppositions adopted can possibly have so far invalidated this result as to have made it very many times greater or less than the truth.

Within similar limits of uncertainty we may obtain something like a conjectural estimate of the mutual distance of the particles of vapours, and even of the actual magnitude of the elementary atoms of liquids, as supposed to be nearly in contact with each other; for if the distance at which the force of cohesion begins is constant at the same temperature, and if the particles of steam are condensed when they approach within this distance, it follows that at 60° of Fahrenheit the distance of the particles of pure aqueous vapour is about the 250 millionth of an inch; and since the density of this vapour is about one sixty thousandth of that of water, the distance of the particles must be about forty times as great; consequently the mutual distance of the particles of water must be about the ten thousand millionth of an inch. It is true that the result of this calculation will differ considerably, according to the temperature of the substances compared; for the phenomena of capillary action, which depend on the superficial tension, vary much less with the temperature than the density of vapour at the point of precipitation: thus an elevation of temperature amounting to a degree of Fahrenheit lessens the force of elasticity about one ten thousandth, the superficial tension about one thousandth, and the distance of the particles at the point of deposition about a hundredth. This discordance does not, however, wholly invalidate the general tenor of the conclusion; nor will the diversity resulting from it be greater than that of the actual measurements of many minute objects, as reported by different observers; for example, those of the red particles of blood, the diameter of which may be considered as about two million times as great as that of the elementary particles of water, so that each would contain eight or ten trillions of particles of water at the utmost. If we supposed the excess of the repulsive force of liquids above that of elastic fluids to depend rather on a variation of the law of the force than of the number of particles co-operating with each other, the extent of the force of cohesion would only be reduced to about two thirds; and, on the whole, it appears tolerably safe to conclude, that whatever errors may have affected the determination, the diameter or distance of the particles of water is between the two thousand and the ten thousand millionth of an inch. Cohesion.

Sect. II.—*Relations of Heterogeneous Substances.*

We must now return from this conjectural digression to the regions of strict mathematical argument, and inquire into the effect of the contact of substances of different kinds on the tension of their common surfaces, and on the conditions required for their equilibrium. Whatever doubts there may be respecting the variation of the number of particles co-operating when the actual density of the substance is changed, there can be none respecting the consequence of the contact of two similar substances of different densities; for the less dense must necessarily neutralise the effects of an equivalent portion of the particles of the more dense, so as to prevent their being concerned in producing any contractility in the common surface; and the remainder, acting at the same interval as when the substance remained single, must obviously produce an effect proportional to the square of the number of particles concerned, that is, of the difference of the densities of the substances. This effect may be experimentally illustrated by introducing a minute quantity of oil on the surface of the water contained in a capillary tube; the joint elevation, instead of being increased, as it ought to be according to M. Laplace, is very conspicuously diminished; and it is obvious, that since the capillary powers are represented by the squares of the density of oil and of its difference from that of water, their sum must be less than the capillary power of water, which is proportional to the square of the sum of the separate quantities.

Upon these principles we may determine the conditions of equilibrium of several different substances meeting in the same point, neglecting for a moment the consideration of solidity or fluidity, as well as that of gravitation, in estimating the contractile powers of the surfaces, and their angular situations. We suppose then three liquids, of which the densities are A, B, and C, to meet in a line situated in the plane termination of the first; the contractile forces of the surfaces will then be expressed by $(A-B)^2$, $(A-C)^2$, and $(B-C)^2$; and if these liquids be so arranged as to hold each other in equilibrium, whether with or without the assistance of any external force, the equilibrium will not be destroyed by the congelation of the first of the liquids, so that it may constitute a solid. Now, unless the joint surface of the second and third coincides in direction with that of the first, it cannot be held in equilibrium by the contractility of this surface alone; but supposing these two forces to be so combined as to produce a result perpendicular to the surface of the first substance, this force may be resisted by its direct attraction; the forces which tend to cause the oblique surface to move either way on it, balancing each other, and the perpendicular attraction being counteracted by some external force holding the solid in its situation. Consequently the force expressed by $(B-C)^2$, reduced in the proportion of the radius to the cosine of the angle, must become equal to the difference of the forces $(A-B)^2$ and $(A-C)^2$; and if the radius be called unity, this cosine must be

$$\frac{(A-C)^2-(A-B)^2}{(B-C)^2} = \frac{2AB-2AC-(B^2-C^2)}{(B-C)^2}$$

$$= \frac{2A-(B+C)}{B-C}$$, which is the excess of twice the density of the solid above the sum of the densities of the liquids, divided by the difference of these densities; and when there is only one liquid, and $C = 0$, this cosine becomes

Cohesion. $\frac{2A}{B} - 1$, vanishing when $2A = B$, and the density of the solid is half of that of the liquid, the angle then becoming a right one, as Clairaut long ago inferred from other considerations. Supposing the attractive density of the solid to be very small, the cosine will approach to -1, and the angle of the liquid to two right angles; and on the other hand, when A becomes equal to B, the cosine will be 1, and the angle will be evanescent, the surface of the liquid coinciding in direction with that of the solid. If the density A be still further increased, the angle cannot undergo any further alteration, and the excess of force will only tend to spread the liquid more rapidly on the solid, so that a thin film would always be found on its surface, unless it were removed by evaporation, or unless its formation were prevented by some unknown circumstance which seems to lessen the intimate nature of the contact of liquids with dry solids. For the case of glass and mercury we find $\frac{A}{B}$ about $\frac{1}{8}$, and the cosine $-\frac{3}{4}$, which corresponds to an angle of 139°; and if we add a second liquid, the expression will become $\frac{-6-C}{8-C}$, which will always indicate an angle less than 180°, as long as C remains less than 1, or as long as the liquid added is less dense than glass. There must, therefore, have been a slight inaccuracy in the observation mentioned by M. Laplace, that the surface of mercury contained in a glass tube becomes hemispherical under water; and if we could obtain an exact measurement of the angle assumed by the mercury under these circumstances, we should at once be able to infer from it the comparative attractive density of water and glass, which has not yet been ascertained, although it might be deduced with equal ease from the comparative height of a portion of mercury contained in two unequal branches of the same tube, observed in the air and under water. The cosine is more exactly $-\cdot735$, in the case of the contact of glass and mercury, and $\frac{2A}{B} = \cdot265$, whence $\frac{A}{B} = \frac{1}{7\cdot55}$, which is a disproportion somewhat greater than that of the specific gravities; but it must probably vary with the various kinds of glass employed.

There is also another mode of determining the angle of contact of a solid with a single liquid, which has been ingeniously suggested by M. Laplace: it is derived from the principle of the invariability of the curvature of the surface at a given elevation; and its results agree with those which we have already obtained, except that it does not appear to be applicable to the case of more than one liquid in contact with the given solid. Supposing a capillary tube to be partially inserted into a liquid, if we imagine it to be continued into a similar tube of the liquid, leaving a cylinder or column of indefinite length in the common cavity, then the action of either tube upon the liquid immediately within it will have no tendency either to elevate or to depress the column; but the attraction of the portion of the tube above the column will tend to raise it with a certain force, and the lower end of the tube will exert an equal force upon the portion of the column immediately below it; and this double force will only be opposed by the single attraction of the liquid continuation of the tube drawing down the column above it, so that the weight of the column suspended will be as the excess of twice the attractive force of the solid above that of the liquid. Now supposing two plates of the solid in question to approach very near each other, so that the elevation may be very great in comparison with the radius of curvature of the surface, which in this case may be considered as uniform, the weight suspended will then be simply as the elevation, which will be the measure of the efficient attractive force, and will vary with it, if we suppose the nature of the solid to vary, the radius of curvature varying in the inverse ratio of the elevation; but the radius of curvature is to half the distance of the plates, as unity to the numerical sine of half the angular extent of the surface, or the cosine of the angle of the liquid, so that this cosine will be inversely as the radius, or directly as the elevation, that is, as the efficient attractive force, which is expressed by $2A - B$ becoming $= -1$ when A vanishes, and consequently being always equal to $\frac{2A-B}{B}$, as we have already found from other considerations. If we wished to extend this mode of reasoning to the effect of a repulsive force counteracting the cohesion, we should only have to suppose the diameter of the tube diminished on each side by the interval which is the limit of the repulsion, since beyond this the repulsion could not interfere with the truth of the conclusions, for want of any particles situated in the given directions near enough to each other to exhibit it; and within the stratum more immediately in contact with the solid, the forces may be supposed to balance each other by continuing their action along its surface until they are opposed by similar forces on the outside of the tube or elsewhere; and indeed such a repulsive stratum seems in many cases to be required for affording a support to the extended surface of the liquid when the solid does not project beyond it. It may also be shown, in a manner nearly similar, by supposing the column to be divided into concentric cylinders, that the superficial curvature of the liquid will not affect the truth of the conclusion.

Cohesion.

Sect. III.—*Forms of Surfaces of Simple Curvature.*

We may now proceed upon the principle admitted by all parties, of a hydrostatic pressure proportional to the curvature of the surface of the liquid, which is equivalent to a uniform tension of that surface, and which either supports the weight or pressure of the fluid within its concavity, or suspends an equal column from its convexity, whether with the assistance of the pressure of the atmosphere, or more simply by the immediate effect of the same cohesion that is capable of retaining the mercury of the barometer in contact with the summit of the tube; and on this foundation we may investigate the properties of the forms assumed by the surface, first considering the cases of simple curvature which are analogous to some of the varieties of the elastic curve, and next those of the surfaces having an axis of revolution, which will necessarily involve us in still more complicated calculations.

A. *Let the height of the curve at its origin be a, the horizontal abscis z, the vertical ordinate y, the sine of the angular elevation of the surface s, the versed sine v, and the rectangle contained by the ordinate and the radius of simple curvature r; then the area of the curve will be rs, and* $y = \sqrt{(a^2 + 2rv)}$.

The fluxion of the curve z is jointly as the radius of curvature $\frac{r}{y}$, and as the fluxion of the angle of elevation, which we may call w, or $dz = \frac{r}{y}\,dw$, and $dx = \sqrt{(1-s^2)}\,dz = \sqrt{(1-s^2)}\frac{r}{y}\,dw$; but $\sqrt{(1-s^2)}\,dw = ds$, consequently $dx = \frac{r}{y}\,ds$, and $y\,dx$, the fluxion of the area, becomes equal to $r\,ds$, and the area itself to rs. In order to

Cohesion. find y, we have $dy = sdz = s\frac{r}{y}dw = \frac{r}{y}dv$; whence $ydy = rdv$, and $y^2 = 2rv + aa$, y becoming equal to a when v vanishes.

It may also be immediately inferred, that the area of the curve must vary as the sine of the inclination of the surface, from considering that, according to the principles of the resolution of forces, the tension being uniform, the weight which it supports must be proportional to that sine.

Scholium. The value of r for water at common temperatures is about one hundredth of a square inch, according to the results of a variety of experiments compared by Dr Young; or, more correctly, if we adopt the more recent measurement of M. Gay Lussac, ·0115; for alcohol M. Gay Lussac's experiments give $r = ·0047$, and for mercury $r = ·0051$. Dr Young had employed ·005 for mercury, a number which appears to be so near the truth that it may still be retained, for the greater convenience of calculation. Hence, in a very wide vessel, the smallest ordinate a being supposed evanescent, and $y = \sqrt{(2rv)} = ·1516\sqrt{v}$, the height of the water rising against the side of the vessel, when $v = 1$, will be ·1516; and the utmost height at which the water will adhere to a horizontal surface, raised above its general level, will be $2\sqrt{r} = ·2145$. For mercury, y becomes in these circumstances $\sqrt{(·0102v)} = ·101\sqrt{v}$, and if $s = ·735$, $v = ·322$, and the depression of the surface in contact with a vertical surface of glass becomes ·0573; and again, when $v = 1·735$, as in the case of a large portion of mercury lying on a plate of glass, the height y is ·133; and if the glass had no attraction at all for mercury, v would become 2, and the height ·1428. The actual tension of the surface of mercury is to that of water as ·0051 × 13·6, or ·06936 to ·0115; that is, a little more than six times as great; while the angle of contact of mercury with glass, which is more attractive than water, would have led us to expect a disproportion somewhat greater. If we take a mean of these results, and estimate it at seven times, the value of $\sqrt{r}$ will be reduced by immersing mercury standing on glass into water in the ratio of $\frac{6}{7} \times \sqrt{\frac{13·6}{12·6}}$, since the buoyant effect of the water increases the value of r, so that $\sqrt{(2r)}$ will be ·09, and the angle approaching to 180°, the height will be about ·127.

B. *When the curve is infinite, the abscis x becomes* $= \frac{1}{2}\sqrt{r}\,\mathrm{HL}\frac{2\sqrt{r} - \sqrt{(4r-yy)}}{2\sqrt{r} + \sqrt{(4r-yy)}} + \sqrt{(4r-y^2)}$, *reckoning from the greatest ordinate $y = 2\sqrt{r}$; and the excess of the length of the curve above the abscis is $2\sqrt{r} - \sqrt{(4r-y^2)}$.*

In this case, a being $= 0$, $y^2 = 2rv$; but $\frac{dx}{dy} = \frac{1-v}{s} = \frac{1-v}{\sqrt{(2v-vv)}} = \frac{2r-2rv}{\sqrt{(4r-2rv)}\sqrt{(2rv)}} = \frac{2r-yy}{\sqrt{(4r-yy)y}}$; and, by the common rules for finding fluents, $x = \frac{2r}{4\sqrt{r}}\mathrm{HL}\frac{2\sqrt{r} - \sqrt{(4r-yy)}}{2\sqrt{r} + \sqrt{(4r-yy)}} + \sqrt{(4r-y^2)}$, which vanishes when $y = 2\sqrt{r}$; and for the length of the curve, since $\frac{dz}{dy} = \frac{1}{s} = \frac{1}{\sqrt{(2v-vv)}} = \frac{2r}{\sqrt{(4r-yy)y}}$; subtracting the former fluxional co-efficient from this, we have $\frac{ydy}{\sqrt{(4r-yy)}}$ for the fluxion of the difference; and the fluent of this is $-\sqrt{4r-y^2}$.

Corollary 1. Hence, where the curve is vertical, we find $x = ·5328\sqrt{r}$; and where the inclination amounts Cohesion. to a second, $x = 11·28\sqrt{r}$; for example, in the case of water, $\sqrt{r}$ being ·1072, the latter value of x will become 1·21, and the former ·056; so that the surface must be considered as sensibly inclined to the horizon at the distance of more than an inch from the vessel, but scarcely at an inch and a half; and for mercury these distances will be two thirds as great. This circumstance must not be forgotten when mercury is employed for an artificial horizon, although, where the vessel is circular, the surface becomes horizontal at its centre; and in other parts the inclination is materially affected by the double curvature.

Corollary 2. The form of the surface coincides in this case with that of an elastic bar or a slender spring of infinite length, supposed to be bent by a weight fixed to its extremity; since the curvature of such a spring must always be proportional to its distance from the vertical line passing through the weight. We may therefore deduce from this proposition the correction required for the length of a pendulum like Mr Whitehurst's, consisting of a heavy ball suspended by a very fine wire. Now the radius of curvature of the spring is $\frac{Maa}{12fy}$ (Art. Bridge, Prop. G); the modulus of elasticity, of which M is the weight, being for iron or steel about 10,000,000 feet in height: and since eighty inches of the wire weighed three grains, the thickness a, supposing it to have been one third or two fifths of the breadth, as is usual in wire flattened for hair springs, must have been about $\frac{1}{375}$ of an inch; the weight f was 12,251 grains; and the weight of M of ten million feet must have been $\frac{3}{80} \times 12 \times 10000000$ grains; consequently, $\frac{Maa}{12fy} = \frac{3 \times 10000000}{80 \times 12251 \times 375 \times 375y} = \frac{1000}{12251 \times 375y} = \frac{1}{4594y}$, which is analogous to $\frac{r}{y}$ in these propositions; consequently $\sqrt{r} = \frac{1}{68}$; and the whole value of $\sqrt{(4r-y^2)}$ from $y = 2\sqrt{r}$ to $y = 0$, is $\frac{1}{34}$ of an inch. Now, supposing the spring to have been firmly fixed at the axis of vibration, the excess of its length above the ordinate will always be measured by $2\sqrt{r} - \sqrt{(4r-y^2)}$; but $\sqrt{(4r-y^2)} = \sqrt{(4r-2rv)} = \sqrt{r}\sqrt{(4-2v)}$, which is the chord of the supplement of the arc of vibration in the circle of which the radius is $\sqrt{r} = \frac{1}{68}$; and the ball will be drawn above its path to a height equal to the distance between this circle and another of twice the diameter, touching it at its lowest point; but a perpendicular falling from this point on the wire would always be found in a circle twice as much curved as the first circle; and if it were made the centre of vibration, the ball would always be raised twice as far above its original path as the distance between the first circle and the second, which is the measure of the effect of the curvature; so that the pendulum must be supposed to be shortened half as much as this; that is, in the present instance, $\frac{1}{136}$ of an inch. If, however, the spring remained, in Mr Whitehurst's experiments, at liberty to turn within the clip, and was firmly fixed at a considerable distance above, the variation of the length must have been only that which belongs to half of the arc of vibration; that is, one fourth as great as in the former case, since the versed sine is initially as the square of the arc; but since it would affect the spring both above and below the clip, it would be doubled from this cause, and would amount to $\frac{1}{272}$ of an inch; so that the true correction would be liable to vary from ·00735 to ·00367, according to the mode of fixing the wire. But since this error must have affected both Mr Whitehurst's pendulums in an equal degree, and the result was deduced from the dif-

Cohesion. ference, and not the proportion of the lengths, it is free from any inaccuracy on this account. The calculation, however, sufficiently proves the necessity of attending to the effect of different modes of fixing the spring, in order that no variation may be made in the different experiments compared without a proper correction. The elasticity of such a wire as Mr Whitehurst employed, could not have produced any sensible error, by co-operating with the force of gravitation, since it did not amount to one two-millionth part of the weight of the ball.

C. *The relation of the ordinate and abscis may be generally expressed by means of an infinite series.*

When the curve is concave towards the abscis throughout its extent, the ordinate may be compared with the lengths of hyperbolic and elliptic arcs, as Maclaurin has shown with respect to the elastic curve (*Fluxions*, § 928): but his solution fails in the more ordinary cases of the problem; and even where it is applicable, the calculation is very little facilitated by it. Segner has made use of two different forms of infinite series, each having its peculiar advantages with respect to convergence in particular cases; and other forms may be found, which will sometimes be more convenient than either of these. The value of the cotangent $\frac{dx}{dy}$ being in general $\frac{1-v}{\sqrt{(2v-vv)}}$ $= \frac{2r-2rv}{\sqrt{(4r-2rv)}\sqrt{(2rv)}} = \frac{2r-yy+aa}{\sqrt{(4r-yy+aa)}} \cdot \frac{1}{\sqrt{(yy-aa)}}$, we may retain either of these fractions, and expand the other by means of the binomial theorem.

1. In the first place, making $4r + a^2 = c^2$, we have $(c^2-y^2)^{-\frac{1}{2}} = \frac{1}{c} + \frac{1}{2}\cdot\frac{y^2}{c^3} + \frac{3}{4\cdot2}\cdot\frac{y^4}{c^5} + \frac{5}{8\cdot2\cdot3}\cdot\frac{y^6}{c^7} + \ldots$, and $\frac{dx}{dy} =$

$$\frac{2r+aa}{\sqrt{(yy-aa)}}\left(\frac{1}{c} + \frac{1}{2}\cdot\frac{y^2}{c^3} + \frac{3}{4\cdot2}\cdot\frac{y^4}{c^5} + \ldots\right) - \frac{1}{\sqrt{(yy-aa)}}\cdot\left(\frac{y^2}{c} + \frac{1}{2}\cdot\frac{y^4}{c^3} + \frac{3}{4\cdot2}\cdot\frac{y^6}{c^5} + \ldots\right).$$

Now, in order to find the fluents of the separate terms, we have first $\int\frac{dy}{\sqrt{(yy-aa)}} = \text{HL}\,(y + \sqrt{[yy-aa]})$; and calling this logarithm L,

$$\int y^2\,\frac{dy}{\sqrt{(yy-aa)}} = \frac{y}{2}\sqrt{(y^2-a^2)} + \frac{a^2}{2}\,\text{L};$$

$$\int y^4\,\frac{dy}{\sqrt{(yy-aa)}} = \left(\frac{y^3}{4} - \frac{3a^2y}{8}\right)\sqrt{(y^2-a^2)} + \frac{3a^4}{8}\,\text{L};$$

$$\int y^6\,\frac{dy}{\sqrt{(yy-aa)}} = \left(\frac{y^5}{6} - \frac{5a^2y^3}{24} + \frac{5a^4y}{16}\right)\sqrt{(y^2-a^2)} + \frac{5a^6}{16}\,\text{L};$$ and

$$\int y^8\,\frac{dy}{\sqrt{(yy-aa)}} = \left(\frac{y^7}{8} - \frac{7a^2y^5}{8\cdot6} + \frac{7\cdot5a^4y^3}{8\cdot6\cdot4} - \frac{7\cdot5\cdot3a^6y}{8\cdot6\cdot4\cdot2}\right)\sqrt{(y^2-a^2)} + \frac{7\cdot5\cdot3a^8}{8\cdot6\cdot4\cdot2}\,\text{L}:$$

whence by substitution we have

$$x = \frac{2r+aa}{4r+aa}\,\text{L} + \left(\frac{2r+aa}{2(4r+aa)^3} + \frac{1}{4r+aa}\right)\cdot\left(\frac{y}{2}\sqrt{[y^2-a^2]} + \frac{a^2}{2}\,\text{L}\right) + \ldots\ldots$$

2. If we reduce $\frac{1}{\sqrt{(yy-aa)}}$ into a series, we have $\left(1-\frac{aa}{yy}\right)^{-\frac{1}{2}} = 1 + \frac{1}{2}\frac{a^2}{y^2} + \frac{3}{4\cdot2}\cdot\frac{a^4}{y^4} + \frac{5}{8\cdot2\cdot3}\cdot\frac{a^6}{y^6} + \ldots$, and $\frac{dx}{dy} = \frac{2r+aa-yy}{\sqrt{(cc-yy)}}\cdot\left(\frac{1}{y} + \frac{1}{2}\cdot\frac{a^2}{y^3} + \frac{3}{4\,2}\cdot\frac{a^4}{y^5} + \ldots\right)$. Cohesion.

Then, for the fluents,

$$\int\frac{ydy}{\sqrt{(cc-yy)}} = \sqrt{(c^2-y^2)}; \int\frac{dy}{y\sqrt{(cc-yy)}} = \text{HL}\,\frac{c-\sqrt{(cc-yy)}}{c+\sqrt{(cc-yy)}} = \text{L};$$

$$\int\frac{dy}{y^3\sqrt{(cc-yy)}} = -\frac{\sqrt{(cc-yy)}}{2c\,cyy} - \frac{1}{2cc}\,\text{L};$$

$$\int\frac{dy}{y^5\sqrt{(cc-yy)}} = \left(-\frac{1}{4c^2y^4} + \frac{3}{8c^4y^2}\right)\sqrt{(c^2-y^2)} + \frac{3}{8c^4}\,\text{L};$$

$$\int\frac{dy}{y^7\sqrt{(cc-yy)}} = \left(-\frac{1}{6c^2y^6} + \frac{5}{24c^4y^4} - \frac{5}{16c^6y^2}\right)\sqrt{(c^2-y^2)} - \frac{5}{16c^6}\,\text{L};$$ and by combining these fluents we obtain a second series for x.

3. These series may be employed with advantage where the initial ordinate is very small, the one being more convenient for the upper, and the other for the lower part of the curve; but where the elevation a is more considerable, the form of the curve will be more readily determined by means of fluents derived from circular arcs. Beginning with the expressions $\frac{dx}{dy} = \frac{1-v}{\sqrt{(2v-vv)}}$, and $y^2 = a^2 + 2rv$, we may seek for a value of x in terms of v; and since $2ydy = 2rdv$, $dy = \frac{r}{y}dv = \frac{rdv}{\sqrt{(aa+2rv)}}$, and $dx = \frac{1-v}{\sqrt{(2v-vv)}}\cdot\frac{rdv}{\sqrt{(aa+2rv)}}$. The binomial $(aa+2rv)^{-\frac{1}{2}}$ may then be expanded into a series of integral powers of v, and the fluents may be found by means of the equations $\int\frac{dv}{\sqrt{(2v-vv)}} = \int\frac{dv}{s} = w$, the arc of which v is the versed sine; $\int\frac{vdv}{s} = s - w$;

$$\int\frac{v^2dv}{s} = \left(\frac{v}{2} - \frac{3}{4}\cdot2\right)s + \frac{3}{8}\cdot4\,w; \int\frac{v^3dv}{s} = \left(\frac{v^2}{3} - \frac{5}{24}\cdot4v + \frac{5}{16}\cdot8\right)s - \frac{5}{16}\cdot8w; \text{ and } \int\frac{v^4dv}{s} = \left(\frac{v^3}{4} - \frac{7}{8\cdot6}\cdot4v^2 + \frac{7\cdot5}{8\cdot6\cdot4}\cdot8v - \frac{7\cdot5\cdot3}{8\cdot6\cdot4\cdot2}\cdot16\right)s + \frac{7\cdot5\cdot3}{8\cdot6\cdot4\cdot2}\cdot16w.$$

4. Another series may be obtained by the expansion of $\frac{1}{\sqrt{(2v-vv)}}$ into $\frac{1}{\sqrt{(2v)}}\cdot\left(1+\frac{1}{4}v+\frac{3}{8\cdot2}v^2+\frac{5}{16\cdot2\cdot3}v^3+\ldots\right)$, whence $\frac{dx}{dy} = \left(1-\frac{yy-aa}{2r}\right)\sqrt{\frac{r}{yy-aa}}\times\left(1+\frac{1}{4}\frac{yy-aa}{2r}+\frac{3}{8\cdot2}\left(\frac{yy-aa}{2r}\right)^2+\ldots\right)$: the fluxions belonging to the series $(y^2-a^2)^{-\frac{1}{2}}dy$, $(y^2-a^2)^{\frac{1}{2}}dy$, $(y^2-a^2)^{\frac{3}{2}}dy$; and the fluents of these are

$\text{HL}\,(y+\sqrt{[y^2-a^2]}) = \text{L}$; $\frac{1}{2}y\sqrt{(y^2-a^2)} - \frac{1}{2}a^2\,\text{L}$; $(\frac{1}{4}\sqrt{(y^2-a^2)} + \frac{3}{8}a^2)\,y\sqrt{(y^2-a^2)} + \frac{3a^4}{8}\,\text{L}$; which afford a result somewhat resembling that which is deduced from the first method.

Cohesion.

5. We may also express x in a series of integral powers of y only, if we suppose it to begin at some point in which the curve is inclined to the horizon, where the height is p, calling it at other points $p + y$; and making $\frac{dx}{dy} = r = a + by + cy^2 + \ldots$; we have then $x = \beta + ay + \frac{1}{2}by^2 + \frac{1}{3}cy^3 + \ldots$, and the area $\int (p + y)\, dx = \gamma + pay + \frac{1}{2}pby^2 + \ldots + \frac{1}{2}ay^2 + \frac{1}{2\cdot 3}by^3 + \frac{1}{3\cdot 4}cy^4 + \ldots$, which must be equal to rs (Prop. A.): but $s = \frac{dy}{\sqrt{(dx^2 + dy^2)}} = \frac{1}{\sqrt{(1 + rr)}}$, which may be developed by means of the Taylorian theorem $\varphi(A + H) = \varphi A + \frac{d(\varphi A)}{dA} H + \frac{d^2(\varphi A)}{dA^2} \cdot \frac{H^2}{2} + \ldots$, taking $A = a$, and $H = by + cy^2 + \ldots$, whence $H^2 = b^2y^2 + 2bcy^3 + (2bd + c^2)y^4 + \ldots$ $H^3 = b^3y^3 + 3b^2cy^4 + \ldots$; consequently $rs = r\varphi a \ldots$

$$= \frac{r}{\sqrt{(1 + aa)}} + \frac{r}{da} \cdot d \frac{1}{\sqrt{(1 + aa)}} (by + cy^2 + dy^3 + ey^4 + \ldots)$$
$$+ \frac{r}{2da^2} \cdot d^2 \frac{1}{\sqrt{(1 + aa)}} \cdot (b^2y^2 + 2bcy^3 (2bd + c^2)y^4 + \ldots)$$
$$+ \frac{r}{2\cdot 3da^3} \cdot d^3 \frac{1}{\sqrt{(1 + aa)}} (b^3y^3 + 3b^2cy^4 + \ldots)$$
$$= \gamma + pay + (\tfrac{1}{2}pb + \tfrac{1}{2}a)y^2 + (\tfrac{1}{3}pc + \tfrac{1}{6}b)y^3 + \ldots;$$

and hence by comparing the homologous terms, we find $\gamma = \frac{r}{\sqrt{(1 + aa)}}$, $\frac{r}{da} \cdot d \frac{1}{\sqrt{(1 + aa)}} \cdot b = pa = \frac{-ra}{(1 + aa)^{\frac{3}{2}}} \cdot b$, and $b = -\frac{p}{r}(1 + aa)^{\frac{3}{2}}$; and in a similar manner we may determine the subsequent co-efficients; but the calculation is somewhat laborious, and has no particular advantages.

6. We may still more readily obtain a similar series for y in terms of the powers of x with constant co-efficients; calling $\frac{dy}{dx}$, t, and making $t = bx + cx^2 + dx^5 + \ldots$ whence $y = a + \frac{1}{2}bx^2 + \frac{1}{4}cx^4 + \frac{1}{6}dx^6 + \ldots$, and the area $\int y dx = ax + \frac{1}{2\cdot 3}bx^3 + \frac{1}{4\cdot 5}cx^5 + \ldots = rs = \frac{rt}{\sqrt{(1 + tt)}} = rt(1 - \frac{1}{2}t^2 + \frac{3}{4\cdot 2}t^4 - \frac{3\cdot 5}{8\cdot 2\cdot 3}t^6 + \ldots)$. But $t^3 = b^3x^3 + 3b^2cx^5 + \ldots$ and $t^5 = b^5x^5 + \ldots$: hence we have the equation

$$\frac{ax}{r} + \frac{1}{2\cdot 3r}bx^3 + \frac{1}{4\cdot 5r}cx^5 + \ldots =$$
$$bx + cx^3 + dx^5 + \ldots$$
$$- \tfrac{1}{2}b^3x^3 - \tfrac{1}{2} \cdot 3b^2cx^5 - \ldots$$
$$+ \tfrac{3}{8}b^5x^5 + \ldots;$$

consequently $b = \frac{a}{r}$, $c = \frac{1}{2\cdot 3r}b + \frac{1}{2}b^3$, and $d = \frac{1}{4\cdot 5r}c + \frac{5}{2}b^2c - \frac{3}{8}b^5$.

It is the less necessary to enter into any further detail of these results, as we have a table calculated by Segner, with his son's assistance, which is sufficient to afford us a general idea of the forms of the curve in different circumstances. The unit of this table is the quantity $\sqrt{r}$, which Segner calls the modulus of capillary attraction, and which for water is ·1072 inch. The table begins with the extreme ordinate, where the curve is vertical: we have then the least ordinate, a; the greatest ordinate, where the curve again becomes horizontal; and the abscis corresponding to the extreme ordinate and to the greatest ordinate.

Cohesion.

Extreme Ordinate.	Least Ordinate.	Greatest Ordinate.	Greatest Abscis.	Terminal Abscis.
$100\sqrt{r}$	99·99	100·01	·01	·000001
90	89·99	90·01	·01	·000002
80	79·99	80·01	·01	·000003
70	69·99	70·01	·01	·000004
60	59·99	60·02	·02	·000007
50	49·98	50·02	·02	·00001
45	44·98	45·02	·02	·00002
40	39·97	40·02	·02	·00003
35	34·97	35·03	·03	·00004
30	29·96	30·03	·03	·00006
25	24·96	25·04	·04	·0001
20	19·95	20·05	·05	·0002
15	14·93	15·07	·07	·0004
10	9·90	10·10	·10	·001
9	8·89	9·11	·11	·002
8	7·87	8·12	·13	·003
7	6·85	7·14	·14	·004
6	5·83	6·16	·17	·007
5	4·79	5·19	·21	·01
4	3·74	4·24	·26	·02
3	2·64	3·32	·37	·06
2	1·41	2·45	·65	·22
1·9	1·27	2·37	·71	·27
1·8	1·11	2·29	·79	·33
1·7	·94	2·21	·91	·47
1·6	·75	2·13	1·10	·65
1·5	·50	2·06	1·40	·96
1·47	·40	2·04	1·64	1·18
1·445	·30	2·02	1·86	1·44
1·428	·20	2·01	2·24	1·82
1·418	·10	2·003	2·92	2·49
1·4142	·01	2·000	5·22	4·80
1·4142	·001	2·0000	7·52	7·09
1·4142	·0001	2·0000	9·82	9·39
1·4142	·00001	2·0000	12·12	11·70
1·4142	·000001	2·0000	14·43	14·00

It may be observed that the last six values of the least ordinate are in geometrical progression, while the abscis increases in arithmetical progression; the difference of the abscisses 2, 3, being the hyperbolical logarithm of 10, which is the common multiplier of the ordinates. Although the table appears to be generally accurate, yet we cannot always depend on the last figures. Thus the ultimate difference of the two last columns is made ·43, while it ought to be ·53 (Prop. B. Cor. 1). It is scarcely necessary to remark, that if we look in the fourth column for half the distance between two parallel planes of glass, in a vertical position, the first and second columns will give us the height to which water will rise between them, where it touches the glass, and in the middle of the interval.

Sect. IV.—*Surfaces of Double Curvature.*

When the liquid is contained in a tube, or when it forms itself spontaneously into a drop having an axis of revolution, it becomes necessary to consider the effect of the

Conesion. tension in a direction transverse to that of the principal section; since the curvature will cause it to exhibit an equal pressure, whatever the direction of the section to which it belongs may be; and the curvatures of the sections perpendicular to each other will either co-operate with or counteract each other, according as the convexities of both are on the same side, or on the opposite sides, of the surface. But the simple consideration of the tension supporting the weight of the parts below, or the equivalent pressure in a contrary direction, will at once afford us the equations necessary for the solution of the problem, without any immediate reference to the curvature in question.

D. *The form of a surface of revolution may be determined by means of an infinite series.*

The fluxion of the weight or mass of the parts contained within the cylindrical surface, of which x is the radius or abscis, and y the ordinate, being always proportional to $yx\dot{x}$, and the fluent to $\int yx\dot{x}$; and the extent of the circumference supporting it varying also as x, and the contractile force being diminished when reduced to the direction of gravitation, in the ratio of the radius unity to the sine of the elevation s, it will always be proportional to xs; so that we have the general equation $\int yx\dot{x} = mxs$. Now if we suppose y incomparably greater than x, and the surface extremely minute, the variation of y may be neglected, and we have in this case $\int yx\dot{x} = \frac{1}{2}yx^2$; and supposing also $s = 1$, and the curve vertical, $\frac{1}{2}yx^2 = mx$, and $\frac{1}{2}yx = m$, x becoming also equal to the radius of curvature. But it is easy to perceive that the height y must be twice as great, for any value of x, as in the case of a simple curvature, since each portion of the circumference has here only to support a wedge, which is only half as heavy as a parallelopiped of the same height; so that $\frac{1}{2}yx$ will be equal to yx in Proposition A, and $m = r$.

In order to obtain a series for finding y from the equation $\int yx\dot{x} = mxs$, we may put the tangent $t = \frac{\dot{y}}{\dot{x}} = bx + cx^3 + dx^5 + \&c.$, whence $y = a + \frac{1}{2}bx^2 + \frac{1}{4}cx^4 + \frac{1}{6}dx^6 + \&c.$, and $\int yx\dot{x} = \frac{1}{2}ax^2 + \frac{1}{2\cdot4}bx^4 + \frac{1}{4\cdot6}cx^6 + \frac{1}{6\cdot8}dx^8 + \&c.$; and the value of $s = \frac{t}{\sqrt{(1+tt)}}$ being expanded into a series, as in Proposition C, n 6, calling $\frac{1}{m}$, or $\frac{1}{r}$, q, we find

$$s = \frac{q}{x}\int yx\dot{x} = bx + cx^3 + dx^5 + cx^7 + \&c.$$
$$- \tfrac{1}{2}b^3x^3 - \tfrac{1}{2}\cdot3\,b^2cx^5 - \tfrac{1}{2}\left\{\frac{3\,b^2d}{3\,bc^2}+\right\}x^7 + \&c.$$
$$+ \tfrac{5}{8}\,b^5\,x^5 + \tfrac{5}{6}\cdot5\,b^4c\,x^7 + \&c.$$
$$- \tfrac{5}{16}\,b^7\,x^7 - \&c.$$
$$= \tfrac{1}{2}\,qax + \frac{1}{2\cdot4}\,qbx^3 + \frac{1}{4\cdot6}\,qcx^5 + \frac{1}{6\cdot8}\,qdx^7 + \&c.;$$

consequently $b = \frac{1}{2}qa = \frac{a}{2r}$, and $a = \frac{2b}{q} = 2rb$; and by continuing the calculation, and reducing the values, we find

$$c = \frac{1}{2\cdot4}qb + \tfrac{1}{2}b^3$$
$$d = \frac{1}{2\cdot4^2\cdot6}q^2b + \frac{10}{2\cdot4\cdot6}qb^3 + \frac{3}{2\cdot4}b^5$$
$$e = \frac{1}{2\cdot4^2\cdot6^2\cdot8}q^3b + \frac{82}{2\cdot4\cdot6^2\cdot8}q^2b^3 + \frac{105}{2\cdot4\cdot6\cdot8}qb^5 + \frac{15}{2\cdot4\cdot6}b^7$$
$$f = \frac{1}{2\cdot4^2\cdot6^2\cdot8^2\cdot10}q^4b + \frac{652}{2\cdot4\cdot6^2\cdot8^2\cdot10}q^3b^3 + \frac{2645}{2\cdot4\cdot6\cdot8^2\cdot10}q^2b^5 + \frac{1260}{2\cdot4\cdot6\cdot8\cdot10}qb^7 + \frac{105}{2\cdot4\cdot6\cdot8}b^9$$
$$g = \frac{1}{2\cdot4^2\cdot6^2\cdot8^2\cdot10^2\cdot10}q^5b + \frac{5197}{2\cdot4\cdot6^2\cdot8^2\cdot10^2\cdot12}q^4b^3 + \frac{59855}{2\cdot4\cdot6\cdot8^2\cdot10^2\cdot12}q^3b^5 + \frac{70522\cdot5}{2\cdot4\cdot6\cdot8\cdot10^2\cdot10}q^2b^7 + \frac{17325}{2\cdot4\cdot6\cdot8\cdot10\cdot12}qb^9 + \frac{945}{2\cdot4\cdot6\cdot8\cdot10}b^{11}$$
$$h = \frac{1}{2\cdot4^2\cdot6^2\cdot\cdot12^2\cdot14}q^6b + \frac{41800}{2\cdot4\cdot6^2\cdot8^2\cdot\cdot12^2\cdot14}q^5b^3 + \frac{1303034}{2\cdot4\cdot6\,8^2\cdot10^2\cdot12^2\cdot14}q^4b^5 + \&c.$$
$$i = \frac{1}{2\cdot4^2\cdot6^2\cdot\cdot14^2\cdot16}q^7b + \frac{339412}{2\cdot4\cdot6^2\cdot8^2\cdot\cdot14^2\cdot16}q^6b^3 + \&c.$$
$$k = \frac{1}{2\cdot4^2\cdot6^2\cdot\cdot16^2\cdot18}q^8b + \frac{2779888}{2\cdot4\cdot6^2\cdot8^2\cdot\cdot16^2\cdot18}q^7b^3 + \&c.$$
$$l = \frac{1}{2\cdot4^2\cdot6^2\cdot\cdot18^2\cdot20}q^9b + \frac{22941328}{2\cdot4\cdot6^2\cdot8^2\cdot\cdot18^2\cdot20}q^8b^3 + \&c.$$

We may here observe, that the numerical co-efficients of the highest powers of b form the series $\frac{1}{2}$,

$$\frac{3}{2\cdot4},\ \frac{3\cdot5}{2\cdot4\cdot6},\ \frac{3\cdot5\cdot7}{2\cdot4\cdot6\cdot8},\ \frac{6}{6},\ \frac{3\cdot5\cdot7\cdot9}{2\cdot4\cdot6\cdot8\cdot10},\ \frac{8}{6};$$

the ratio of the successive terms of both continually approaching to equality, and those of the next in order the series $\frac{3}{2\cdot4},\ \frac{2}{6},\ \frac{3\cdot5}{2\cdot4\cdot6},\ \frac{4}{6},\ \frac{3\cdot5\cdot7}{2\cdot4\cdot6\cdot8}$; but the laws of the numerical co-efficients in general appear to be wholly incapable of being reduced to any simple form. It will be convenient for calculation to form tables of the logarithmic values of these co-efficients, which may be continued by means of successive differences, for as many terms as are requisite for any practical purpose. The indices, with lines drawn over them, are to be considered as negative numbers.

Logarithmic Co-efficients of the Value of the Sine.

$s = ($
$+ \overline{1}.\ 0969100\ qx^2$
$+ \overline{3}.\ 7166987\ q^2x^4$
$+ \overline{4}.\ 0354574\ q^3x^6$
$+ \overline{6}.\ 1323674\ q^4x^8$
$+ \overline{8}.\ 0531861\ q^5x^{10}$
$+ \overline{11}.\ 8278768\ q^6x^{12}$
$+ \overline{13}.\ 4776288\ q^7x^{14}$
$+ \overline{15}.\ 0182362\ q^8x^{16}$
$+ \overline{18}.\ 4619336\ q^9x^{18}$
$+ \overline{21}.\ 8184809\ q^{10}x^{20}$
$+ \ldots)\ bx$
$+ \overline{2}.\ 3187587\ qx^2$
$+ \overline{3}.\ 6375174\ q^2x^4$
$+ \overline{4}.\ 6482413\ q^3x^6$
$+ \overline{5}.\ 4694937\ q^4x^8$
$+ \overline{6}.\ 1456895\ q^5x^{10}$
$+ \overline{8}.\ 7008651\ q^6x^{12}$
$+ \overline{9}.\ 1510234\ q^7x^{14}$
$+ \overline{11}.\ 5080209\ q^8x^{16}$
$+ \overline{13}.\ 7811595\ q^9x^{18}$
$+ \overline{15}.\ 9774\ldots\ q^{10}x^{20}$
$+ \overline{16}.\ 1026\ldots\ q^{11}x^{22}$
$+ \overline{18}.\ 160\ldots.\ q^{12}x^{24}$
$+ \overline{20}.\ 16\ldots..\ q^{13}x^{26}$
$+ \overline{22}.\ 10\ldots..\ q^{14}x^{28}$
$+ \overline{24}.\ 0\ldots\ldots\ q^{15}x^{30}$
$+ \ldots)\ b^3x^3$
$+ (\overline{3}.\ 8927900\ qx^2$
$+ \overline{3}.\ 5337080\ q^2x^4$
$+ \overline{4}.\ 8558231\ q^3x^6$
$+ \overline{5}.\ 9851885\ q^4x^8$
$+ \overline{6}.\ 9727959\ q^5x^{10}$
$+ \overline{7}.\ 82\ldots..\ q^6x^{12}$
$+ \overline{8}.\ 57\ldots..\ q^7x^{14}$
$+ \overline{9}.\ 27\ldots..\ q^8x^{16}$
$+ \overline{11}.\ 97\ldots..\ q^9x^{18}$
$+ \overline{12}.\ 77\ldots..\ q^{10}x^{20}$
$+ \ldots)\ b^5x^5$
$+ (\overline{3}.\ 5917600\ qx^2$
$+ \overline{3}.\ 4368580\ q^2x^4$
$+ \overline{4}.\ 9595058\ q^3x^6$
$+ \ldots\ b^7x^7$
$+ \overline{3}.\ 3576767\ qx^2$
$+ \overline{3}.\ 3498514\ q^2x^4$
$+ \ldots)\ b^9x^9$
$+ (\overline{3}.\ 1657913\ qx^2$
$+ \ldots)\ b^{11}x^{11}$
$+\ .$

Cohesion.

Logarithmic Co-efficients of the Value of the Ordinate y.

$$y = \left[\frac{2b}{q}\right] + 0{\cdot}6989700$$
$$+ \overline{2}.\ 4948500\ qx^2$$
$$+ \overline{4}.\ 9385474\ q^2x^4$$
$$+ \overline{5}.\ 1323674\ q^3x^6$$
$$+ \overline{7}.\ 1323674\ q^4x^8$$
$$+ \overline{10}.\ 9740048\ q^5x^{10}$$
$$+ \overline{12}.\ 6817488\ q^6x^{12}$$
$$+ \overline{14}.\ 2735087\ q^7x^{14}$$
$$+ \overline{17}.\ 7629636\ q^8x^{16}$$
$$+ \overline{19}.\ 1609036\ q^9x^{18}$$
$$+ \ldots)\ bx^2$$
$$+ (\overline{1}.\ 0969100$$
$$+ \overline{2}.\ 5406074\ qx^2$$
$$+ \overline{3}.\ 6482413\ q^2x^4$$
$$+ \overline{4}.\ 5486749\ q^3x^6$$
$$+ \overline{5}.\ 2918175\ q^4x^8$$
$$+ \overline{7}.\ 9049851\ q^5x^{10}$$
$$+ \overline{8}.\ 4062959\ q^6x^{12}$$
$$+ \overline{10}.\ 8090509\ q^7x^{14}$$
$$+ \overline{11}.\ 1235822\ q^8x^{16}$$
$$+ \overline{13}.\ 3576 \ldots q^9x^{18}$$
$$+ \overline{15}.\ 5176 \ldots q^{10}x^{20}$$
$$+ \overline{17}.\ 607 \ldots . q^{11}x^{22}$$
$$+ \overline{19}.\ 637 \ldots . q^{12}x^{24}$$
$$+ \overline{21}.\ 60 \ldots . . q^{13}x^{26}$$
$$+ \overline{23}.\ 5 \ldots . . q^{14}x^{28}$$
$$+ \ldots .)\ b^3x^4$$
$$+ \overline{2}.\ 7958800$$
$$+ \overline{2}.\ 5337080\ qx^2$$
$$+ \overline{3}.\ 9350043\ q^2x^4$$
$$+ \overline{3}.\ 1313165\ q^3x^6$$
$$+ \overline{4}.\ 1769159\ q^4x^8$$
$$+ \overline{5}.\ 08 \ldots . . q^5x^{10}$$
$$+ \overline{7}.\ 87 \ldots . . q^6x^{12}$$
$$+ \overline{8}.\ 51 \ldots . . q^7x^{14}$$
$$+ \overline{9}.\ 35 \ldots . . q^8x^{16}$$
$$+ \overline{10}.\ 18 \ldots . . q^9x^{18}$$
$$+ \ldots .)\ b^5x^6$$
$$+ \overline{2}.\ 5917600$$
$$+ \overline{2}.\ 6709412\ qx^2$$
$$+ \overline{2}.\ 1056338\ q^2x^4$$
$$+ \ldots .)\ b^7x^8$$
$$+ (\overline{2}.\ 4368579$$
$$+ \overline{2}.\ 4959794\ qx^2$$
$$+ \ldots .)\ b^9x^{10}$$
$$+ (\overline{2}.\ 3119193$$
$$+ \ldots .)\ b^{11}x^{12}$$
$$+ \ldots$$

E. *The elevation or depression of a liquid contained in a given tube may be found by reversing the series.*

Having a given value of x, the semidiameter of the tube, and also of s, the elevation or depression of the surface of the liquid at the point of contact with the solid, we obtain an equation of the form $s = Ab + Bb^3 + Cb^5 + \ldots$; and from this we may determine the central elevation or depression $a = 2rb$ by the well-known method of the reversion of series, which give as the value $b = \frac{1}{A}s - \frac{B}{A^4}s^3 - \left(\frac{C}{A^6} - \frac{3B^2}{A^7}\right)s^5 - \left(\frac{D}{A^8} - \frac{sBC}{A^9} + \frac{12B^3}{A^{10}}\right)s^7 - \ldots$. But it is more convenient to assume an approximate value of b, a little less than $\frac{s}{A}$, and to find the corresponding value of s; then, since $ds = Ad\,b + Bb^2d\,b + 5C\,b^4d\,b + \ldots$, if we make $Ab + 3B\,b^3 + 5C\,b^5 + \ldots = \Sigma$, we shall have $\frac{ds}{db} = \frac{\Sigma}{b}$; consequently the small increments of s and b will be to each other as Σ to b, and we obtain the correction of b from the error of the calculated value of s; and if the calculation be repeated with the corrected value of b, the second result will always be sufficiently near to the truth.

In order to judge of the accuracy of this mode of calculation, which M. Laplace appears to have thought liable to some undefined objection, it will be necessary to enter into the details of its different elements, which will sufficiently show the degree of convergence of the series, and the greatest possible amount of error.

Values of the Co-efficients of s for Tubes of different Diameters, r being ·005, *and* $s = {\cdot}75$.

D = 2x	s = bx ×	+ b³x³ ×	+ b⁵x⁵ ×	+ b⁷x⁷ ×
1·0	47·176	7190		
·8	15·774	274		
·6	5·737	13·214	200	
·4	2·399	·8556	1·625	
·2	1·2717	·06311	·03693	·0311
·1	1·0638	·01155	·00486	·00278

Hence if

b =	s =
0·3073	·7248 + ·0252
·1147	·7237 + ·0265
·4160	·7160 + ·0254 + ·0060 + [·0026]
1·503	·7211 + ·0240 + ·0041 + [·0010]
5·776	·7345 + ·0122 + ·0024 + ·0007 + [·0003]
14·004	·7449 + ·0040 + ·0008 + ·0002 + [·0001]

It appears, upon inspection of this table, that the co-efficients of bx alone always determine $\frac{29}{30}$ of the value of the quantity required, and these are easily calculated with perfect accuracy, so that the error must always be far less than $\frac{1}{30}$, and in fact the actual uncertainty never exceeds $\frac{1}{1000}$ of the whole, at least in the last four examples. The differences of M. Laplace's approximatory calculations from these results are incomparably greater, so that we cannot hesitate to consider these differences as errors. Indeed, when we recollect that in the method employed by M. Bouvard, under M. Laplace's directions, the radius of curvature of each of the small portions into which the curve has been cut up, has been determined from the ordinate at the beginning of the portion, it is obvious that the curvature thus found must be less than the truth, and that in order to obtain any required curvature of the whole surface, the depression must be increased in the same proportion; and there is no ready way of appreciating the amount of this error. Dr Young had before attempted to avoid it, in making an estimate of the same nature, by calculating for the middle of each portion; but, from some accident, the numbers of his table, published in 1807, are generally a little too small, although the method which he then employed is nearly the same as that which M. Laplace afterwards adopted, except that for the lowest portion of the curve M. Laplace had recourse to an infinite series, applicable only to that part. The elements deduced in Nicholson's *Journal* for 1809, from M. Gay Lussac's experiments, which are $r = {\cdot}0051$ and $s = {\cdot}7353$, agree better with the numbers found in M. Laplace's table, than those from which it was constructed, which were $r = {\cdot}005038$ and $s = {\cdot}729$; the depressions being always a little larger than the true results from the elements assumed.

The value of the ordinate y depends also principally on the first variable member of the series, although the subsequent co-efficients are not so inconsiderable as in the determination of the sine. Thus, taking $x = {\cdot}2$, and $b = 1{\cdot}503$, we have $y = a + {\cdot}813\ bx^2 + {\cdot}99\ b^3x^4 + 2{\cdot}97\ b^5x^6 + \ldots = {\cdot}01503 + {\cdot}0489 + {\cdot}0054 + {\cdot}0015 + [{\cdot}0006] = {\cdot}0714$, which is the marginal depression, leaving ·0564 for the height of the convex portion $y - a$. We may determine the effect of any small variations in this height, in the same manner as that of the sine of the inclination; supposing them to depend on a change of the angle of contact only, the quantity r remaining unaltered, it is obvious that q and x must retain their value, while y and b only vary, and making $Y = Ab + 3Bb^3 + \ldots = b\frac{d(y-a)}{db}$, we have $Y : b = d(y-a) : db$. In the present instance, we find $Y = {\cdot}0489 + 3 \times {\cdot}0054 + 5 \times {\cdot}0015 + \ldots = {\cdot}079$; and supposing, as in the example suggested by M. Laplace, the variation of the height $y - a$ to be ·00394, which is $\frac{1}{20}$th of Y, that of b will be $\frac{1}{20}$th of b, or ·075, and the variation of the central depression a, ·00075, which is somewhat less than one fifth of the alteration in

Cohesion || Cohorn.

the height of the convex portion; but in smaller tubes it is obvious that the variations of the depression a might much exceed that of the height of the convex portion. Nothing can be easier or more direct than this part of the calculation; and it is remarkable that M. Laplace should have considered the awkward contrivance of building up a curve, like the arch of a bridge, with fourteen blocks on each side, as possessing any thing like an "advantage" over the series in the determination of this variation.

If we wish to find the effect of a small variation of the diameter of a tube, from D to D $\pm$ D', on the depression a of the mercury contained in it, we may use for the interpolation the formula $\frac{a'}{a} = 10^{\frac{CD'}{}} - 1$, C being about 2·9 for tubes between 1 inch and $\frac{1}{5}$th of an inch in diameter, and being elsewhere easily deduced from the depressions already known. For variations of the cohesive power, and of its measure r, we may suppose the whole of the numbers of the table to be altered in the proportion of the supposed alteration of $\sqrt{r}$, and the change produced by restoring the diameter to its former dimensions may then be calculated like any other interpolation. There is also a more comprehensive formula, which seems to express the depression in tubes of all sizes with great accuracy; it is this, $a = \frac{\cdot 015}{D + 48 D^{3\cdot 492 + 3\cdot 26 D}}$: and it might even be possible to shorten the original calculation by a comparison of the series with the expansion of this empirical formula, if it were of any farther importance to facilitate the mode of computation. But for all practical purposes, it will be sufficient to collect the results already obtained into a comparative table, arranged in chronological order; and it is remarkable, that they are all comprehended, without any material exception, between the two values assigned to each as near the truth in Dr Young's first table, the mean of those values never differing a thousandth of an inch from the result of the more correct calculation; while the error of Lord Charles Cavendish's experiments, notwithstanding their general accuracy, sometimes amounts to nearly one hundredth. (T. Y.)

Cohesion || Cohort

Table of the Depression of Mercury in Glass Tubes.

Diameter.	CENTRAL DEPRESSION										Marginal Depression.	Difference.	Diameter.
	Observed by Ld Cavendish.	Dr Young, Phil. Trans. 1805.		Laplace, 1806.	Dr Young, 1807.	Nicholson's Journal, 1809.		Laplace, 1810.	Correct Calculation.		Empirical Formula.	Nich. 1809.		
						$r = 005$ $s = 750$	$r = 0051$ $s = 7555$		$r = 005$ $s = 750$	$r = 005038$ $s = 729$		$r = 005$ $s = 750$		
Inches.		Diagr.	Form.											
1·00						·00031	·00032		·0003073	·000307	·00031			1·00
·90						·00060	·00062				·00059			·90
·80						·00115	·00118	·00128	·001147	·001144	·00112			·80
·70						·00220	·00224	·00244			·00220			·70
·60	·005	·005		·0038	·0045	·00411	·00416	·00462	·004160	·04128	·00421	·0637	·0596	·60
·50	·007	·007	·008		·0074	·00799	·00805	·00868			·00799	·0676	·0596	·50
·45					·0100	·01100	·01106	·01174			·01099	·0690	·0580	·45
·40	·015	·012	·017	·0136	·0139	·01516	·01522	·01591	·01503	·01486	·01495	·0714	·0562	·40
·35	·025	·017	·024		·0196	·02093	·02098	·02165			·02082	·0745	·0536	·35
·30	·036	·027	·033		·0280	·02902	·02906	·02965			·02881	·0787	·0497	·30
·25	·050	·038	·044		·0404	·04064	·04067	·04117			·04025	·0850	·0444	·25
·20	·067	·056	·064		·0589	·05800	·05802	·05798	·05776	·05696	·05771	·0966	·0386	·20
·15	·092	·085	·088		·0880	·08620	·08621	·08538			·08568	·1171	·0309	·15
·10	·140	·140	·140		·1424	·14027	·14027	·13940	·14004	·13726	·14002	·1619	·0216	·10
·05					·2964	·29497	·29497				·29502	·3060	·0110	·05

COHOBATION, a term invented by Paracelsus to denote the repeated distillation of the same liquor from the same materials.

COHORN, Menno, Baron de (1641–1704), the rival and contemporary of Vauban, was born at Leeuwarden, in Friesland. He inherited a taste for military science from his father; and having studied mathematics at Franeker, under his uncle Fullenius, he entered the service as captain when only sixteen. Having distinguished himself at the siege of Maëstricht, and afterwards at the battles of Senef, Cassel, St Denis, and Fleurus, he was promoted to the rank of colonel. In the campaign of 1675, he performed an important service at the siege of Grave, by successfully employing the means which he had invented for crossing the fosses of fortified places, and thus carrying a bastion without a counter-scarp, the access to which was defended only by the river Meuse; a service for which he received, on the spot, the warmest commendations of Vauban. At a subsequent period Cohorn applied his theory of fortification to the fortress of Coverden; and during the war between Holland and France distinguished himself by new exploits. At the siege of Namur he defended Fort William against Vauban in the most gallant and determined manner; but was at last compelled to yield to superior force, and surrender the work to his great rival. In 1695, however, he recovered the fort, when defended by Boufflers. This alternate taking and retaking of Namur, under Vauban and Cohorn, is considered as illustrative of their respective systems; Vauban sparing his artillery and men, and trusting principally to the efficiency of his works; whilst Cohorn, sacrificing everything to the desire of abridging the siege, by striking the besieged with surprise and terror, was equally prodigal of means and of men. In 1702, Cohorn, now appointed lieutenant-general, published his *New Method of Fortifying Places;* and in the following year he applied his system to the conduct of the siege of Bonn, which he forced to capitulate in three days. He died, March 17, 1704, at the Hague, whither he had gone, at the invitation of Marlborough, to concert measures for the ensuing campaign. Bergen-op-Zoom, which was fortified by Cohorn, is generally considered his masterpiece. It was, however, taken by the French under Löewendahl in 1747, after a feeble defence; and in 1814 an attempt to carry it by a *coup-de-main*, planned by Lord Lynedoch, miscarried only by an extraordinary accumulation of adverse accidents. See Fortification.

COHORT, in *Roman Antiquity*. See Army, vol. iii., p. 631.

Coif || Coimbatore

COIF, the badge of a sergeant-at-law, who is called sergeant of the coif, from the caul or cap (a circular piece of black silk edged with lawn), which he wears on his head when he is called to the degree of sergeant.

The chief use of the coif was to cover the clerical tonsure.

COIMBATORE, a British province in the south of Hindustan, under the jurisdiction of the Presidency of Madras. It is bounded on the N. and N.W. by Mysore; on the E. by the British districts of Trichinopoly and Salem; on the S.E. by that of Madura and the native state of Travancore; and on the W. by the territory of Malabar and the native state of Cochin. It is situate between Lat. 10. 14. and 12. 19; Long. 76. 36. and 78. 16.; and comprises an area of 8280 square miles. The province may be generally described as a level country, rising gradually towards its western frontier, where, at the deep gap of Palghatcheri (which completely intersects the great range of the Western Ghauts from E. to W.), it attains an elevation of between 800 and 900 feet above the level of the sea. On its eastern extremity the district opens upon the extensive plain of the Carnatic. The slope of the province being from W. to E., the drainage is conveyed by several streams to the Cauvery, and ultimately discharged by its channel into the Bay of Bengal. The chief tributaries of the Cauvery during this part of its course are the Bhovani, Ambrawulty, and Noyel. The climate is stated to be superior in point of salubrity to that of the maritime districts of the Carnatic. No considerable supply of rain is derived from the S.W. monsoon, which, being intercepted by the Western Ghauts, is thereby prevented from affecting the plains of Coimbatore; but during the prevalence of the N.E. monsoon, when the wind blows from the Bay of Bengal, the temperature is moderate, the Cauvery and its tributaries are replenished by the rains, and the low grounds become deluged with water. In winter there are sometimes showers with heavy dews, a very cold air, and south-easterly winds. The spring is generally dry, with light breezes from the S., and moderate dews. In April the weather becomes hot, and the thermometer ranges from 76° to 93°, rising in the succeeding month as high as 96° or 98° in the shade.

Among the vegetable productions is the Mauritius sugar-cane lately introduced, and the cultivation of which is officially reported to be favourably progressing. Experiments have been also made for the introduction of the American species of cotton, the produce of which, in this district, is stated to be well suited to the British market. Tobacco of excellent quality is grown. Forests of teak and other valuable timber, including the sandal tree, are scattered over the frontier hills. Iron ore appears to be the only mineral of importance.

Many sheep are bred in the country, of which there are two kinds; the one short-bodied, with a short small tail; the other of a thinner make, with long ears and scanty wool. Though small, they are of good quality, fattening readily, and affording delicious meat. There is also a breed of goats, which, however, are very inferior to those reared higher up the Ghauts. The pasture, though it looks bare, seems to be more nutritious than that on the banks of the Ganges. The wild animals are nearly the same as in other parts of India. Elephants abound in the secluded valleys towards the Ghauts. There are also black bears, which are not usually considered dangerous unless when they are molested; though they are very strong, and not afraid to encounter the tiger.

In the Madras census of 1851, the population of the province is given at 1,153,862, consisting for the most part of Hindus.

Coimbatore was first annexed to the kingdom of Mysore about the year 1746, a short time before the usurpation of the chief power by Hyder Ali. It was occupied by the British in 1783, but restored to Tippoo Saib at the conclusion of the first war with that prince. Upon the overthrow of Tippoo in 1799, it formed part of the conquered territory allotted to the East India Company, and was forthwith annexed to the British dominions. Coimbatore || Coin.

COIMBATORE, a town of Hindustan, and capital of the province of the same name, is situate on the left bank of the river Noyel, a feeder of the Cauvery. The streets are wide, airy, and neatly built. This city, as well as the whole province, suffered severely in the wars which took place between the sovereigns of Mysore and the British. Since its permanent occupation by the latter, the city has recovered considerably, and contains 2000 houses, which is about half the number it possessed under Hyder's government. It has a mosque, built by Tippoo, who occasionally made Coimbatore the place of his residence. The elevation of the town above the sea is 1483 feet. Distance south from Seringapatam 100 miles. Lat. 11., Long. 77. 1.

COIMBRA, capital of the province of Beira, Portugal, stands on the north bank of the Mondego, 115 miles N.N.E. from Lisbon. The early history of Coimbra is involved in much obscurity. It is not known if the foundations of the city were laid by the Romans; they cannot with certainty be traced farther back than the time of the Goths. Previous to the sixteenth century it was the capital of the kingdom, and strongly fortified; but it is now surrounded only by an old and ruinous wall, and the houses are falling into decay. Its trade is purely local, as the Mondego is only navigable in flood, and its port, Figueira, is upwards of 20 miles distant. There are, however, considerable manufactures of earthen-ware, linen and woollen fabrics, combs, &c. The country to the south of the Mondego is the most fertile and salubrious in Portugal, and, accordingly, the neighbourhood of Coimbra is studded with villas. It derives its principal importance from being the seat of the only university in the kingdom. Lisbon was the original seat of this university, which was transferred in 1306 to Coimbra. Some time after it was restored to Lisbon, where it existed till 1527. In that year it was again transferred to Coimbra, where it has ever since remained. It consists of 18 colleges, and is attended by 1400 students. It is divided into 6 faculties—viz., theology, canon law, civil law, medicine, mathematics, and philosophy, and has a staff of 39 professors. Its library, museums, and academical apparatus generally, are on the same scale of magnificence. Coimbra is the see of a bishop, who is suffragan to the Archbishop of Braga; and besides the cathedral it has 8 parish churches, and numerous conventual institutions. In the neighbourhood is the splendid monastery of Santa Clara; and near it is the celebrated *Villa of Tears*, where Iñez de Castro is said to have been murdered. Pop. 16,000.

COIN, a piece of metal converted into money by the impression thereon of certain marks or figures. Coin differs from Money as the species from the genus.

Ancient Coins are those chiefly which were current among the Jews, Greeks, and Romans. Their values and proportions are as follows:—

JEWISH.

					L.	s.	d.
Gerah (Sept. *obolus*)					0	0	1·36875
10	Bekah				0	1	1·6875
20	2	Shekel			0	2	3·375
1000	100	50	Maneh / Mina Hebraica		5	14	0·75
60000	6000	3000	60	Talent	342	3	9
Solidus aureus, or sextula, worth					0	12	0½
Siclus aureus, worth					1	16	6
A talent of gold, worth					5475	0	0

In the preceding table silver is valued at 5s., and gold at L.4 per ounce.

GRECIAN.

												L	s.	d.	Qrs.
Lepton												0	0	0	·116
7	Chalcus											0	0	0	·8125
14	2	Dichalcum										0	0	0	1·625
28	4	2	Hemiobolium									0	0	0	3 25
56	8	4	2	Obolus								0	0	1	2 5
112	16	8	4	2	Diobolum							0	0	3	1
168	24	12	6	3	1½	Triobolum						0	0	4	3·5
224	32	16	8	4	2	1⅓	Tetrobolum					0	0	6	2
336	48	24	12	6	3	2	1½	Drachma				0	0	9	3
672	96	48	24	12	6	4	3	2	Didrachmon			0	1	7	2
1,344	192	96	48	24	12	8	6	4	2	Tetradrachmon		0	3	3	0
33,600	4,800	2,400	1,200	600	300	200	150	100	50	25	Mina	4	1	3	0
2,016,000	288,000	144,000	72,000	36,000	18,000	12,000	9,000	6,000	3,000	1,500	60 Talentum	243	15	0	0

Of these, the drachma, didrachmon, &c., were of silver; the rest for the most part of brass. The other parts, as tridrachm, tribolus, &c., were sometimes coined. The drachma is nearly equal to a French franc.

The Grecian gold coin was the stater aureus, weighing two Attic drachms, or half of the stater argenteus, and exchanging usually for twenty-five Attic drachms of silver, in our money..... L 0 18 6
According to our proportion of gold to silver..... 1 0 0
There were likewise the stater Cyzicenus, exchanging for twenty-eight Attic drachms, or... 1 2 9
Stater Philippicus and stater Alexandrinus..... 1 3 6
Stater Daricus, according to Josephus, worth fifty Attic drachms, or..... 1 1 10
Stater Crœsus, of the same value.

ROMAN COPPER.
(Before Augustus.)

Sextula							
1½	Quadrans						
2	1⅓	Triens					
3	2	1½	Semissis				
6	4	3	2	As			
12	8	6	4	2	Dupondius		
24	16	12	8	4	2	Sestertius	
48	32	24	16	8	4	2	
96	64	48	32	16	8	4	

ROMAN SILVER
(Before Augustus.)

					L	s.	d.	Qrs.
					0	0	0	·35416
				Teruncius	0	0	0	·53125
					0	0	0	·7083
2	Sembella				0	0	0	1 0625
4	2	Libella			0	0	0	2 12
					0	0	1	25
16	8	4	Sestertius		0	0	2	·5
32	16	8	2	Quinarius	0	0	4	1
64	32	16	4	2 Denarius	0	0	8	2

ROMAN COINS.
(After Augustus.)

								L.	s.	d.	Qrs
Sextula								0	0	0	·3125
1½	Quadrans							0	0	0	·46875
2	1½	Triens						0	0	0	·625
3	2	1½	Semissis					0	0	0	·9375
6	4	3	2	As				0	0	0	1·875
12	8	6	4	2	Dupondius			0	0	0	3·75
24	16	12	8	4	2	Sestertius		0	0	1	3·5
48	32	24	16	8	4	2	Quinarius or Victoriatus	0	0	3	2
96	64	48	32	16	8	4	2 Denarius	0	0	7	2

Coinage. Of these, the denarius, victoriatus, sestertius, and sometimes the as, were of silver, and the rest of brass. See As, &c. There were sometimes also coined of brass the triens, sextans, uncia, sextula, and dupondius.

	L.	*s.*	*d.*	*Qrs.*
The Roman gold coin was the aureus, which weighed generally double the denarius; the value of which, according to the first proportion of coinage mentioned by Pliny, was	0	15	7	2
According to the proportion that obtains now amongst us, worth	0	18	5	3·25
According to the proportion mentioned by Tacitus, and which afterwards obtained, whereby the aureus exchanged for twenty-five denarii, its value was	0	15	7	2

Coinage.

For further particulars respecting ancient coins, see MEDALS. *Modern Coins* are treated of under MONEY. (L. S.)

COINAGE.

MONEY is a measure of value and medium of exchange: coinage is the art of fabricating money.

So soon as nations emerge from a state of barbarism, when simple barter no longer suffices to meet their wants, they will invent some common or conventional measure of value by which to exchange their products and carry on their commerce. In the rude ages of society, cattle are said to have been the common medium of commerce; and among the patriarchs of old they were the measure of man's wealth and greatness. The armour of Diomede, says Homer, cost only nine oxen; but that of Glaucus cost a hundred oxen. In some countries, in former times, salt was the measure of value and instrument of exchange; and in others shells formed the circulating medium. But as the necessities of nations multiply, and their commercial transactions extend, they soon discover the inadequacy of these means, and will search for something of a more steady and durable character, which shall serve both as a circulating medium, as well as a medium of exchange with other countries trading with them. From a very early period metals, as possessing that character in a high degree, were chosen to perform these important functions. They are not only less perishable than other articles, but they can, without loss, be divided into any number of parts, and be united again by fusion: they can be hammered or rolled into plates, and moulded into any shape: and occupying less bulk than other articles, they are easily transported from place to place.

"Different metals," says Adam Smith, "have been made use of by different nations for this purpose. Iron was the common instrument of commerce among the ancient Spartans, copper among the ancient Romans, and gold and silver among all rich and commercial nations. Those metals seem originally to have been made use of for this purpose in rude bars, without any stamp or coinage. Thus we are told by Pliny, upon the authority of Timæus, an ancient historian, that, till the time of Servius Tullius, the Romans had no coined money, but made use of unstamped bars of copper, to purchase whatever they had occasion for. These rude bars, therefore, performed at this time the function of money."

Before the invention of coined money, the precious metals were exchanged by weight only; but as many obvious inconveniences attended that custom, as an initiatory step pieces of metal rudely shaped were stamped with their weight; and then by degrees the art of coining money was introduced, intended not only to indicate by the stamp of the sovereign authority the weight, but also the fineness of the coin. So long as copper and iron performed the functions of money and measure of value, probably the weight only was the test of value; but with regard to gold and silver, another element enters into their appreciation of as much consequence as the weight itself. The quality or fineness of these metals, by which the value is determined, can only be discovered by the laborious process of assay; and therefore (as Adam Smith remarks), before the institution of coined money, unless this tedious and difficult operation were undertaken, people must always have been liable to the grossest frauds and impositions; and instead of a pound weight of pure silver, might receive, in exchange for their goods, an adulterated composition of the coarsest and cheapest materials. To guard the public against such frauds, to facilitate exchanges, and thereby encourage industry and commerce, mints were established, in which pieces of metal of determinate weight and fineness were stamped by public authority, in order to declare the quantity and uniform goodness of the money so stamped, that it should pass from hand to hand without doubt or suspicion.

In early times these coins, or pieces of metal, constituted or denoted weights of different denominations; or, in other words, they expressed the weight or quantity of metal contained in them, as in the Roman *as* or *pondo*, which, when money was first coined at Rome, signified a pound weight of good copper, consisting of twelve ounces, as in our troy pound. So the English pound sterling originally expressed not a coin exchangeable into 20 shillings, but simply a pound weight of silver of sterling fineness. The French *livre* likewise contained, in the reign of Charlemagne, a pound weight of silver of a determinate quality. And on the authority of Adam Smith, the Scots money-pound contained, from the time of Alexander I. to that of Robert Bruce, a pound of silver of the same weight and fineness with the English pound sterling. English, French, and Scots pennies, too, contained all of them originally a real pennyweight of silver, or $\frac{1}{240}$th of a pound. The shilling also seems originally to have been the denomination of a weight, and not of a coin of conventional value.

As the transition from mere barter (by which one product of labour is exchanged for another), to the use of metals as instruments of commerce, indicates an advance in civilization; so the transition from the latter to the fabrication of coined money, however rude and inartificial at first, marks another progressive step in culture and refinement; while the various designs impressed on the coin, and the mode of manufacture testify in nice degrees the slow advancement of society in art, taste, and ingenuity.

An inquiry, therefore, into the coinage of a country like Great Britain, from the earliest times, possesses an interest apart from the subject itself as a mere antiquarian research, because it throws an indirect ray of light on the social condition of the people from age to age, and enables us to note the progressive steps of their improvement in taste, refinement, and mechanical invention, as well as to ascertain their comparative wealth and social comfort, indicated by the value of the necessary articles of life. The subject partakes not, indeed, of the true dignity and importance of history; but, in a less ambitious channel of research, it is not without utility and instruction.

In order to illustrate the necessary connection that exists between the social and political condition of a nation and its coinage, we need only to refer to the rude ill-fashioned coins

Coinage.

of our semi-barbarous ancestors, and contrast them with the elegant and highly-finished specimens of the present day. The forge and hammer, and other manual appliances, are now superseded by mechanical contrivances of the highest order, which, with artistical design and beauty, co-operate to embellish and impart elegance to the coin of the realm. If this description be true of the external features of our currency, it is equally true with respect to the uniformity of its fineness; of more importance than even taste and beauty. The somewhat mysterious and alchemical ordeal of trying "by fire, by water, by touch, by weight, or by all or any of them," has found a less empirical and more certain substitute in the scientific art of assaying the precious metals.

Another pre-eminent advantage we have acquired by means of those mechanical contrivances referred to, is the vast rapidity with which money can now be coined and issued to the public—an element in the comparison of ancient and modern times of great significance to a commercial country, like great Britain, in which the currency is liable to be disturbed by external causes, and in which the public exigencies are as uncertain as they are urgent and imperious.

It is not too much to assert, therefore, that in a view of the coinage of Great Britain we possess within certain limits a faithful record of the progress of its civilization. The view is of necessity a contracted one, but not the less true and authentic. Like the history of the customs, habits, and modes of life of a nation, it fills but a subordinate part, and aims no higher; nevertheless a knowledge of it is not only useful but indispensable. The coinage of a country speaks with unerring accuracy and truth; and so long as coins are extant to bear witness to barbarity or refinement, rudeness or taste, ugliness or beauty, clumsiness or elegance, we cannot, as in some other historical researches, be perverted by prejudice or deceived by ignorance. It is truthful, because it bears the impress of truth, and stands as a kind of living memorial of past generations. A rude, shapeless coin, with an effigy resembling the unformed scrawl of a child, is as certain a proof of the low state of civilization in art and mechanism as analogous imperfections would be in painting or sculpture; while a beautiful and elegant and well-finished coin speaks convincingly of corresponding ideas and tastes in the nation. And when such evidences of refinement prevail among the people, the state and excellence of the coinage will always afford a subject of pleasure and congratulation. In Great Britain our coins have not certainly attained the highest degree of excellence, though for some time they appeared gradually approaching it; and we would fain hope that in future the step may be progressive rather than retrograde; though as a commercial nation we are too apt to be indifferent to such claims on our admiration as objects of taste call forth, however jealous we may be of the fineness of the coinage. It is indeed too frequently the tendency of modern ideas of economy, applied to public works, to give little encouragement to whatever concerns art and enterprise.

Though we have in this cursory manner pointed out some of the uses to which a history of the coinage may be made subservient, our design is to give only a brief outline of the subject, accompanied by a detailed description of the various operations and processes concerned in the fabrication of money, as well as some account of the recent changes introduced into the constitution and management of the Royal Mint.

Money in ancient times.

On the first landing of Julius Cæsar on the shores of Britain, he describes the inhabitants as a race just emerging from barbarism, and their money could not therefore be of a high order. Their use of money was circumscribed by their simple wants and limited commerce; and, according to him, it consisted of rude pieces of brass and iron rings, regulated to a certain weight, which probably were in use strung together, as the Chinese do at this day with their inferior money. He makes no allusion to coins or money of gold or silver, and it may be inferred none existed; for although foreign coins at one period circulated freely in Britain, it is improbable amongst such a people as the ancient Britons that such should have been the case. Both Strabo and Tacitus, indeed, speak of the gold and silver of Britain, as if indigenous to the soil; but as gold has not been discovered in any considerable quantity since that period, and as silver is not found except in combination with lead, we may conclude these writers received their information from mere hearsay or tradition. It is not probable that a people emerging from barbarism, without art or science, should have imported gold for the purpose of coinage; nor can we give them credit for that degree of skill and ingenuity necessary to separate the silver from the lead in their mines. So far from this being probable, we are informed that even the brass of which their chief money consisted was imported from abroad, though the soil was rich in copper; and that of iron they produced but a small quantity, being devoid of skill and enterprise.

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Tacitus says, "Britain produces gold, silver, and other metals to reward its conquerors:" but in refutation of this, Dr Henry, as well as others, remark, that if the Britons had any gold or silver amongst them, either coined or uncoined, when they were first invaded by the Romans, it was certainly unknown to their invaders, which it is not likely to have been if they came in quest of treasure, as Suetonius avers, who says that not the gold but the pearls of Britain, famous then, were the chief incitement to Cæsar's invasion. Writers on such subjects often deal in hyperbole, attributable to want of accurate information with regard to the countries they described. Thus, according to Diodorus Siculus, even Gaul was famous for the abundance of its gold, and the Gauls for their skill and dexterity in discovering, refining, and working that metal. We cannot believe the gold to have been the produce of their own mines, though it may have been common among them. Their coins are represented to be of pure gold, without any alloy of baser metals; and not only their coins, but their rings, chains, and other trinkets, were made of gold equally fine.

The first attempt of the ancient Britons to coin money, though not accurately ascertained, may be referred to a period subsequent to Cæsar's second invasion; and we may suppose the appearance of Roman coins amongst them prompted them to imitation, however rude and unlike. As their coins consisted of gold and silver, as well as inferior metals, indicating, therefore, a rapid stride in refinement and civilization, some have, not without plausibility, conjectured them to be of foreign origin, imported in the way of commerce; because the initial letters stamped on them appear to have some reference to the names of certain Gaulish princes, mentioned by Cæsar or Tacitus. Dr Henry observes on this curious subject—"It is not unreasonable to suppose that some of the Gauls, retiring from their country to avoid the Roman yoke, and settling in Britain, which was still free after the retreat of Cæsar, brought with them the art of coining money, in the same taste in which it was practised in Gaul, immediately before the conquest of that country by the Romans; when a new and more beautiful manner was introduced. This conjecture is confirmed by the remarkable resemblance of these coins to those of the ancient Gauls." But Ruding, who is always a truthful and generally an accurate guide in such curious researches, takes exception to this, and remarks, that "if we proceed to examine the coins themselves, they furnish no proofs to justify their appropriation to any country. The far greater part of them are without any legend; and on the rest are to be found only initial letters, or at

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most single syllables, which, by the ingenuity of antiquarians, have been compelled to express any meaning they have thought fit to adopt." It is singular, however, that a nation without any known mines of gold or silver, and without any commerce worthy of the name, whose inhabitants were exceedingly poor, and with whom the value of money was great, should have indulged in such a token of refinement as a gold currency. Yet certain it is, that a considerable number of the coins of Cunobeline have been preserved, containing his name, sometimes in full, sometimes abbreviated, with the name of the capital of his kingdom—Camalodunum (Colchester),—and so far we cannot question their appropriation to an ancient British king. The dominions of this petty monarch extended from the coasts of Norfolk, Suffolk, and Essex, westward across the island to the banks of the Severn; and he is supposed to have reigned during the times of Augustus, Tiberius, and Caligula. Possessing the wisdom to appreciate the refinement and civility of the Romans, this monarch seems to have introduced considerable improvement into his coins, forming them in a measure on the model of the Roman money. "On some of these coins," says Ruding, "the name of the monarch is given with a Latin termination, and the devices which are impressed upon others are evident imitations of the coins of Augustus Cæsar. All the letters are plainly Roman. But it is in outward appearance alone that these coins agree with the Roman money of that period in which Cunobeline is generally supposed to have reigned, for in weight they are widely different. The cause of this variation from the prototype in so important a point cannot now be ascertained; but it seems to justify a suspicion that the weights were regulated in conformity with other British money then current: and in confirmation of this suspicion, it may be observed that some of the coins which bear Cunobeline and Camalodunum resemble in type those which are usually attributed to earlier British kings."

But the improvements introduced by this monarch were destined to be of short duration; because a few years after his death, Britain having again been subjected to the Roman dominion under Claudius, and by his severity reduced to a mere province of the Roman empire, the native mints ceased to coin British money; and, agreeably to the Roman policy, an edict was issued to the effect that all money current should bear the imperial stamp.

Though the Roman money, which must have been abundant, continued to circulate in Britain after the inroad of the Saxons, about the middle of the fifth century, mints were subsequently established in various places, regulated by laws which the Saxon conquerors brought from the Continent, and which differed in many particulars from those of the Romans. Some have indeed doubted whether these people, at their invasion of Britain, possessed any knowledge of the art of coining money—supporting their opinions on the authority of Tacitus; but the best authorities on the history of our coinage controvert this hypothesis by the better testimony of the coins themselves. "Sceattæ," says Ruding of the Saxon coins so called, "are known of the early kings of Kent, some of which must have been struck within the sixth century; and there are others so similar to them in type, as to justify their appropriation to the same people, but which, from their symbols, were evidently coined before their conversion to Christianity, and were, therefore, probably brought with them from the Continent." This distinguishing mark—the cross—is also wanting on the sceattæ of Ethelbert I., king of Kent, in whose reign the conversion of the Saxons from paganism by the monk St Augustin commenced.

Of the internal constitution of the heptarchic mints no records remain; but if we may judge by specimens of coins extant, the taste and mechanical skill of the Saxons were scarcely superior, if at all, to those of the ancient Britons. Unlike these, they disdained to follow the Roman models (of which many beautiful specimens must have been preserved), but pursued a rude and barbarous method of their own; and hence their coins are found to differ in form, type, and weight, from those current amongst them at the same time. They are of equal weight and fineness with the later Anglo-Saxon pennies. The coiners, or moneyers, as they are called, stamped their names upon the money; but the custom of adding the place of mintage was of rare occurrence, and almost solely confined to the ecclesiastical coins of Canterbury.

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When the heptarchy was dissolved, and its different petty kingdoms united under one rule, the mints were regulated by laws framed in the Wittenagemote, or great council of the nation; and besides the royal establishments, the mints of York and Canterbury enjoyed the privilege of coining money; but it is conjectured, with much probability, that the dies were supplied by the crown, and that the sovereign participated to a certain extent in the profit.

The most ancient coins known to have existed amongst the Anglo-Saxons were the sceattæ, supposed to be the first coined by them in Britain. They are of very rude and clumsy workmanship, while their weights vary from 7½ to 20 grains and upwards. By the laws of Athelstan (924-940), the value of this coin is stated to be such, that 30,000 of them equal L.120, and it was therefore less valuable than a penny by a 25th part. Besides these, there appears to have been also another coin of inferior denomination, worth a quarter of a penny, but of what metal it was composed we are ignorant.

The penny was the next coin made of which we have any knowledge. The word appears, says Ruding, in the laws of Ina, king of the West Saxons, about the year 688, and is in a manner, therefore, consecrated by its antiquity. Its probable origin is derived from *pendo*, to weigh; and if that etymology be admitted, it will appear probable, observes the same authority, that "the penny was not known to the Saxons before their arrival in Britain, but was adopted, together with its name, at the same time that mynet, from *moneta*, was introduced." The penny may be considered, therefore, the ancient unit of our currency.

Of that coin, 240 are supposed to have been fabricated out of a pound weight of silver, giving thus 24 grains to each, and making the pound consist of 5760 grains, as at present. Hence the origin of our *pennyweight*, equal to 24 grains, and the 240th part of a pound. Twenty pennies to the ounce seem to have been also the weight of the Norman coins of that denomination. "The legal weight of the penny," Clarke observes, "continued through the whole period of the Saxon government. It was always the 240th part of the pound. Their laws, from the first mention of it to the last, give it this uniform valuation." Nevertheless, there is evidence to show that, at different periods, if not during the same period, there were two pound weights in use, one as above, and another consisting of only 5400 grains troy, called the Tower pound.

There was likewise a halfpenny coined in silver, and probably a farthing, or quarterpenny of the same metal; which will not appear surprising if we consider the great value of money in those ages, and consequent low price of the necessaries of life. Besides these subdivisions of the penny, there seems to have been also another piece equivalent to the third part of that coin, which continued in use as late as the reign of Henry I. "But," says Ruding, "even so small a coin as one-fourth of a penny could not be sufficiently minute to answer the common purposes of exchange, at a time when most of the necessary articles of life were to be purchased at prices so far beneath what is now considered to be their value; when, for instance, in the reign of Athelstan, an ox was sold for 30 pennies, and a sheep for one shilling."

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Accordingly, the Anglo-Saxons coined inferior money of brass, called *stycas*, two of which were equal to one farthing. They had also other monies, or denominations of money, the exact nature of which cannot now be determined; but of the sceattæ, the penny, the halfpenny, farthing, and styca (all undoubted coins), specimens remain, except the farthing. The mancus, the mark, the thrisma, the ora, and other denominations in Saxon, Danish, and Norman times, were probably like talents and shekels, weights of current money, and not coins. In truth, the origin of all coin denominations in early times were weights; for originally the precious metals passed by weight in commerce; and when for convenience pieces of metal came to be stamped, these pieces were well known weights of the country where they were coined. The smaller coins were regular subdivisions of the greater, made into so many for each pound.

The Saxon shilling differed from the Norman shilling of 12 pence in value, six of them making only 30 Saxon pennies, or a mancus.

The Pound	Was a denomination of money only, and not a coin, and signified as many coins as were made out of a pound of metal = 5400 grains troy.
The Mark	The same; an Anglo-Danish denomination, $\frac{2}{3}$ds of a pound = 8 oz. = 3600 grs.
The Mancus	The same; a weight equal to 30 pennies = 6 shillings.
The Ora	The same; Danish subdivision of the mark, $\frac{1}{8}$th or one ounce = 450 grs.
The Thrisma	Three Saxon pennies; not a coin
The Shilling	Five pennies = 112½ grs; do.
The Sceattæ, Penny, Halfling, Feorthling, Styca	Real coins.

240 Pennies = 1 Pound — 5 Pennies = 1 large Shilling
160 ... = 1 Mark — 4 ... = 1 lesser do.
30 ... = 1 Mancus — 3 ... = 1 Thrisma
20 = 1 Ora — 20 Sceattæ = 1 Shilling = 5½ grs. troy.

We can discover no satisfactory evidence of the Saxons having coined money in gold; and if coins of that metal circulated amongst them (as appears to have been the case), the inference is, they came from abroad; as, for example, *bezants*, which sometimes occur in Anglo-Saxon transactions, deriving their appellation from Byzantium or Constantinople, and so of others. "During the existence of the Anglo-Saxon and Anglo-Danish government," says Ruding, "there is reason to believe no other metals besides silver and brass were coined in their mints." The use of the latter metal seems to have been rejected by the Anglo-Norman monarchs, and silver became the sole material of coinage for a long established period, until gold was introduced by Henry III.

Ancient mode of coining.

Our knowledge of the mode of coining money in early times is extremely imperfect; but all agree that it was rude and inartificial, and so appears to have continued for many centuries. Neither the Anglo-Saxons nor Anglo-Normans were famous for their skill or inventive powers. To both we are beholden for many excellent laws, but not for those mechanical arts and contrivances which so much now contribute to the wealth and glory of England. And, therefore, it cannot but be esteemed a remarkable fact, that a nation which, above all others on the face of the earth, is distinguished for mechanical invention, and pre-eminent for those arts which elevate a kingdom in the scale of civilization,—remarkable for its restless activity, enterprise, and adaptation of natural laws to useful purposes in almost every branch of science,—should, in its infancy and even for ages after, have displayed none of these national characteristics. On the contrary, it seems to have been wholly indebted to the Continent for those advantages. And when improved machines were introduced into England for the coinage of money, the nation was slow in adopting them. Like our hand-loom weavers, the people opposed any invention that seemed to militate against the interests of manual labour, while at the same time they had little aptitude to turn the inventions of others to their own advantage.

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The metal brought to the mints for coinage was, after being tried, reduced to sterling or standard by alloy when too fine, and refined if too low in quality; but by what means the latter operation was performed we remain in ignorance. The metal so melted was cast into small bars, and these were flattened by a hammer; and out of these fillets or plates, square pieces were cut of nearly equal weight, and then rounded at the forge. These were stamped simply by fixing a die in a block of wood, while another was used as a punch, and repeatedly struck with a hammer till it received the required impression. Money fabricated in this rude manner was necessarily imperfect, from the difficulty of always placing the two dies exactly over each other when the blank piece was between them, as well as from the improbability of a man being able to strike a blow with such force and precision as to make all parts of the impression equally perfect.

Even in the reign of Edward I., it is recorded in the Red Book of the Exchequer, that the new money then coined was made in the following manner: first, the metal was cast from the melting-pot into long bars, which were cut with shears into square pieces of as exact a weight as possible, and these were with the tongs and hammer forged into a round shape; after which they were blanched, that is, made white by annealing and boiling, and afterwards stamped or impressed with a hammer to make them perfect money.

From this unskilful and imperfect process, scarcely any improvement seems to have found its way into England until the introduction of the machines called the *mill* and *screw*, applied first to the coinage of France about the middle of the sixteenth century. The coining press or mill was of French origin, the invention of which is generally ascribed to one Antome Brucher, an engraver, who in 1553 first tried it in the palace of Henry II., for the stamping of counters. It continued in use till 1585, when it was laid aside on account of its being found more expensive than the hammer coinage, and so remained until the year 1623, when Briot, a French artist, unable to persuade the government to adopt it again, came over to England, where it was immediately put in practice at the mint, under the direction of Briot himself, who was appointed chief engraver. It was, however, abandoned for the reason assigned, until one Blondeau, forty years after, persuaded Charles II. to introduce it again into the mint, with some other mechanical improvements of his own invention; and eventually it created a revolution both in the manner of coining and in the appearance of the coins themselves. For the great change which then took place in the form and impression of the new money struck by this invention, gave it a decided superiority over the old coinage.

The *mill* and *screw* are generally conceived to be synonymous with the coining-press as one machine; but it is not improbable that two distinct machines were comprehended in that expression; the screw or mechanical power employed in giving the impression to the coins, and the mill or mechanism driven by horse-power, by which the metal was rolled instead of being hammered into plates. The introduction of a mere coining machine would have been of little use without a corresponding improvement in other processes, and quite incompatible with the slow and clumsy mode of forging the metal formerly in use. The inference is in some degree corroborated by the reputed costliness of using the machine; for a coining-press will cost little more than the labour of working it. Before the introduction of steam-power, human labour was employed in driving the coining-presses; but probably animal labour was used in driving the rolling-mill, and hence the expense must have been considerable, if not compensated by the extent of the coinage.

Sterling, &c.

In the fabrication of money from the precious metals, it

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is a fundamental law that some particular standard should be adopted as regards the composition of the metal: and this was called by our Saxon ancestors *sterling*. The origin of the word, which has remained so many ages in familiar use, is involved in some obscurity; but it is generally understood to have expressed what we now call the *standard* of our silver currency, for it was never applied to coins made of the more precious metal, gold. While by custom and habitude we speak of pounds sterling, our Saxon and Norman ancestors signified by these words pounds in weight of coin of sterling silver. On this curious subject, it is remarked by Ruding, that in England, and all over the continent of Europe, it designated the standard quality of our silver money; and it is a striking circumstance in the history of our coinage, that the fineness of the silver coins, which was expressed by that word, has preserved its integrity unbroken from the reign of Henry II. (at the lowest calculation), down to the present time—a period of more than 600 years. This standard consists of 11 ounces 2 pennyweights of fine silver and 18 pennyweights alloy to the pound troy, or $\frac{11}{12}\frac{2}{12}\frac{18}{12}$dwts. Dr Henry, in his *History of Great Britain*, says that the standard of Anglo-Saxon money consisted at one time of 9 parts of silver and 1 of copper; but that must apply to a very early period, as there can be no doubt of the great antiquity of the *sterling*. If, to perfect the proposed decimal system of coinage, the standard were altered or reduced to $\frac{9}{10}$ths as respects silver, the coincidence would be singular.

Sterling silver remained in high repute all over the Continent, because it was superior to any other currency; and even in England the words conveyed for centuries the ideas of goodness and purity. And we may remark here that the gold coins of England, from the reign of Henry III., when they were generally introduced, to the reign of Henry VIII., who debased their purity, were made of fine gold. This is a remarkable circumstance, because as gold in its native state is rarely discovered so pure, the existence for a long period of a coinage fabricated of that metal in a state of purity necessarily implies the knowledge of the art of refining, which must have been practised at a very early period. Pliny, indeed, says that in his time gold was refined by mercury, which mingled with it, but rejected all alloy, and the gold was freed from the mercury by squeezing both in skins, in which operation the mercury ran through and left the gold in a pure state. Some of the Greek gold coins were also of great purity, as those of Philip of Macedon, and his son Alexander the Great, rivalled by those of the other princes and cities which immediately followed. Those of the successors of Alexander in Egypt were 23 carats 3 grains fine, and 1 carat grain alloy, which we give on the authority of Jacob in his book on the "Precious Metals." Pinkerton, on the authority of a French writer, informs us that the goldsmiths of Paris, in assaying some gold coins of Vespasian, found in them no more than a 788th part of alloy. But though the Greek and Roman coins attained so high a standard, their silver coins were not so pure. Those of the Greeks were inferior to ours; and also the Roman of the earliest period, though slightly.

During the reign of Henry VIII., the currency of both gold and silver was greatly debased and corrupted, as compared with that of former reigns. He fabricated coins of what was called crown gold, 22 carats fine, which was eventually adopted as the standard of our gold currency. Some of his silver money was so much depreciated as to contain no more than a third part of fine silver. But notwithstanding this nefarious and dishonourable proceeding on the part of the crown, the true, ancient, and venerable standard or sterling was always regarded by the people with a degree of affection and reverence somewhat similar to that which on great occasions they expressed in favour of their ancient laws and charters. So soon, therefore, as Queen Elizabeth was firmly fixed on her throne, she listened to the reasonable demands and just representations of the country, and restored the ancient standard of our silver coin, which happily has remained untouched to this day. Coinage.

The following table will show the variations of the standard from Edward I. to the reign of Elizabeth. From the most authentic documents, it appears the standard remained uniformly the same through the long extended period from Edward I., and perhaps before, to the 34th year of Henry VIII., when the proportion fell to 10 ounces of fine silver, and 2 ounces of alloy to the pound weight troy.

[illegible]	11	2	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	6	[illegible]	9	[illegible]	[illegible]
[illegible]	1	[illegible]	8	[illegible]	[illegible]
1st ... Edward VI.	4	.	8	.	80
3d ...	6		6	...	120
4th	3	.	9		60
6th .. .	11	1	...	19	221
Mary, and Philip and Mary	11	1		19	221
Elizabeth	11	2	.	18	222
Victoria	11	2	..	18	222

In the earliest times, the silver coins were equal in weight and in tale; that is, each penny was a pennyweight of silver, or 24 grains. Such was, indeed, the theory; for the coins in reality rarely reached to the counterpoise of a pennyweight. The intention was frustrated either by the great imperfection of manufacture, or, as Ruding maintains, from design—as the irregularity was too nearly general to be attributable to accident. But may this discrepancy not in part be explained by supposing that at one period the pound contained only 5400 grains, which would give only $22\frac{1}{2}$ grains to the penny instead of 24 grains? No doubt also the profit of the *shere*, or remedy on the coin for errors of fabrication, sometimes offered too strong a temptation to our monarchs who looked to the coinage of money as a considerable source of revenue; while, on the other hand, the dishonest propensities of the moneyers, and the evil habit of clipping the coin, increased the evil. In consequence of the diminution of weight, arising from one or all of these sources, any considerable payment in coin required to be made by weight, and the deficiency made good. Exchanges were also instituted to change light money for that of full weight; and it was no uncommon artifice of our kings of old to call in the coins, in order that they might have the profit of the shere: and at such times the coins were taken by weight and not by tale, inflicting, therefore, great loss on the possessor.

It is observed by Ruding, that the professed standard weight of 24 grains continued for more than 200 years from the Norman conquest, that is, until the 28th year of Edward I. From that time until the 43d of Elizabeth, a period of full 300 years, the legal weight of the coins was progressively diminished; and yet notwithstanding the variations in the price of bullion which have taken place since the conclusion of her reign, the weight continued stationary for more than 200 years—that is, until the 55th year of the reign of Geo. III.

We have already incidentally remarked, that anciently what we now denominate a pound in currency was in reality a pound weight of sterling silver; and if that assertion be correct, then it follows that silver relatively to gold is three times cheaper than it was in former times. A pound of silver was worth then 240 pennies, or say 20 shillings: now the market value is about 60 shillings, or 720 pence, and the mint price 66 shillings. In researches of this nature it

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Privilege of coining. The privilege of coining money has always been claimed as a prerogative of the executive power, which was guarded with extreme jealousy. "The legitimation of money," says Sir Matthew Hale, "and the giving it its denominated value, is justly reckoned *in jura majestatis*, and in England it is one special part of the king's prerogative." And Ruding observes, "As to the impression of the coins, the stamping thereof is the unquestionable prerogative of the crown, and it was in very few instances communicated to those persons on whom the privilege was conferred; for, in general, the dies were sent either from the Exchequer, or from the master of the mint in the Tower." The privilege implied that the authority of the crown was necessary to give legal currency to the coin; and although Blackstone thinks it did not extend to the debasement of the coin to the injury of the people, no one can doubt that the power was not always legitimately exercised. In truth, it is only in the case of a depreciated currency that the king's proclamation is necessary to give legal circulation to the coin of the realm; and as a protection to his subjects, the tender is limited within narrow bounds.

In early Saxon and Norman times, royal establishments existed in almost every town of any importance for the coinage of the king's money. During the reign of Ethelred, who died in 1017, it is said that no less than 38 mints were in various places employed for this purpose. The reason is not difficult to perceive. The communication between different parts of the country was extremely imperfect and hazardous, and it became necessary to institute mints and exchanges in provincial towns for the purpose of supplying the neighbouring districts with money to carry on their commerce; but as communication was rendered easier, these subordinate mints and exchanges by degrees fell into disuse, till at length they all became concentrated in the metropolis, where one establishment has been found adequate for the supply of the whole kingdom.

After the Norman conquest, the number of mints was greatly reduced, so that in the reign of Henry VI., who died 1461, the only mints in England were at Bristol, Canterbury, Coventry, Durham, London, Norwich, Oxford, and York; but in the reign of Henry VII., they were further limited to Canterbury, Durham, York, and London. It is supposed by some, that in the time of Elizabeth, when the currency was purified and improved, all the coins of the realm were struck in London only, as no traces of other mints are to be found from that period; but it remains on record that in the reign of William III., when a great recoinage of silver took place, several local mints were employed along with the one in the metropolis in order speedily to complete that vast undertaking.

Athelstan is said to have been the first monarch who enacted any regulations for the government of the various mints. In his laws, promulgated about the year 928, it is provided that one sort of coin only should be current throughout the kingdom; and he granted to various towns by name a number of coiners or moneyers proportionate to their size and consequence, and to all boroughs of inferior ranks one moneyer each. The provincial mints were under the control of that within the Tower of London, from which, as paramount, the dies were issued, and for which the moneyers paid a regular fee upon every alteration of the coins. They seem also to have paid an annual rent (we presume for the use of the premises,) which in the city of London amounted to L.75—a very considerable sum at that time. The rents of the other mints, however, were much lower than this. Coinage.

The chief use of the exchanges appointed in various places was to increase the facility of distributing the coins made at the mints, to change new money for old, to receive the coins when called in by the monarch when light, clipped, or defective, and for the purpose of purchasing bullion for the supply of the mints; for it appears our monarchs claimed the exclusive right of purchasing bullion, and appointed officers (to whom they delegated that branch of the prerogative), called *custodes cambii*, and *custodes monetæ*. It was the duty of these functionaries not only to exchange the current coins, but also to receive wrought plate and foreign coins according to their fineness; and as the exportation of the coins of the realm was prohibited, they furnished persons going out of the kingdom with foreign money in exchange for English, and also supplied merchants and strangers coming into the kingdom with English coins in exchange for foreign.

From these sources, and from the coinage of money, the crown derived a considerable revenue, which from time to time it sought to augment by means not the most scrupulous or honourable.

Ancient constitution of the mints. The constitution of the mints in the earliest times of British history, and the regulations applied to the coinage, are questions of antiquarian research, which will be deemed more curious than profitable. The materials for such an inquiry are extremely meagre and incomplete; for, according to Ruding, both the Anglo-Saxon laws and Domesday-Book are silent on the subject. They frequently mention the moneyers, but make no allusion to any other officers of the mint; though it is reasonable to suppose that the crown, whose prerogative it was to coin money, must have had some jurisdiction over those who were employed in the practical operations. It may be inferred that each mint was supervised by a head or mint-master, whether of the mint-proper or the exchange, who, receiving a certain rate on the coinage, paid those under him; while the moneyers, on the other hand, out of their allowance, paid the labourers under them. This may not have been the case at the earliest period of our history, but the custom may certainly be traced back to very remote times.

On the early Saxon coins are found, besides the names of the monarchs, those of other persons who are with great probability conjectured to be the moneyers, and not the mint-masters; because, on the later Anglo-Saxon money the names of those officers frequently occur, with the addition of their title of office; and this fact, coupled with the silence of ancient records, has led Ruding to conclude that they were the only persons employed in the Anglo-Saxon and early Anglo-Norman mints. He thinks, too, this opinion is corroborated by the circumstance, that in the reign of Henry I., when the money was so much corrupted as to call for a sentence of most exemplary severity on the offenders, the punishment is said to have been inflicted upon moneyers only, without the least mention of any other officer. This was also the case on a similar occasion in the reign of Henry II. But if it be true that the moneyers were required to stamp their names on the coins as a token of their responsibility, and as an attestation of the integrity of the coin, the punishment of any other persons might not have been necessary. Ruding remarks on this subject, that "It should seem that the *reeve* had in the Anglo-Saxon times some kind of connection with the mint or jurisdiction over it; for in the laws of Cnut it is provided, that if any person ac-

Coinage. cused of false coinage should plead that he did it by license of the reeve, that officer should clear himself by the triple ordeal. If he failed to do this, he was to suffer the same punishment as the falsifier himself; which, in the same chapter of the law, is said to be the loss of that hand by which the crime was committed—without any redemption either by gold or silver. As it would scarcely be possible for the reeve to prove the falsity of such an accusation, it seems probable that his situation with respect to the mint was such as to make it his duty to superintend the operations of it, and to prevent all clandestine practices." The same authority further observes, that after the Norman conquest the officers of the mint appear to have been in some degree under the jurisdiction of the court of exchequer, as they were admitted to their respective stations in that court, and took before the barons the customary oath of office.

Mr Ruding is unable to determine the exact period when it became necessary to place some superintending authority in the mint to prevent the bad practices of the moneyers; but adds, it is probable such an officer, if the *gerefa* or reeve were not a presiding functionary, was appointed between the twenty-sixth year of Henry II., when the moneyers alone were punished for the adulteration of the money, and the third year of Richard I., when Henry de Cornhill accounted for the profits of the cambium of all England, except Winchester. This, however, appears to be conjectural; for this the first warden of the mint was most probably appointed to collect the revenue arising from the seignorage charged upon the coinage of bullion, although the duties might also extend to the fabrication of the coins, with the view of preventing the master or the moneyers from taking any undue advantage of the crown or the public by the debasement of the currency.

In the reign of Edward I., about 1279, it appears all the mints in England became consolidated under one master, Tournemire of Marseilles, who became personally responsible for the entire coinage. Between him and the king an agreement, somewhat analogous to the future mint indentures, was entered into, by which an allowance was secured to him to cover all the charges of coinage. In this we have the germ of that system of contracts or agreements by which the mint was afterwards carried on.

But, according to Ruding and others, the mint did not attain its full constitution of superior officers until the eighteenth year of Edward II., *i.e.*, at the beginning of the fourteenth century; when an officer, under the title of comptroller first appears, who delivered in his account distinct from those of the warden and master, as theirs likewise were from each other. "Thus they operated as mutual checks, and no fraud could be practised without the criminal concurrence of all those three persons." One of the peculiar duties required of the comptroller was, annually to make out a roll, called usually the comptrolment-roll, containing an account of all the gold and silver coined, and to deliver it on oath before one of the barons of the exchequer. It was always written on parchment, and formed a permanent record of the coinages of the mint.

The office of king's assayer constituted another check of even greater importance; for to this officer was confided the assaying of all the bullion, after it had been melted for coinage, as well as the coin itself, and hence he became responsible to the king for the purity of the whole coinage. Persons exercising those functions are found on record in the reign of Henry III.; but it is probable some such officer existed from the earliest period of the fabrication of money, although we are unable to define the precise date of his appointment. In after times the office, by degrees, acquired more consequence and authority, as no coin could be issued to the public without the sanction of the king's assay-master; and therefore, as Ruding remarks, he became "the sole guardian of the purity of many millions of money." And it may be added that, in modern times at least, the responsible duty has always been discharged with honour and fidelity, and to the great advantage of the public. Coinage

This ancient and honourable office was swept away, with the old constitution of the mint, in 1851.

Besides these, there was another officer of some importance in ancient times, who bore the title of *cuneator*, or keeper of the dies; and which still exists under the quaint name of "clerk of the nons." This office is supposed to have been hereditary; and the person executing its duties is said to have appointed the engravers of the dies, who were thus under his immediate cognizance and authority. He took charge of the dies as they were struck, accounted for them, and supplied the various local mints with dies. By right of office he claimed the broken dies as his perquisite.

The moneyers were persons strictly employed in the fabrication of the coin; but in what manner they were paid, and what degree of rank they anciently held, are subjects open to dispute. It cannot be doubted, however, that as regards the operative branches of the mints, they were persons of some importance, though not necessarily of high rank. In times when mechanical knowledge was rare, and skill in any art deemed a mystery, such endowments were greatly valued, and gave importance to the possessor. After a careful analysis, Ruding is disposed neither to place them in the rank of superior officers nor of common workmen. They were probably employed under a superintending head, on the part of the crown; enjoying, at the same time, peculiar rights and privileges of their own. Without being exactly a corporate body, that is, having a charter of incorporation from the crown, as a company of mechanics they may have possessed some of that exclusive spirit which characterized the trades of London. Theirs was a craft and mystery, which would naturally assume some of the consequence of other crafts. On various occasions they appear to have acted as a recognized body, and their petitions and remonstrances were listened to by the monarch as if they had rank and power separate from the general officers of the mint. This will appear quite natural and consistent to those who are conversant with the customs and usages in ancient times. Nothing can be more absurd than to measure those simple and primitive ages by the standard of modern society; and to conclude that the moneyers were only common workmen because they worked with their own hands, subjecting themselves to servile duties unbecoming officers of the mint, must only betray ignorance of history, and of the mode of life in former ages. Moneyers.

We have already observed, that they stamped their names on the coins as a mark of responsibility—a custom which prevailed at a very early period in this island; for, according to Ruding, they are found upon the money of Egbert, king of Kent, which is the second in point of antiquity in the Anglo-Saxon series, and must be dated about the middle of the seventh century. They were usually stamped on the reverse of the coin, but in some few instances they are found on the obverse, whilst the name of the monarch is removed to the other side. They amounted sometimes to 300 or 400; and it appears seven or eight moneyers were attached to each mint, employing labourers under them, when the exigencies of the case required it. In ancient times, it is said, they were compelled to march with the Vicomes when he went with the army, and were severely fined on refusal; and whenever the king came to a place where a mint existed, they were obliged to coin as much money as he pleased out of his silver. Hence they were sometimes called king's moneyers, and are so entitled in a writ of Henry III. And when one of them died, the king had a certain sum for a relief; and if he died intestate, his property devolved to the king. They paid a certain annual rent to the king, and also a kind of fine upon any renewal of the money for the dies, which were sent from the mint

Coinage. in the Tower. In some cases they had houses allowed to them rent free. And amongst their peculiar privileges, they appear to have been exempt from local taxation; for Henry III., in the writ already alluded to, commands the mayor of London not to disturb them by exacting tallages contrary to their privileges. On the other hand, on pain of disfranchisement and imprisonment, they were required not to distribute any coin till delivered into the office of receipt and assayed; they were enjoined to work whenever required; they were punished for false coinage, &c. According to Sir Matthew Hale, it was deemed treason if they made the coins too light, or not of the legal fineness.

The moneyers of modern times arrogated corporate rights and privileges, and a vested right therefore in the coinage of the country; but Ruding justly remarks, that they never were a corporate body exclusive of the other officers of the mint; for it seems in the reign of Edward I. the privileges which belonged to the moneyers alone extended to all the officers of the mint; and after various confirmations of succeeding monarchs they were afterwards granted and secured to them as a corporate body in the first year of Queen Elizabeth. Nevertheless they were a very ancient body, as we have shown, and they enjoyed not corporate but prescriptive rights of a peculiar kind, which have now been abolished, along with other rights and privileges, by an act of the legislature.

It has been contended that the names marked on the coins were not those of the moneyers, so called, but of the minter, monetarius, or mint-master, who with his journeymen under him conducted the whole operation; but such a conclusion is contrary to the truth, and directly opposed to the evidence of history as well as the authority of the best writers. The number of such names is sufficient of itself to disprove the assumption.

Seignorage. Connected with the subject of coinage is the seignorage, or profits of coinage, which appear at one time to have formed no inconsiderable part of the revenues of the crown; and which were often levied without regard to principles of justice and equity, or the interests of the people. The seignorage was not always a regular, much less a moderate rate, but depended on the caprice, the avarice, or the necessities of the sovereign. And accordingly, under one pretext or another, the coin was frequently called in and renewed, merely to augment this pecuniary advantage. "The profits of the seignorage," says Lord Liverpool, in his *Letter to the King*, "was so much considered by our monarchs as a certain branch of their revenue, that they were occasionally granted, whole or in part, either to corporate bodies for their advantage, or for defraying certain charges expressed in the grant itself. They were sometimes granted to individuals by way of pension," &c.

The seignorage was not properly a money charge for coining, but arose from a certain deduction made from the bullion coined, and comprehended—1st, the charge for defraying the expenses of coinage (included in a rate allowed to the master of the mint); and, 2dly, the sovereign's profit by virtue of his prerogative. Ruding supposes the former of these to have been almost coeval with the invention of coined money. But it is probable this deduction did not long remain limited to that simple charge, as the monarch by increasing it discovered a facile and profitable mode of enhancing his revenue. In the earliest mint account that is met with, says Ruding, namely one of the 6th year of Henry III., the profit on the coinage is stated to have been 6d. in the pound. This appears from the entries under that year of bullion coined in the mint at Canterbury, where the profit upon L.3898 is stated to have been L.97, 9s. 2d., which is exactly sixpence in the pound. Of that sum the king had L.60, 18s. 3½d., and the archbishop L.36, 10s. 10½d.; and the whole sum of L.97, 9s. 2d. is stated to be the amount of *exitus lucri*, that is, we presume, the clear profit, after all the expenses were deducted. And Coinage. this agrees with the [illegible] taken in the 28th year of Edward I., amounting [illegible] upon every pound, out of which the master of the mint had 5½d. for all expenses, and there remained 9d. clear profit to the king. But as this latter date is about 78 years subsequent to the former, it is not improbable that the seignorage had been raised during that time in the proportion of nine to six.

The profit of the *shere*, or the remedy as now it is called, was also sometimes considerable. This was strictly an allowance made for unavoidable imperfections in the fabrication of the coin, as regards weight only, which from time to time was made instrumental to the illegal gain of the king and wardens of the mint. But as there is the same chance of an increase as of a decrease in the lawful weight, it is manifest no considerable profit could be derived from this source unless by a uniform and systematic coinage of the money under the weight, though perhaps within the remedy. Some idea of the extent of such profits may be formed from the confession of Sir William Sharington, who, in the reign of Edward VI., was vice-treasurer of the mint at Bristol. He says, "that in three years he profited by the *shere* more than L.4000, answering to the king for the say and sheare 12d., and taking the profit of the rest to himself."

It is remarked, however, by Snelling in his *Silver Coinage*, that "it does not appear that our princes made any considerable advantage of this, until Queen Elizabeth, in her fourteenth year, allowed Lonison the master only eightpence, instead of fourteenpence farthing, in every pound, to bear all expenses; which obliged him to avail himself of the remedy, amounting to sixpence farthing in the pound, as appeared by the report of the commissioners appointed to examine into this affair; after which the queen empowered him, by commission, dated Dec. 31st, in her twenty-first year, to coin silver at 11 oz. 1 dwt. in fineness, and 60s. 3d. in the pound weight, which were delivered by tale, taking thus half the remedy, which amounted to about 6¼d. as before." It seems, however, that Lonison took a still further advantage, and *shered* the silver at sixty shillings and fivepence or sixpence, and the gold at L.36, 3s. and after at L.36, 3s. 6d., while he paid to the queen's subjects only 60s., or L.36 by tale, by which means the public paid eleven shillings instead of four shillings for gold; and two shillings and sixpence instead of one shilling and sixpence for silver.

Towards the latter end of her reign, and during the first seventeen years of James I., the money was again paid out by tale, and therefore the profit of the shere came to the crown, which before belonged to the merchant. The latter monarch by a proclamation made a reduction on the seignorage levied on the coin.

At the great re-coinage of silver in the reign of William III., the money is said to have been *shorn* at something more than L.3, 2s. 3d. per lb., and made current at L.3, 2s.; thus allowing 3d. per lb. weight for the profit of the shere, or rather more than eight shillings in every hundred pounds of money.

With respect to times and usages more modern, Ruding observes, that "in the present mode of conducting the coinage, very nearly the whole advantage of the shere is given to him who brings bullion to the mint; for the coins are by the increased skill and attention of the moneyers found greatly within the remedies allowed. Thus it will appear, from a reference to the account of a trial of the pyx in 1799, that when the remedy allowed has been 1 lb. 3 oz. 18 dwts., the actual deficiency has amounted to no more than 1 dwt. 15 grs. If the whole advantage of the shere had been taken, it would have produced from the coinage of about five years, which was then tried, nearly L.80,000." As silver is coined exclusively by the crown, any profit of this kind goes to the benefit of the public; but with regard to gold, the importer receives the advantage, if

Coinage.

any. For it should be observed that the remark of Ruding, on the increased skill and attention of the moneyers, is as applicable now as then to the coinage of the realm, while at the same time the remedies have suffered considerable diminution, so that the chances of gain and loss must be esteemed nearly equal.

There is, however, another more certain source of profit to the importer of gold into the mint for coinage, not alluded to by writers on the subject, and that is the increment on the assay, or on the fineness of the metal, which to that extent augments the standard weight, and consequently the value of his bullion. The assay report which accompanies the gold, and by which its market value is computed, does not according to usage come closer than one-eighth of a carat grain, or 7½ grains per lb. troy; but when the importer carries his gold to be coined, another assay is made at the mint, much finer and more delicate than the trade-assay, in order to attain the exact standard, and he receives any benefit arising from fractional parts; in a word, he has delivered to him a greater weight of coined money than his bullion represented by the assay on which he purchased it. On an average, this profit is supposed to be equivalent to about one-sixteenth of a carat grain = 3¾ troy grs. or nearly 8d. per lb. weight By a return made by the Bank of England this gain, or increase of bullion, is estimated to have amounted to the large sum of L.59,262, 16s. 6d. on L.48,659,643 coined between 1816 and 1837.

18th Char. II., cap. 5.

By an act of Charles II., the seignorage formerly levied on the coin of the realm was entirely abolished; and it was ordained that whoever brought sterling silver, or crown or standard gold to the mint should receive in exchange an equal weight of the current coin. And for the encouragement of coinage the king undertook to bear all the expenses, so that the importer received standard weight for standard, and sterling for sterling in coin, "without any defalcation, diminution, or charge for the assaying, coinage, or waste in coinage;" and to defray these charges the monarch was authorized to raise certain duties upon wines, spirits, &c., as, in the words of the act, "it cannot be reasonably expected that the expense, waste, and charge of assaying, melting down, and coinage, be borne by your Majesty."

1st James II., cap. 7.

This important act was revived and continued by James II. as a great benefit to the country, lest "this kingdom be deprived for the future of so great a good as it hath thereby for these years last past enjoyed;" and also by William III., in whose reign several acts were passed to improve the coinage, and punish those guilty of clipping the coin. In the reign of George III., at the instance of Lord Liverpool, a seignorage was again put upon silver, and so much of the act of Charles II. as related to coining silver brought to the mint without charge was repealed, as well as a former act of George III., which required sixty-two shillings to be coined out of every lb. troy of silver. 11th Geo III., cap. 12

By the act 56th Geo. III, cap. 68, it was enacted that the pound of silver should be coined into 66 shillings, "of which 62 shillings per lb. shall be delivered to the importer, and 4 shillings retained for assaying, loss, and coinage;" and any surplus, after defraying these charges, was ordered to be carried to the consolidated fund. It was further enacted that old silver coin of the realm brought to the mint may be exchanged for its full nominal value in new silver coin; but in effect this act destroyed all temptation on the part of the public to coin silver, and consequently that branch of the coinage now devolves on the crown.

At the same time that the silver currency was depreciated (though coined of the legal standard of fineness), the legal tender was reduced from L.25 to 40 [illegible] remains to this day. Formerly, gold and silver [illegible] were tenders to any amount; but, as the act declares, "great inconvenience having arisen from both these precious metals being concurrently the standard measure of value, and equivalent of property," gold coin was declared to be hereafter the only legal tender and measure of value.

The amount realized by the seignorage was formerly retained by the master of the mint to defray the expenses of coinage, agreeably to the act, and the surplus paid to the public account; but by a subsequent act of William IV., to regulate the financial arrangement of the mint, the seignorage was required to be paid into the bank to the credit of the consolidated fund, and the charges of the mint to be brought annually before parliament. 7th Will IV., cap. 9 (1837)

When the market price of silver is 5s. per ounce, the seignorage is equivalent to precisely ten per cent. (the cost of coinage being about 2 per cent.), and hence there is a very large apparent profit to the crown; but as the government is subject to the renewal of the silver currency, and to the great loss accruing from the wear of the coin, and consequent diminution of the weight, the gain from this source eventually cannot be considerable.

The following table will succinctly afford a view of the seignorage on gold and silver from as early a period as can be obtained:—

Table to show the Seignorage on the Coinage, from the reign of Edward III. to the reign of Victoria; and the variations in the value of Gold and Silver.

REIGN	One lb. of Gold coined into	Seignorage of the Crown.	Allowance to Master of Mint.	One lb of Silver coined into	Seignorage of the Crown.	Allowance to Master of Mint
	L. s. d.	L. s. d.	L. s. d.	L. s. d.	L s. d.	L. s. d.
30th Edward III.	15 0 0	0 6 8	0 1 2	1 5 0	0 0 9½	0 0 6½
Henry VI	22 10 0	0 13 0	0 2 6	1 10 0	0 2 0	0 0 7
Henry VIII.	22 10 0	0 2 6	0 1 10	2 5 0	0 1 0	0 0 10
34th Do.	28 16 0	1 4 0	0 3 4	2 8 0	0 8 0	0 2 4
36th Do.	30 0 0	2 10 0	...	4 16 0	2 0 0	...
37th Do.	30 0 0	5 2 0	...	...	...	...
Edward VI.	34 0 0	1 0 0	...	7 4 0	4 4 0	...
6th Do.	36 0 0	0 2 9	...	14 8 0	8 8 0	...
19th Elizabeth	36 0 0	2 7 0	0 1 6	3 0 0	0 1 6	...
25th Do.	36 0 0	0 6 0	0 4 9	3 0 0	0 1 10	...
27th Do.	33 0 0	0 7 0	0 5 9	...	...	...
43d Do.	33 10 0	0 10 0	0 5 9	3 2 0	0 2 0	...
James I.	40 10 0	1 10 0	0 6 5	3 2 0	0 2 6	...
10th Do.	44 10 0	2 5 0	0 6 0	...	...	...
17th Do.	44 10 0	1 1 0	0 6 0	...	...	...
Charles I.	41 0 0	1 1 5	0 6 5	3 2 0	0 2 0	...
1650 Commonwealth	41 0 0	0 15 0	0 2 5	...	...	...
Charles II.	44 10 0	Nil.	0 2 5	3 2 0	...	...
Geo. I.	46 14 6	Do.	...	3 6 0	0 4 0	...
Victoria	46 14 6	Do.	...	3 6 0	0 4 0	...

Coinage.

Supply of bullion.

As a collateral branch of the subject, it is of some interest to inquire how bullion was supplied to the mint to be coined into money.

As we have seen, Strabo and Tacitus speak confidently of ancient Britain having produced abundantly gold, silver, and other precious metals, the reputation of which afforded an incitement to conquest; while Suetonius ascribes to the pearls of Britain the temptation as well as reward to Julius Cæsar to visit the wild, barbarous, and inhospitable regions of the north. Probably both assertions are equally without foundation, originating in the fabulous character given to distant and unknown countries.

So far from the Britons being skilful in mining (who could not so much as clothe themselves with any art higher than barbarians), it is said that the brass or copper out of which their rude money was fabricated came from abroad, and that of iron they produced an inconsiderable quantity, though both iron and copper abound in England and Wales.

It appears that from an early period silver was found in Britain, which probably was extracted from the lead mines; for it is asserted that the art or process of separating silver from lead was discovered and practised in times very remote. But on this head our researches have not brought to light accurate information, and perhaps the inquiry would be deemed more curious than profitable.

In the reign of Edward I., silver was discovered in Devonshire, probably combined with lead; and as there existed a great scarcity of bullion, the laws enacted with regard to mines were exceedingly strict in requiring the silver to be brought to the mints for coinage; and of the produce of the mines, the king claimed ⅓d, while the other ⅔ds were granted to the owner of the soil. At this period a considerable amount of foreign bullion appears to have been purchased for the mint, according to the account of William de Wymondham, warden of the mint. The scarcity of the precious metals seems to have induced all manner of fraud to be perpetrated by those who worked in metals; and accordingly an act of Edward I. commands that all vessels of gold shall be assayed, touched, and marked, and that "none shall from henceforth make or cause to be made any manner of vessel, jewel, or any other thing of gold or silver, except it be of good and true alloy, that is to say, gold of a certain touch, and silver of the sterling alloy, and that none work worse silver than money. And that no manner of vessel of silver depart out of the hands of the workers until it be assayed by the wardens of the craft; and further that it be marked with the leopard's head. And that they work no worse gold than of the touch of Paris." By the laws of Edward III., goldsmiths are forbidden to melt sterling farthings or halfpennies to make into vessels; none are permitted without the king's license to convey gold or silver forth of the realm; no false money or counterfeit sterling is allowed to be brought into the kingdom to defraud the people; and to encourage coinage, "all people of what realm or dominion they be, may safely bring to the exchanges, and to no place else, bullion, silver in plate, vessel of silver, and all manner of money of silver of what value soever it be, and there receive good and convenient exchange." By another act it is rendered unlawful to exchange money, or derive any profit therefrom, except the king's exchangers; and "it is accorded, that the money of gold and silver, which now runneth, shall not be impaired in weight nor in alloy; but as soon as a good way may be found, the same be put in the ancient state as in the sterling." And it is required, that the moneyers and other wardens and ministers of the money shall receive plate of gold and silver by the weight, and in the same manner shall deliver the money when it shall be made.

In consequence of the great scarcity prevailing of halfpence and farthings of silver, it is enacted by a law of Henry IV., that a third part of the silver "brought to the bullion" be coined into these denominations, and goldsmiths and others are forbidden to melt them. And it is ordained by the same monarch, "that none from henceforth shall use to multiply gold or silver, nor use the craft of multiplication; and if any the same do, that he incur the pain of felony in this case." Coinage.

A singular law of Henry V. ordains that every foreign merchant buying wool in England to carry it abroad, shall bring to the master of the mint for every sack one ounce of bullion of gold, and for every three pieces of tin an ounce of gold, or the value in bullion of silver, upon pain of forfeiture. And that no English gold shall be received in payment but by the king's weight; a great part of the gold current being of light weight, and of inferior quality; and to remedy this great evil, the king offers pardon to all his leges who shall bring the same to the mint to be made into new money.

In the reign of Henry VI. it is enacted to the intent that more bullion be brought to the mint and coined, that the master of the mint "keep his alloy in the making of white money according to the form of his indenture." And he is required to strike, from time to time, half nobles, *farthings* of gold, groats, half groats, pence, halfpence, and farthings, for the ease of the people, according to the tenure of the indenture betwixt the king and him."

These and other laws up to the time of Elizabeth were passed with the view of encouraging coinage, intimidating false coiners and clippers of coin, and securing bullion for the mint; but their operation must, to a great extent, have been ineffectual; for as respects coining, the inducement was such that no merchant would have taken his bullion to the mint except by compulsion, as he was not only subjected to all the charges of coinage, but likewise had to pay the king's seignorage—his gold or silver being returned to him in coined money, less these onerous exactions. The profit must, therefore, have been uncertain; but, probably from finding no ready market for his precious ware, and the laws being stringent against exportation of coin and bullion, he had no alternative but to take it to the mint. As the population and wealth of the country increased, there appears to have been difficulty in supplying the country with money, and hence the crown from time to time was induced to remit or diminish both the seignorage and the mint charge.

In the reign of James I., the lead mines of Wales were discovered by Sir Hugh Middleton, and the silver from that source was coined into money.

With regard to gold, of which probably very little existed in England in former times, it is said that none was coined until the reign of Edward III., when the first entry of its being brought for coinage remains on record. But we may more strictly date the coinage of that metal from the reign of Henry III. As we previously observed, the gold of that period was coined at 24 carats fine, or pure gold, and so continued at that standard till the eighteenth year of Edward III., when it fell to 23 carats 3½ grs., and ½ carat grain of alloy; caused, no doubt, by the extreme difficulty, if not impossibility, of obtaining gold, by refining or otherwise, of a quality so superior; for it may be inferred that whatever may have been the process of refining pursued in those times, by fire or by water, there existed some method of purifying gold as well as silver, though no authentic knowledge of it has descended to us.

The high standard referred to, not exceeded by any other coins known, continued to prevail till the reign of Henry VIII., who, to augment his revenue, corrupted the whole currency, and reduced some of his gold coin as low as 20 carats fine. He likewise coined crowns of gold of the standard of 22 carats fine, which subsequently took the name of crown gold, and which, in the reign of Charles II., was made by law the sole standard of gold in England, and so continues to this day. We find that money of both

Coinage. qualities circulated in England till the reign of the latter monarch.

The difficulty referred to in supplying the mint with bullion now no longer exists, while the various expedients adopted to induce it to come to the mint are no longer necessary. When silver coin is required by the public the master of the mint orders a supply of bullion, in bars or foreign coin, to be purchased in the market, which he pays for by a draft on the Bank of England. When gold coin is called for, the bank, on the contrary, sends bullion to the mint for coinage, and supplies the public exigencies; for it may be remarked that since the merchant was enabled by law to receive at the bank the fixed rate of L.3, 17s. 9d. an ounce standard for his bullion, the temptation to employ the mint ceased; because, as the mint price for gold is L.3, 17s. 10½d. an ounce, the difference was found scarcely sufficient to cover the loss of interest on capital.

In modern times the market value of gold and silver has remained almost stationary for some years, and consequently the relative proportion of one metal to the other has scarcely varied. This fact proves that the supply and demand have been uniform; but now we have some evidence of disturbing causes, in the recent marvellous discoveries of gold in California and Australia, which may eventually destroy the equilibrium; and as the discovery of America and its treasures of silver gradually altered the relative proportions of the precious metals, so may recent discoveries in course of time effect a similar change. Remarkable, indeed, would it be, if the causes referred to were eventually to reduce the proportion of 15 to 1, the average of modern times, to 9 to 1, the proportion calculated by good authorities to have existed in the reign of Henry I. The following table shows the approximate relative value from the reign of that monarch to that of Victoria; and it may be deduced from it, that the rise in the value of gold from the accession of James I. to Charles II. was equal to 32 per cent.; and from Charles II. to George III.—a period of 135 years—no less than 39$\frac{33}{67}$ per cent.:—

Relative proportion of Silver to Gold, from the reign of Henry I. to the reign of Victoria.

REIGN.	Proportion of Silver to Gold.	Standard of Gold.
Henry I.	9 to 1	24 carats.
Henry III	10 ... 1	.
Edward III.	12 . 1	23 3½
Henry VI	10 ... 1	...
Edward IV.	11$\frac{11}{16}$ ... 1	...
Henry VIII	11$\frac{666}{720}$ 1	22 . .
34th Do	10$\frac{10}{11}$ ... 1	.
36th Do	6$\frac{6}{11}$ . . 1	.
37th Do	5 . . 1	...
3d Edward VI.	5$\frac{5}{13}$ .. 1	...
4th Do.	4$\frac{538}{538}$ . . 1	.
5th Do.	2$\frac{194}{538}$ ... 1	...
6th Do.	11$\frac{177}{179}$ ... 1	23 3½
	11$\frac{1}{10}$ ... 1	22 ...
Elizabeth	11 ... 1	..
43d Do.	10 ... 1	...
James I.	12 ... 1	.
Charles II.	14$\frac{231}{232}$ .. 1	. .
William and Mary	15 .. 1	...
George I.	15 ... 1	
56th George III.	14$\frac{888}{1000}$ . . 1	.
Victoria	15 ... 1	...

Materials of money. Among the Anglo-Saxons silver and brass formed the material of money coined by them, though foreign gold circulated to a limited extent; but, says Ruding, "the use of the latter appears to have been rejected by the Anglo-Norman monarchs, and silver became the sole material of coinage for a long extended period, until the more precious metal, gold, was introduced into the mint by Henry III." The penny was consequently the lowest coin until the reign of Edward I.; and afterwards farthings were coined in silver, and so continued as long as the increased value of silver allowed, but at length their size of necessity so much diminished, that the making of them ceased in the reign of Edward VI. Gold and silver, therefore, formed the only coins during several centuries, to the great inconvenience of the people, who required for their ordinary purchases money of a lower denomination; and it has been conjectured that some kind of metallic tokens circulated, as a substitute; for it is not possible a nation could carry on the daily transactions of life without some medium of exchange proportionate to the low value of all the necessaries of life. Coinage.

We find that James I., to remedy this evil, caused tokens of brass and copper to be struck as a substitute for the farthing, but at a value so much inferior to the rate at which they were issued, that they rapidly sunk into contempt.

Charles II., 1665–1672, amongst other great improvements, has the merit awarded to him of introducing a new coinage of copper, which was issued under certain limitations. In the year 1684 it appears some coins were also fabricated of tin; and James II. coined others of gun-metal and pewter.

Recoinage of silver. After the changes effected in the mint in the reign of Charles II. by the adoption of improved mechanical contrivances,—which caused a revolution in the various processes of coinage, and a change in the duties of the moneyers and others engaged in the mint, as well as a great reduction in the rate per pound paid to the master of the mint, and to the moneyers, by reason of the rapidity and economy resulting from the new machinery,—we have no great event to record till the reign of William III., when a great recoinage of silver took place, and when some important laws were enacted for the improvement and regulation of the currency. Notwithstanding the recoinage of the money of the Commonwealth under Charles II., and the act for the encouragement of coinage, the silver money at that period appears to have been greatly depreciated; partly by base money circulating with the silver, but chiefly by a great loss of weight caused by the dishonest practice of clipping and defacing the coin of the realm. The extent of the evil may be estimated by the fact, that no less a sum than L.7,000,000 sterling was coined in silver, the expenses of which were defrayed out of certain duties levied for that purpose. This undertaking being beyond the capacity of the mint in London, other establishments were instituted or revived, so that the coinage should keep pace with the money brought in to be exchanged. "The king," says Hume, "ordered mints to be erected in York, Bristol, Exeter, and Chester, for the purpose of the recoinage, which was executed with unexpected success; so that in less than a year, the currency of England, which had been the worst, became the best coin in Europe."

The state of the coin had previously become a national grievance, so intolerable, that it could not escape the attention of parliament; and accordingly a committee of the commons' house was appointed to deliberate on the state of the nation with respect to the currency. A recoinage was strenuously recommended by Mr Montague, who acted on this occasion by the advice of Sir Isaac Newton; but vehement opposition was made to that proposal by a large section of the house and of the people. "Another question arose," says Hume, "whether the new coin in its different denominations should retain the original weight and purity of the old, or the established standard be raised in value. The famous Locke engaged in this dispute, against Mr Lowndes, who proposed that the standard should be raised. The arguments of Mr Locke were so convincing, that the committee resolved the established standard should be preserved with respect to weight and fineness. They likewise resolved,

Coinage. that the loss accruing to the revenue from clipped money should be borne by the public." To meet this, a tax on glass windows was subsequently raised to the amount of L.1,200,000.

In order to facilitate and hasten the exchange of coin, a reward of 5 per cent. was offered to all who should bring in either milled or broad unclipped money, to be applied in exchange of the clipped money throughout the kingdom. A reward of 3d an ounce was also offered to all persons who should bring wrought plate to the mint to be coined.

A bill was likewise brought in for taking off the obligation and encouragement for coining guineas for a certain period. "Upon which," says Hume, "the commons proceeded to lower the value of this coin; a task in which they met with great opposition from some members, who alleged that it would foment the popular disturbances. At length, however, the majority agreed that a guinea should be lowered from 30s. to 28s., and afterwards to 26s. Eventually a clause was inserted in the bill for encouraging people to bring plate to the mint, settling the price of a guinea at 22s.; and it naturally sunk to its original value of 20s. 6d."

In the great controversy on the restoration of the currency at that time, Mr Lowndes, who differed from Mr Locke, wished to execute the coinage at a rate per ounce conformable to the market price of silver, so that the new currency, we apprehend, should form the standard of value; overlooking the fact, that the market price exceeding the mint price arose from the deficiency in the weight of those coins by which silver was bought and sold. "Mr Locke," says a writer on the subject, "with that acuteness for which he was so justly esteemed, contended that if 5s. 2d. of the coin weighed an ounce, that would necessarily be the market price of silver; and that its high price arose from 6s. 4d. of the then currency containing no more than an ounce of standard silver. Consequently, if the coinage were executed at a higher rate than the standard of the 46th of Elizabeth, or 5s. 2d. an ounce, it would be done at the expense of that justice and integrity between the government and the people which no [illegible] would sanction that regarded the rights of personal property. Mr Locke's arguments were so decidedly just, and so convincing, that the government carried the whole nation with them in the measure, though it was heavily felt, owing to the exhausted state of the country, after the long and expensive war it had been involved in."

Despite Locke's arguments, and the policy founded upon them, soon after the great coinage was completed the market price exceeded the mint price of silver; the consequence of which was the rapid disappearance of the new coins, which found their way to the melting-pot, and were sold in bars in the market. Hence before the year 1717 the greater portion of the recoinage had disappeared from circulation, to the detriment of the realm.

Sir Isaac Newton, in September 1717, delivered in his report on the subject to the Lords of the Treasury, in which he gives it as his opinion that gold was considerably overrated in the mint with respect to silver; and in consequence of this report, the guinea was by proclamation declared current at 21s. This reduction helped the relative proportion of gold to silver to approximate nearer to those of the market prices; and as the avowed intention of Newton's report was to give that rise in value to the silver coin which would protect it from being melted down, it appears to have answered its purpose, but only in degree. For "though the recommendation in Sir Isaac Newton's report," says the above authority, "was carried into effect by making the guinea current at 21s., yet it did not restore silver to its function as the standard of our money, and this because the current value was not made lower. Sir Isaac Newton seemed aware of this himself, and recommended that 10d. or 12d. should be taken from the guinea, instead of 6d. This, Coinage. however, was not done; and as the rate of 21s. to the guinea, the proportion of standard gold to silver at the mint, was as 15·07 to 1, the proportion of the market (as we find by the prices of gold and silver) was about 14·50 to 1—which constitutes a difference of about 3 per cent., gold being still thus much rated above its value to silver; and consequently not only was no silver coined, but the good and heavy coins were still melted for the higher price they brought in the state of bullion."

No other legislative measure having been taken than the one referred to, and the market proportion of gold to silver having seldom afforded any encouragement to the public to coin silver, we can have no difficulty in assigning a satisfactory reason for the degraded state of our silver currency during the last century, and up to 1815.

In the year 1774, and onwards, there was a general re- Recoinage coinage of the gold currency, which forms another promi- of gold, nent feature in the history of the mint. The professed ob- 1774. ject of this undertaking was the reformation of the currency, by withdrawing the light and defective coins then in circulation; but the real motive was to prevent, if possible, the new and heavy coins issued from the mint being melted down and sold as bullion. For, by reference to the prices paid by the Bank of England for gold, it appears that 80s. an ounce was the market value, while, at the same time, L.4 of the gold coin then circulating would not weigh more than one ounce. The holders of bank-notes demanded in payment new and heavy coins, which were immediately turned into bullion, and sold at the rate of 80s. an ounce; and this being done on an extensive scale, the bank was compelled to have annually a large coinage of gold to meet the demand. To remedy this inconvenience, the recoinage was undertaken and completed, and it had the effect anticipated; for the price of gold since that period has rarely ever exceeded, but has generally been under the mint price. In truth, as the price at which the bank purchases gold is fixed by act of parliament, and as the bank is compelled to buy all gold tendered to it at the price of 77s. 9d. an ounce standard, some naturally enough question the fact that we have any market price for gold bullion in England. There cannot be a doubt, however, but for that law the price of gold would have fluctuated as other things, according to the supply and demand; and it cannot but be deemed a great benefit to commercial interests to have, by means so simple, a ready and constant market for their bullion, at a price regular and certain.

Political economists disagree as to the cause of the high price of gold previously to the recoinage referred to. That eminent authority, Adam Smith, offers the following solution:—"By issuing too great a quantity of paper, of which the excess was continually returning, in order to be exchanged for gold and silver, the Bank of England was for many years together obliged to coin gold to the extent of between eight hundred thousand and a million a-year, or at an average about eight hundred and fifty thousand pounds. For this great coinage, the bank, in consequence of the worn and degraded state into which the gold coin had fallen a few years ago, was obliged frequently to purchase bullion at the high price of L.4 an ounce, which it soon after issued in coin at L.3, 17s. 10½d. an ounce, losing in this manner between 2½ and 3 per cent. upon the coinage of so very large a sum. Though the bank, therefore, paid no seignorage, though the government was properly at the expense of the coinage, this liberality of government did not prevent altogether the expense of the bank." Upon this passage Ricardo justly remarks, "On the principle above stated it appears most clear, that by not re-issuing the paper thus brought in, the value of the whole currency, of the degraded as well as the new gold coin, would have been raised, when all demands on the bank would have ceased," or in

Coinage. other words, the price of gold would have fallen to its mint price.

During the period of these important transactions the constitution of the mint remained unaltered. The various mints throughout the country appear to have fallen into disuse in the reign of Elizabeth, but some of them were revived and reorganized by William III. in order speedily to accomplish the great recoinage of silver during his reign. Subsequently to that period the provincial mints were abolished or consolidated with that in the Tower of London.

In the year 1670, the crown, while it continued his salary to the master of the mint, restored to him further the contract for melting. On the other hand, an agreement was entered into between the master and company of moneyers, according to ancient custom, by which a rate per pound, graduated to each denomination of money coined, was allowed to the latter.

In 1702 the public appear to have assumed the expense of melting the bullion into bars in order to bring the metal to standard, provided it was near to the standard when imported into the mint; whereas previously, it is thought, this preliminary expense was borne by the individual merchant or importer.

In 1799 the government withdrew altogether from the master of the mint the lucrative contract for melting, and wisely vested it in a subordinate and responsible officer, who, assuming all risk and waste, on consideration of certain *pro ratâ* allowances, relieved the crown, the master, and the public, from all responsibility whatsoever; an arrangement obviously founded on the dictates of experience, as it is also consonant with the principles of common sense.

In the course of this century, the master, who had previously been a permanent officer supervising the coinage, and possessing therefore a practical knowledge of the business, gradually became a ministerial officer, and quitted office on any change of government. The duties of the office were in this manner circumscribed, and more nominal than real; the *de facto* government of the mint devolving on a deputy whose office was permanent.

On the 7th February 1798, his majesty Geo. III., by an order in council, appointed a committee of his privy-council "to take into consideration the state of the coins of this kingdom, and the present establishment and constitution of his Majesty's mint," and the result of their inquiries and deliberation was to advise the erection of a new mint, with improved machinery. This was carried into effect in or about the year 1810.

The old mint, which had existed in the Tower for centuries, was removed to a more spacious building on Tower Hill; and the celebrated engineers, Messrs Boulton and Watt, of Soho, furnished it with engines and machinery of a character superior to anything known at that time in connection with the fabrication of money. The steam-engine was substituted for horse-power, and most of the operations carried on slowly by manual labour were with greater speed and perfection effected by the agency of those ingenious contrivances, nice adaptations, and superior power, called forth by mechanical skill and invention.

Almost simultaneous with the erection of a new and more powerful mint, a new constitution and indenture were given to it in 1815, founded on a report drawn up and presented to the committee of the privy-council by Mr W. Wellesley Pole (afterwards Lord Maryborough), who had been appointed master of the mint in the preceding year. These changes were rendered in some degree necessary by the circumstances of the case: by the enlarged establishment; the increased duties of the officers; and the necessity of a recoinage of the silver currency, as well as the introduction of new denominations of gold coin. The new organization of the mint consisted principally of an adaptation and enlargement of the old constitution, which, like that of the state, had grown up by degrees, and expanded with the wants of the public; and like the constitution of the state, it exhibited, on minute examination, some anomalies and contradictions incidental to its origin. To the same cause may be attributed its apparent want of simplicity, and clear definition of duties; but as it was found by experience adequate to encounter the greatest undertakings, and fully supply the public demands—in times, too, of great difficulty and danger—we may justly infer that if it were found wanting in latter times, the fault should rather be attributed to the management than to the constitution. Coinage.

During the fourteenth and fifteenth centuries, we have it on record that a mint-board was constituted with legislative and executive functions, composed of the three heads of offices, the warden, the master, and comptroller. This governing body was enlarged by Lord Maryborough, and consisted of the master *ex officio*, his deputy virtually the president, the comptroller, the king's assay-master, the superintendent of machinery and clerk of the irons, and, finally, the king's clerk and clerk of the papers, who acted as secretary to the board.

In the operative departments, new agreements or contracts were entered into between the master on the one part, and the moneyers, and the melter and refiner, on the other; the latter office being judiciously separated from that of the deputy-master and his duties, with which it had been previously tampered. These agreements, besides specifying the performance of duties and other obligations, secured certain fixed rates of payment to the moneyers and melter, for each denomination of coin delivered into the office of receipt, and in which rates were comprehended the repairs of machinery, the supply of labour and materials, as well as the waste or loss accruing in the various processes of coining and melting. And for the safety of the crown and master of the mint, large securities were required from the persons holding those responsible offices.

The fundamental principles had in view by Lord Maryborough, in thus remodelling the constitution and management of the mint in 1815, were a system of checks so perfect and complete, as to render fraud impossible; an arrangement with the moneyers and melter, which fully secured the public against all risk; responsibility in each distinct office; and greater efficiency and despatch as regards the coinage. These important changes having been satisfactorily accomplished, the great recoinage of silver commenced in 1816. An act was passed to call in the debased coin then in circulation; and it was enacted that the full nominal value in new money should be exchanged for the old silver brought to the mint, and the treasury was authorized to appoint receivers at various places throughout the kingdom.

The act of Charles II. as to coining silver brought to the mint without charge—the 7th and 8th of Will. III., relative to the weight and fineness of silver coin, under the mint indenture—and so much of the 14th of Geo. III., cap. 42, as requires 62 shillings to be made out of the pound troy of silver—were repealed; and it was enacted, that the pound troy of standard silver should henceforth be coined into 66 shillings, of which 62 shillings shall be delivered to the importer, and 4 shillings retained for assaying, loss, and charges of comage; the surplus, if any, to be carried to the consolidated fund. The act, making silver a tender to L.25, and afterwards by weight, was also repealed, and the tender of this depreciated currency was limited to 40s.

The effect of these acts was, first, to withdraw any inducement to the public to coin silver; and secondly, to circumscribe the circulation of the currency in silver to the country, where it became a mere token exchangeable for a limited amount of gold. Formerly, gold and silver respectively were legal tenders to any amount; but by the 56th of Geo. III., cap. 68, gold coin is declared to be hereafter the only legal tender; and so it continues.

Coinage.

In the year 1817 the first sovereigns were struck at the new mint, and in process of time entirely superseded the old guinea coinage. The mint price of gold being L.3, 17s. 10½d. an ounce, sovereigns were coined at the rate of L.46, 14s. 6d. to the pound troy.

Concurrently with the erection of the new mint, and the powerful machinery which enabled the government to prosecute with rapidity and success large coinages of both silver and gold, a refinery was established, as a necessary appendage to supply the mint with both metals in a fine state, to counterbalance the baseness of the gold and silver then brought to the mint, so as to bring them up to standard purity. This branch of business proved to be a great undertaking of itself, and for some years was extensively carried on at great cost to the public. Coarse silver was refined on the test by means of lead, and gold by the agency of nitric acid. But circumstances of a peculiar character were secretly operating to destroy the necessity for refining, for the special purpose referred to; because these tended to diminish the amount of coarse metal in the market, or rather to supply steadily large amounts of fine gold and silver.

In France a new and far cheaper process had been discovered and carried on clandestinely for many years, for refining both gold and silver by means of sulphuric acid, in large vessels of platinum; and a lucrative return for capital was found in simply extracting small portions of gold from silver, and silver from gold, which would not have yielded any profit under the old and expensive system. In consequence of this our sovereigns, alloyed partly with silver, were conveyed to Paris and refined for the sake of the silver they contained, while all silver supposed to hold gold in combination was bought up in the English market. To counteract in degree the exportation of gold coin, a refinery on the French system was established in the royal mint in 1829, as an experiment, in the first instance, at the sole expense of Mr G. F. Mathison, then melter and refiner; but subsequently he was indemnified for his outlay, and the refinery was adopted by the government under certain conditions. Mr Mathison was induced to undertake this meritorious work by the urgent persuasion of Mr Herries, the then master of the mint, who properly conceived that no public establishment in this country should, on mere economical grounds, be so incomplete as to be unable to meet all requirements of a public nature, or lag behind in the general progress of science and art. By such undertakings, when liberally supported, enterprise is encouraged, skill called forth, and science promoted. But the government, influenced by an injudicious economy, which tends to destroy all public spirit, have judged differently; and the refinery, along with the engraving department in the mint, has been abolished as a public establishment.

In the year 1837, a committee of the House of Commons was appointed, at the instance of Mr Joseph Hume, to inquire into the management and expenses of the mint, with the view of reforming the alleged abuses and corruption of that establishment; but although very voluminous evidence was taken, no report was presented, in consequence of the abrupt termination of the session of parliament. The desire of reform was then most urgent; the abuses of the mint so great as to demand instant remedy; the expenses so extravagant as to require immediate attention;—yet so fitful was this zeal for reform, that ten long years were allowed quietly to elapse before the inquiry was resumed.

Recoinage of light gold coin.

In 1842 commenced a large recoinage of light gold coin, which fully employed the machinery of the mint for a considerable period of time. This expensive undertaking was forced upon the government in consequence of the complaints and representations of the public, a great part of the gold currency having by wear fallen below its legal current weight. As the standard of value, and medium of exchange, the defective character of the gold coin influenced the foreign exchanges to the extent of its depreciation, and to the prejudice, therefore, of the foreign merchant. Moreover, the law making coin under the current weight no longer a legal tender, the embarrassment of the public would have been great if a speedy remedy had not been applied to meet the evil. The law of the case, therefore, was proclaimed and put in force; but the government on this occasion, instead of throwing the onus or loss on the individual holders of the light and defective coin, undertook to receive it from the Bank of England within a definite period, and recoin it at the public expense, returning new sovereigns weight for weight. The amount so withdrawn from circulation exceeded L.11,000,000; and the treasury not only bore the ordinary charges of coinage on this large amount, but the loss of weight, the waste in melting, the depreciation of standard, and the cost of assays. Notwithstanding this extensive purification of the currency, the evil was found to be only mitigated, not remedied; and the bank was authorized for the future to receive all light gold coin tendered at a fixed price per ounce (instead of sending it to the mint), which being thus withdrawn from circulation, is periodically melted down into bars, and treated simply as bullion. This process going on from time to time, if strictly adhered to, must eventually purify the currency, maintain the standard value of our coin, and therefore efface the reproach affixed to it here and abroad. The renovation of the silver currency is also proceeding, though by slow degrees; but, as its circulation is limited to the country, and the tender fixed by law to 40s., the evil arising from its depreciation is of secondary importance.

Coinage.

New constitution of the mint.

We have now arrived at a period in the history of the mint and of the coinage of considerable importance to the country, which comprehends a fundamental change in the constitution of the mint, and a new organization of its management. The thirst for change, which distinguishes this era, and marks all public measures, is not appeased by a simple reform; a revolution, radical and complete, can alone satisfy this restless, if not dangerous, desire. It is easy to destroy what is ancient, reared by the wisdom and sagacity of our forefathers; but it needs wise men to construct and build up again. In the zeal for change, conformable to what are called progressive ideas, and the haste and imperfection incidental to modern legislation, we lose sight of those precautions and prudential checks deemed by our ancestors necessary to such an establishment as a mint. What fate was to the ancients, economy is to the moderns; it overrules all by an iron despotism, and subjects every principle to its sway. Before it the appeal of reason is unheard, the dictates of judgment disregarded, and the teaching of experience despised. But it is not a wise economy that is aimed at, or sought for, that implies security, efficiency, and just principles; but cheapness, which is so little consistent with true economy, that eventually it proves to be its greatest enemy. The so-called principle of economy, now predominant in public measures, before which everything good, sound, and stable is made to yield, will sometimes overreach itself; and experience may teach us that if a saving be made in one direction, a loss tenfold greater will accrue in another. It may be predicted safely, that with regard to the new management of the mint, those principles will hereafter be found peculiarly applicable.

On the 15th February 1848, a commission was appointed by the Queen to inquire into the constitution and management of the mint; and, after collecting farther evidence of an unimportant character, the royal commissioners presented their report to parliament in the session of 1849.

Appended to the report, they published several papers or disquisitions on mints and mint affairs of unequal merit: an admirable analysis of the constitution of the mint, by Sir Edward Pine Coffin; a treatise by Colonel Forbes, of the

Coinage. Calcutta mint, more commendable for its theory than its practical utility; and a very long, elaborate, and antiquarian paper by the secretary, the principal object and purpose of which was to disprove the claim of the company of moneyers to the title and distinction of a corporation. The report itself, brief, clear, and explicit, proposes a thorough reform of the mint in all its branches; recommends a revision of the constitution of the mint and government, and at the same time a termination to the system of contracts, or more properly agreements, under which the operative departments of coining and melting had been carried on safely and efficiently for centuries. The only substantial charge brought against these departments was the great profits which had from time to time been derived from the coinage; but instead of diminishing the rates of charge, it was deemed expedient to place these departments on an entirely different footing.

The leading principles being laid down in the report of the commissioners, it was left to the treasury to devise the best means of giving them effect; and as a preliminary step the deputy-master, Sir James Morrison, who had served the public above half a century, was superseded by Captain Harness, of the engineers, on whose opinions and recommendations it is supposed the reform of the mint was finally accomplished. The responsibility, however, of the changes devolved on Sir John Herschel, who was subsequently appointed to fill the office of first permanent master of the mint, on the retirement of Mr Shiel, president of the commission.

An order in council, dated the 7th March 1851, empowered the master of the mint, subject to the approval of the lords of the treasury, to alter the constitution and establishment of the mint.

One of the first acts consequent on this was the dissolution of the board, as constructed by Lord Maryborough in 1815; which seems to have exercised its functions without much influence or authority, and in a manner neither to inspire sentiments of dignity nor respect; and to the weakness and irresolution of its government may be attributed many of those abuses and anomalies which had by degrees grown up in the establishment.

Under the above order in council, power was taken to give legal notice, according to their agreements, for the termination of the contracts of the company of moneyers and the melter and refiner; and ultimately these officers vacated their offices, having compensation granted to them by the treasury for the loss of their privileges and emoluments; but it appears to us not in a manner to meet the justice of the case, as regards the company of moneyers, who had claims superior to all others.

Their claim to be considered a body corporate, if illusory or erroneous, did not necessarily invalidate the vested right which they had in their offices from time immemorial; and even assuming that an order in council had authority to dissolve the company in the summary way in which it was effected (which may be doubted), it appears somewhat unreasonable to regulate the retiring allowances of such functionaries by the law applicable to the superannuation of government clerks, &c.

As we have said, the main charge made against the moneyers and melter was the largeness of their emoluments; but no attempt was made to reduce them, and the fault therefore, if any, must rest with the government. No man or body of men are expected voluntarily to propose a reduction of emolument. And, moreover, as economy was supposed to be the ruling principle in the reform, it is a grave question whether the public interests would not have been better served by retaining the services of these officers for life, who had the advantage of long-tried experience, especially as by prematurely placing them on the pension list to the annual amount of L.8000, they have involuntarily become, as all pensioners must be, burdens to their country. Coinage.

The office of the Queen's assay master, one of the most ancient and most important in the mint, was also abolished, along with that of the master's assay master. The Queen's clerk and clerk of the papers (formerly a board officer), and the weigher and teller, were converted into senior clerks.

Previously to Mr Shiel's retirement from office he was required by the treasury to report as to what measures he would recommend to carry out the reform of the mint; and in this document it appears he differed in opinion from the rest of the commissioners with regard to the abolition of all contracts in carrying on the practical operations of coining; and suggested that while the melter should be a salaried officer, the coining department might advantageously be farmed out, under certain conditions, to a respectable contractor, who would be required to give sureties to the amount of L.30,000. One of those conditions was that the government should supply the steam power, and the contractor labour, materials, &c., taking upon himself all risk and responsibility, and paying over to the government the waste of metal accruing in the various operations; and as an indemnity for this risk, loss and expenses of manufacture, it was stipulated that certain rates should be allowed on each denomination of money coined.

It was likewise suggested in the report, that a contract might advantageously be made with persons out of the mint for the supply of standard silver bars fit for coinage; and that the scissell, broken coin, and cuttings, arising from the manufacture, should be sold or exchanged.

With regard to the assay department, which in every other mint is deemed a necessary appendage, it is said, "It would be a better arrangement if several competent persons were appointed to act as assayers to the mint, on a fixed scale of fees, the master of the mint being empowered to call upon any of them to make, within separate laboratories, such independent assays as he may require, and the original reports of those assays being preserved as public records." These assayers, without any recognised official connection with the mint otherwise than their employment in that capacity, and, therefore, without any responsibility whatever beyond their characters as chemists, are in this manner intrusted with those important functions formerly discharged by the Queen's assay master; and consequently the standard of the coin of the realm is in a great measure, if not altogether, made to depend on their fidelity.

The report referred to cannot but be deemed somewhat visionary and inconsistent with all ideas of a well-managed and efficient establishment; nevertheless it received the acquiescence of Sir John Herschel, and the approval of the lords of the treasury. Its principal feature is obviously one antagonistic to the very idea of perfection, and the reverse of the practice prevalent in other well-regulated mints,—namely, the dependence of the mint on operations performed external to it. Formerly, the principle advocated by Lord Maryborough, and acted upon, was, that the mint should be capable of carrying on all the functions necessary to it: now, according to this report, it is made to rely on the skill and ingenuity of persons employed elsewhere. Economy, or rather saving of money, seems to have been the actuating motive in these preliminary arrangements; but time alone can prove whether the results of such policy are consistent with true economical principles, as well as with practical efficiency.

The project of a conditional contract for the coinage, as might have been anticipated, proved a failure; not because enterprising individuals were wanting to undertake such a business, but because the rates were fixed at a price so inadequate to the duties and responsibilities, that ruin to the contractor was a contingency far from improbable. In the

Coinage. report of Sir John Herschel, made to the treasury, it is said, "Before the contract with the moneyers had ceased, a schedule for a contract for three years for the execution of the principal part of the work performed by them, was prepared, and advertisements issued to invite competition." But though offers were made by respectable firms, the rates exceeded those fixed by the government, except in one instance; and the tenders were consequently rejected, the latter firm being unable to provide the necessary security.

The other proposed contract for the supply of silver bars was abandoned, *ab initio*, probably because, on mature reflection, it was found impracticable, if not extremely hazardous.

Viewing these measures in a practical light, we have no doubt whatever that the operations of melting and coining should be carried on by contract, as safer, more efficient, and economical; and the arguments employed by Mr Shiel in favour of such a system as regards the coining are equally applicable to the operation of melting. The chief thing to be guarded against in the working of a mint, is not so much the general expenses, such as labour, materials, and salaries, as the loss of the precious metals; for whatever saving be made by cutting down salaries and wages, even to the point of injustice, this will eventually be swallowed up by the waste of gold and silver in the fabrication of the coin. Salaried officers, unlike contractors, have no personal interest in the conduct of the business, and when inadequately remunerated at the same time, it would be folly and weakness to look for that vigilance and carefulness prompted by the dictates of self-interest; and without such checks patiently and constantly applied, we may reasonably infer that the waste of the precious metals will increase from year to year. If in such matters as coining and other collateral operations, we act agreeably to common sense, we should apply to them precisely the same principles as we apply to manufactories. The sense of duty in public officers is no doubt an element in the calculation; as also a conscientious regard for the public purse; but as these are not wholly or implicitly relied on in private matters, neither should they be in public. To the waste of gold and silver may also be added the increase of all other expenses; for it is contrary to all experience to suppose that government, by means of subordinate agents, can carry on a business like that of coining money with the economy of contractors, whose profits depend on studious attention to this principle.

These principles, however simple and obvious, have been disregarded in the reform of the mint; and we have reason to believe that already the consequences are apparent, however disguised from public inspection.

The system of contract best adapted to a mint appears to be that which combines the public officer and contractor, and which therefore differs in some respects from the system pursued in the French and United States mints. In the former, one man contracts for the whole coinage, at a specified rate, and not only pays those under him, but supplies, out of his own capital, bullion for coinage. In the latter, the coiners and melters are remunerated by fixed salaries, and allowances are made for the waste of the precious metals, not exceeding a fixed rate.

As an improvement upon these plans, we propose that officers engaged in the operative departments should be paid moderate salaries; that the government should supply the steam-power, machinery, and everything in the nature of *plant*, and keep the same in repair; and that a rate should be allowed, determined by experience and actual results, to the head of each department, out of which he should defray the cost of labour, materials, &c., and make good all waste arising from manufacture and other sources. By this simple process the crown, or master of the mint, would be relieved from all risk and responsibility. Officers acting under authority, and guarded by proper checks in the performance of their duties, are as likely to give general satisfaction, and may be as much confided in, as those employed on fixed salaries, while they would have every incitement to keep the waste and expenses within the limit allowed by government. Coinage.

This practical suggestion is founded on the impression that waste of gold and silver is not only a very important element in the expenses of a mint, but that it is an indefinite expense, varying according to circumstances, yet coming on the average within certain limits. But the same circumstances which make it vary so as to baffle nice calculations, and render control over it helpless, may, and do actually, make it gradually increase; such, for example, as ignorance, carelessness, and want of vigilance. For the question is not about large amounts, obvious and tangible, arising from robbery and such like causes, which may be traced—but to minute portions, which, however apparently small and insignificant in ordinary manufacture, swell like arithmetical progression to great value on extensive coinages. For example, a loss of only 2 grains troy per pound of gold, or $\frac{1}{2880}$th of the whole weight, over and above what is certified to be the usual waste, will, on the value of a million, amount to about L.400.

The constitution of the mint being abolished on the 26th July 1851, orders were issued for the new constitution and establishment; amongst which it is said, "The peculiar distinction recognised by the indentures of the mint between the check and executive branches of the mint is abolished. All persons employed in the mint are equally the servants of the sovereign, and all will perform their duties under the immediate orders of the master of the mint." And it is further added, that every person so employed is to consider himself available for all its duties; an order quite inconsistent with the regulations prevailing in other public offices.

The moneyers having vacated their lucrative offices, and the tenders of independent contractors being rejected, measures were immediately taken to carry on the public service in the coining department by the appointment of officers on fixed salaries. Ultimately the office of clerk of the irons and superintendent of machinery was consolidated with that of the chief coiner, who has under him several assistants and clerks.

The melter and refiner having likewise retired on a pension, the same provision was made for the service in the melting department by the appointment of an officer called "senior clerk and melter," with assistants.

The offices of Queen's assay master, and master's assay master, having been abolished, a new office was created called the "resident assayer's office," the principal duty of which is the assay of the bullion imported for coinage. At the same time other parties carrying on the art of assaying out of the mint were appointed "assayers to the mint," paid by a fee on each assay, whose employment it is, in connection with the mint, to try the assays of the gold and silver bars melted for coinage, of the presumed standard, as well as the coin itself when fabricated.

The die department is an exception to the rule, for it remains unreformed—the only change made in it being the amalgamation of the head with the coining department, the duties being supervised by a subordinate.

Circumstances of a peculiar kind for some time retarded the change contemplated in the engraving department; but the death of the chief engraver, suddenly and unexpectedly, precipitated the reform. Love of art and modern economical principles being at variance, the office of chief engraver was abolished, and a new one created, called the "resident engraver," whose duty is of a very circumscribed character. At the same time, the former assistant engraver and medalist, being dismissed from their offices, were appointed "non-resident engravers to the mint," with fixed salaries, and payments conditional on actual work executed.

Coinage.

We shall now proceed to give a practical outline of the various ingenious processes comprehended in the term coinage of money. For as it is said ten men are required to make a pin, so as many different operations are concerned in the manufacture of a single coin; such as, for example, weighing, assaying, melting, rolling, annealing, drawing, cutting-out, milling, blanching, and coining or stamping.

Although any person has by law the right or privilege to coin gold at the mint, the Bank of England is now the only importer of gold bullion; for, as by a recent act the bank is compelled to purchase all gold tendered to it at the fixed price of L3, 17s. 9d. an ounce standard, the merchant or dealer has ceased to obtain any profit or advantage by taking his bullion to the mint. As before remarked, the difference between the mint and market price of gold, and any contingent profit obtained by the advanced value given to the importer's bullion by the assay, are neutralized by the loss of interest on his capital; while the bank, on the other hand, lessens the temptation to coin by making an immediate advance on the bullion tendered for sale. The bank may, therefore, be said to have the entire monopoly of the gold coinage of Great Britain; and, as coiners, they have virtually become the sole issuers of gold coin, being enabled thereby (as is asserted) to control and regulate more effectually the whole currency.

England, with regard to its coinage, differs from other countries in this,—that while they throw the burden of the coinage on the public, and charge a rate to defray the expense, she (by an act of Charles II., subsequently confirmed by one of George III.) pays the whole expense of the gold coinage out of the public treasury, charging nothing for the cost of manufacture. Consequently, gold bullion is coined by the mint at the rate of L3, 17s. 10½d. an ounce, or 1½d. an ounce above the bank price; and the importer has returned to him in coin the exact equivalent of his bullion, standard weight for standard, having credit given to him, at the same time, for the enhanced value of his bullion computed by the mint assay,—arising from the difference paid to the merchant and the increased fineness allowed by the mint.

With regard to the silver and copper coinages, these are undertaken by the crown as its peculiar prerogatives; because, as a considerable seignorage is charged on both, it is manifest the public cannot be permitted to participate in this profit or advantage. Silver is coined at the rate of 5s. 6d. an ounce, or 66s. per pound troy, which would be a seignorage of precisely 10 per cent. when the market price of bullion is 5s. an ounce. Copper is coined at the rate of L.224 a ton weight—more than 100 per cent. profit on the average price of copper. These coins, therefore, must be esteemed in the light of tokens rather than money; and by reason of their depreciation they are restricted in circulation necessarily to the country in which they are made, and are by law a legal tender only to a limited amount.

As the crown, or the government as representative of the crown, can alone coin silver and receive the seignorage, the bullion from which it is coined is purchased in the ordinary way in the market, and paid for out of the public treasury; and the crown becomes liable for the expense of recoining the silver currency when worn out by wear and tear. Hence, when the bank "garbles" the silver coin, as it is technically called, and sends it to the mint to be melted and recoined, the bank receives the value by tale, that is piece for piece, the cost of wear falling wholly on the public. Formerly the seignorage on the coinage was retained by the master of the mint to defray the expenses of the establishment; but by a recent act it is required to be paid in full to the consolidated fund, and the whole expenses of the mint are now voted annually by parliament.

Routine of business. Gold.

When the Bank of England require a coinage of gold, due notice is conveyed to the mint authorities, and the bullion is brought in by the bank in parcels of 100 ingots or bars, weighing about 200 ounces each, or in all about L.70,000 sterling. These deliveries of bullion are officially denominated importations; and their frequency depends entirely on the public exigencies. They ordinarily amount to four each week; but in 1852–53, when the bank treasures were drained by an unprecedented demand for gold coin consequent on the discovery of auriferous deposits in Australia, the amount received by the mint each week for several consecutive months was 900 ingots—value about L.650,000; and about the same amount was returned in coined sovereigns. This was by far the largest coinage ever undertaken by the mint as respects gold, and exhibits in one remarkable instance the enormous resources and wealth of Great Britain.

Coinage.

The bullion sent by the bank is weighed at the scale the same day, in presence of the bank clerk; and assay-pieces being cut from each bar of gold, they are sent to be tried by the mint assayer, along with the assay reports on which the bank purchased the bullion; and thus he is enabled to verify the reports, or note any important errors or deviations. In the meantime the bullion is taken charge of, and locked up under the keys of the master, deputy-master, and one of the senior clerks of the mint; the weight and number of each bar being first recorded in the official books. So soon as the assayer has completed the assays, he sends his reports written on a sheet of paper, side by side with the trade or bank reports, to the master of the mint, who, after inspection, refers them to the comptroller; and upon these the bullion is rated for coinage. It should, however, be remarked that the mint assayer, with the view of reducing the bullion to the standard of our currency—namely, 22 carats fine and 2 carats alloy—is required to report the whole contents of fine gold, as far as so delicate an operation will allow; while, on the other hand, the trade assay takes no cognizance of fractional parts lower than one-eighth of a carat grain = 7½ grains troy. Thus, for example, a bar of gold reported by the trade assay B. 1·2⅛, will, by the mint assayer, be called B. 1·2⅛ + 6 grs.; that is to say, he finds six troy grains more per pound of fine gold than is indicated by the trade report; and it follows, if the bar were so much worse than it is better than standard, or Wo. 1·2⅛, the 6 grains, if discovered, would diminish the *worseness*, as it is called, to that extent.

Formerly, under the old system, these fractional differences were treated in a somewhat different manner, though the result was exactly the same. The master's assay master, whose province it was to examine the bullion at this stage, while he gave the benefit to the importer of the enhanced value of his bullion, carried off these fractions, in computing the standard, by combining the ingots or bars together and ordering them so to be melted; for example, two grains per pound *plus* would compensate for two grains *minus*.

The reports having been properly recorded in the journals against the number and weight of the ingots to which they belong, the computation is made of what is technically called the *betterness* or *worseness* of each ingot, as indicated by the assay; the former being placed in a column on the left, and the latter on the right of the journal, along with the excess grains or fractions beyond the ordinary report. This arithmetical process is called *rating*, and is more easily effected by constructing tables for the purpose, out of which the parts are taken and added together. The tables now in use are calculated decimally, though the complex notation of carats and carat grains is still retained in making the assay reports. If the importation of 100 ingots should consist of mixed gold, some of which are above, some under the standard, the columns are added separately, the excess grains added to the fineness, and then the worseness deducted from the betterness, or *vice versa*, and the

Coinage. difference either added to or deducted from the gross weight, which gives the standard weight, to be computed at the mint price of L.3, 17s. 10½d. an ounce.

A copy of this being sent to the bank and signed (called the mint-bill) shows the amount of standard bullion standing to the debit of the bank in the mint books; and it will appear that in the total sum the value of the bullion is in excess of their own account by the surplus grains on each pound, and by any increase of weight gained at the mint scale.

These preliminary processes completed in the manner described, the ingots are then classed in pots for melting, in a book called the pot-book, which affords an authenticated record of future proceedings. The importation of 100 ingots is generally divided into 16 pots, containing six or seven ingots each; and each pot is numbered accordingly. The pot-book, therefore, is an exact transcript of the journal broken up into 16 parts or sections; and the total of the one should agree with that of the other. Each pot shows the number and mark of the ingots, the gross weight of each; the betterness and worseness and excess grains; and the quantity of alloy authorized to be added to bring the whole to standard. Coinage.

The following table will suffice, as an example, to illustrate the previous description of a pot, as well as convey some idea of an importation (which consists generally of 100 ingots) showing the total gross weight, the rating, the excess grains, and the standard weight.

In the first table, the numbers are of course continued to the end in the journal, and the gross and standard weights are those of the whole importation of 100 ingots.

In the second table, the middle column represents the gross weight; the figures under, the alloy by computation; and the total, 1185·927, the STANDARD WEIGHT.

GOLD IMPORTATION—*January* 10, 1854.

From the Governor and Company of the Bank of England, 100 *Gold Ingots, viz.:—*

Nos.	Betterness Oz.	Betterness Parts	Assay Report	Weight Oz	Weight Parts.	Excess grains Per lb	Total grains.	Worseness. Oz.	Worseness. Parts	Remarks.
A. C. 101	9	·250	B. 1·0⅛	197	·35	4	788			For convenience, the excess grains per lb. are first multiplied by the ounces and then divided by 12, and the residue is converted into decimals, one-eleventh being added to the whole.
102	3	·989	3⅛	112	·35	4	448			
103	3	·667	2⅜	112	·25	4	448			
104	5	·893	3⅜	133	·85	7	938			
123	&c.		Wo. 0·1	127	·15	3	381	-1	·445	
124			0·0⅞	127	·90	1	128	1	·272	
				&c.	&c.					
	860·493									
	10·071		Gross Weight, 16781·75			12)53181		2	·717	
	870·564					11)4431				
	2·717		Standard Wt. 17649·598			403				
Add	867·847					480)4834(10·071				

EXAMPLE OF A POT.

First Pot.

Nos.	Betterness. Oz.	Betterness. Parts.	Gross weight. Oz.	Gross weight. Parts.	Excess grains. Grains troy.	Worseness. Oz.	Worseness. Parts.
LGK 61	...	...	199	·85	200	0	·284
62	...	...	199	·80	...	0	·284
63	...	...	199	·75	600	0	·567
D 362	8	·801	187	·75	188	...	...
363	8	·516	187	35	748	...	...
364	8	·681	185	·20	185	...	...
	25	·998	1159	·70	12)1921	1	·135
		·364	25	·227	160·083		
	26	·362			14·553		
	1	·135			480)174·636		
	25	·227	1184	·927	·363$\frac{114}{480}$		
	Standard weight.						

The pot-book having been verified and signed by the appointed officers, and the weight debited to the melting department in the books of the mint office, the gold bullion is then delivered over to the melter and arranged in trucks or boxes with square partitions, so that each pot is kept separate, and placed in order of its number—the marks and number of the ingots at the same time being compared with the pot-book.

The bullion thus consigned to the melting department, if not melted the same day, is locked up under the keys of the deputy-master or comptroller, the melter, and a junior clerk or assistant.

Previously to the bullion being charged into the pots, the furnaces are lighted by the workmen at an early hour, and the pots gradually annealed, as they are liable to crack by too sudden an application of heat. This is done in the following manner:—black-lead pots calculated to contain rather more than 100 lbs. weight of gold, are placed in a series of furnaces 14 inches square, and 20 inches deep from the grate. On the grate, formed of six moveable Gold melting.

Coinage. iron bars, supported by cross bars let into the brick-work, a stand is placed for the pot, usually cut from the bottom of an old pot, and the concavity being upwards it is filled with common coke dust, to prevent the adhesion of the pot to the stand. To give depth to the pot in the furnace, and allow of as much fuel as the furnace will hold, a muffle formed of baked clay is placed on the pot in such a manner that the rim of each will exactly fit, and the mouth of the muffle is covered with a flat cover made generally of black-lead. The object of this contrivance is to give an additional depth of four inches of fuel above the pot, by which a more equal degree of heat is given to the melted gold (an object of great importance), otherwise there might not be a uniform mixture of the alloy and fine gold, which is easily effected at a proper degree of temperature.

The pot being thus placed upright in the furnace, coke to the depth of a few inches is sprinkled round the pot, and a layer of ignited charcoal, previously prepared in another furnace, is thrown upon the coke, and the furnace then filled up with fuel. To prevent too rapid combustion the door of the furnace is left open, and the damper communicating with the flue is nearly shut; but when the pot is supposed to be properly annealed the furnace door is then closed, and the damper drawn out about half its length. When the pot is heated to a bright red the gold may then be charged, which is done simply by removing the cover from the top of the muffle, and with a pair of tongs carefully placing the ingots on the bottom of the pot. The gold being charged, the copper alloy, weighed by the comptroller or his representative, and checked by the melter, is added to it before being melted; some pulverized charcoal is thrown in to neutralize oxidation; and the furnace having more fuel applied is then shut up, and the damper drawn out. When the metal is thoroughly melted and the temperature deemed adequate, it is well mixed or stirred with a rod of black lead, fixed in tongs, heated to a bright red before putting it into the metal. The pot is then withdrawn from the furnace by first drawing a bar from the grate on each side of the pot, and forcing all the fuel into the ash-pit; a pair of tongs is then made to encircle the pot, to which is attached a lever, by which the pot is lifted upon the top of the furnace. By another pair of tongs, encircling the pot nearly round the middle, it is carried by a man balancing the weight in his hand, and the metal cast into four moulds—a sling from the roof running over a pulley being attached to the side of the tongs, so as to relieve the man who pours, and add a greater degree of steadiness to the operation. The man who holds the sling in one hand, with the other removes the charcoal from the spout of the pot by means of a stick, so as to give a clear stream to the metal. The pot, emptied of its contents, is returned to the furnace, the bars that were withdrawn replaced, and the ignited fuel taken from the ash-pit, thrown into the furnace round the pot, which is again charged with more gold. Such a pot, if carefully treated, may be safely used eight or ten times in the course of the day.

The weight of each pot of gold is from 90 lbs. to 105 lbs. troy, and in this manner it is melted properly in one hour, making four long bars of about 25 lbs. each, measuring 27 inches in length, 1¼ inch in breadth, and nearly one inch in thickness. Formerly four furnaces were found adequate to supply a large coinage of gold, turning out 40 pots, or 4000 lbs. weight a-day, which was accomplished in 11 or 12 hours. More could have been done, by an addition of furnaces and men, but the material could not be supplied beyond the power of the assay office; it being a rule that all assays concerning the coinage should be made within the mint, and on the sole responsibility of one officer. But, under the new system, that restriction has been abolished, in degree at least; and during the late great pressure for coin, assays were sent to private parties out of the mint, which enabled that establishment greatly to extend the gold coinage beyond what was ever experienced; and, consequently, additional furnaces became necessary to keep pace with it, which augmented the amount of gold melted on each day to 5000 lbs., or nearly one-quarter of a million sterling. During several months the amount of coined money delivered to the bank was L.630,000, or 13,500 lbs. weight; and assuming that the bars melted produced 50 per cent. of coin, it would be necessary, to meet this extraordinary demand, to melt at least 27,000 lbs. a-week, or 4500 lbs. a-day; but we believe it exceeded this considerably, as a change in the remedy of the coin greatly increased the number of spoiled pieces, while, on the other hand, the questionable alteration of the assay department caused an immense increase of damaged work in the melting department, from errors and irregularities in the assays. Coinage.

From each gold pot melted in the way described, two samples are cut for the assay, one from the first and another from the fourth bar cast. These are taken in the presence of an authorized officer, weighed carefully, and put up in slips of paper marked with the number of the pot, and then delivered to the master of the mint. The bars of gold being trimmed and cleaned are marked with consecutive numbers and a distinguishing letter, so that if any error should appear the pot can be identified and its composition traced. They are then weighed, two at a time, and the weight is registered in the day-book; and at the end of the day the assays and clippings are added to the account, so as to show the apparent waste that has taken place. The bullion after this is locked up in the melting-house stronghold, under three keys, and remains there till such time as the assay trials have been made, and an order for delivery transmitted by the master of the mint. This being done, the bars are carried to the office of receipt, and weighed in presence of an officer or clerk, who gives a receipt to the melter on the part of the coining department. On the other hand, when the melter receives what is commonly called scissell, spoiled blanks, and other pieces of metal which cannot be made into money, from the coining department, he likewise gives in the same book a receipt for the amount, distinguishing what is scissell, ends, blanks, and brokages. This specification of these returns was at one time a record of great importance, and constituted a check on the proceedings of the moneyers, who were required by the mint indenture to coin of good money seven-twelfths out of the bars delivered to them, minus the ends cut off, and hollow, brittle, or badly melted bars. Consequently the amount of scissell returned to melt should not exceed five-twelfths, and any amount beyond that was obviously to the prejudice of the melter. But now that the contract system no longer exists to cavil with carelessness and indifference, and no one's interest is affected by damaged work, the amount of scissell, by scrupulous nicety in the uniformity of the coin, has greatly increased, and consequently the expense of coinage, which is now defrayed out of the public treasury.

Silver. When silver bullion is imported into the mint for coinage, it passes through the same preliminary stages as gold; but as the crown actually purchases the silver, it also claims the right of the importer of bullion to any benefit derived from the enhanced value given by the mint assay; and this, along with the seignorage, is carried to the public account. The average weight of silver ingots is about 1000 oz. troy; and they are marked, numbered, assayed, rated and potted for melting, nearly in the same way as described of gold bullion. The weight of a silver pot is as near 420 lbs. as can practically be attained; and, generally, five such ingots constitute a pot, with the proper proportion of alloy. Silver ingots are reported in ounces and pennyweights, with excess grains over the half pennyweight, and the standard computed to that of 11 oz. 2 dwts. fine silver, and 18 dwts. al-

Coinage. loy. And, when it is found the silver ingots so imported are mixed of fine and coarse, in whatever proportions, it is the practice to combine some of each together in the same pot, adding the necessary alloy, so as to facilitate the fusion of the metal, and diffuse the alloy more uniformly.

The silver hitherto has been melted in cast-iron pots of a strong fabric, weighing about 1½ cwt. each; but these have recently been superseded by wrought-iron pots of about the same shape and dimensions, which possess some advantages over the others. The cast-iron pots referred to, and lifting and pouring machinery were introduced into the mint in 1811, and were deemed a prodigious improvement on the old, clumsy, and wasteful process of melting silver in small pots, while at the same time they enabled the mint with ease to cast 10,000 lbs. weight of silver daily into bars. At the same time iron moulds were brought into use, instead of those formerly used, which were made of sand.

The cast-iron pots, for many years after they were adopted, were found perfectly successful, and by means of them a great amount of bullion was melted safely, expeditiously, and economically, the waste of silver being much less than the usual allowance for loss by melting; but afterwards various circumstances, not originally foreseen, conspired to detract from the merit if not the utility of this alteration. In the first place, the quality of iron seems everywhere to have deteriorated, consequent, as some would infer, on the introduction of the hot-blast in reducing the ore; but more probably from the haste and rapidity with which it is manufactured. Whether from the original quality of the iron, the ignorance or carelessness of the founder, or both combined, it is certain that in subsequent years the cast-iron pots lost by degrees all the great advantages ascribed to them. In the second place, concurrent with the falling off in the castings themselves, the silver ingot, originally of 60 lbs. weight, in process of time augmented to 80 lbs. and above; and this, coupled with an excess of fine silver in the market, caused by a cheap process of refinage, rendered the fusion far more difficult and hazardous in cast-iron pots, because the degree of temperature necessary to melt fine silver bars of 1000 ozs. each, is considerably higher than can safely be used with such a material; and in such cases the pot was found disabled before it had done a fourth part of the work required of it. Moreover, the iron melting and running from the bottom of the pot left large interior fissures partly filled with silver, difficult to extract, while, at the same time, the porous character of the iron caused a great absorption of the precious metal, which was recovered only in a small degree. The great care and attention, too, during the operation of melting under such circumstances, caused an excessive consumption of fuel, and a great loss of time.

In consequence of these defects and disadvantages, the subject was taken into consideration by Sir John Herschel, master of the mint; and ultimately forged iron pots (manufactured by Messrs Horton of the works at Smithwick near Birmingham) were tried first experimentally, and then adopted, having, by the severest trial, proved eminently successful. The prime cost of such pots is of course four or five times greater than those of cast iron; but it is conceived that is amply repaid in the end by a considerable saving of fuel, by greater safety, by economy of time and labour, and less waste of silver by accidents and absorption—to which may be added the greater amount of work of which they are capable. If we suppose the melting power of a cast-iron pot to be $10 \times 400 = 4000$ lbs. weight, which on the average is not much underrated; by actual experiment, it has been found that the melting power of a forged or wrought iron pot is, on a large average, $40 \times 400 = 16{,}000$ lbs., or four times as great, which if maintained with regularity, would nearly compensate for the superior prime cost. It may, therefore, be assumed, that the latter pots will eventually supersede the former. The reason why they were not sooner introduced, or rather, why in former times they were tried and abandoned, is solely to be attributed to modern improvements, to skill, and perhaps science, applied to the manufacture of such articles. Coinage.

We shall now proceed to a description of the machinery and furnaces of the silver melting department, together with the mode of conducting the process. Silver melting.

The upper part of Plate CLXXXIII. is a perspective view of the machine for pouring the melted silver into the moulds to form the bars for coinage.

Fig. 1. A A are the furnaces in which the metal is melted. They are air-furnaces, built of fire-brick, in the usual manner of melting furnaces; but to render them more durable the brick-work is cased in cast-iron plates, which are put together with screws. B B are the covers to the furnaces, which are held down to the top plate of the furnaces by a single screw-pin for each; and on the opposite side of the cover a handle *a* is fixed. By pushing this handle, the cover is moved sidewise upon its centre pin, so as to remove it from the furnace mouth. A roller is fitted to the cover, to run upon the top plate, and render the motion easy.

The interior figure of each furnace is circular, 30 inches deep and 21 inches in diameter: the bottom is a grate of cast-iron bars, each bar being moveable to admit the air. Upon the grate, in the middle, is placed a pedestal or stand, also of cast-iron, of a concave shape, covered an inch thick with coke or charcoal dust, and upon which the pot is placed. The pedestal is nearly two inches thick, and is made fully two inches broader in its diameter than the pot, the object of which is to protect the hip of the pot from the action of the air ascending through the grate when the furnace is at work. As a higher temperature and quicker draught are used with the wrought-iron pots, than was formerly the case, the pedestal is found to melt; and as a substitute it is proposed to employ similar stands of baked fire-clay moulded to the shape. On the top or mouth of the pot a muffle is fitted, consisting of a ring of iron, six inches deep, the use of which is, as in the case of melting gold, to allow of a greater depth of fuel in the furnace than the mere length of the pot, and which also gives a greater degree of perfection to the process. The top of the ring or muffle is covered with a plate of cast-iron, to prevent the fuel from falling into the pot, and secure the metal against the action of the atmospheric air whilst in fusion. Each furnace has a flue 9 inches wide and 6 inches deep. The flue is 4 inches from the top of the furnace, and proceeding in a horizontal direction, extends to the flue C, which is 9 inches square, and is carried up in a sloping direction to the stack or chimney, 45 feet high from the grate of the furnace.

When the furnace doors BB are closed, the current of air which enters at the grate ascends through the body of the furnace, and causes the fuel, which is coke, to burn very intensely. The degree of heat required may be nicely regulated by a damper, fixed in the flue of each furnace, by the opening or shutting of which the necessary degree of heat may readily be obtained. The damper is a plate of wrought iron, fixed in a frame, and by it the space in the flue is increased or diminished at will. It is fixed in the brickwork of the sloping flue C, about 18 inches above the top of the furnace. The furnace doors B are furnished with small apertures to look into the furnace, which are closed by stoppers or moveable plugs of cast iron.

When the furnace is put to work, it is lighted by some ignited charcoal thrown into it, and around the pot, which is always in its place before the fire is lighted; and upon the charcoal coke is put so as nearly to fill up the furnace. It is customary also to sprinkle some coke previously on the bars of the grate to the depth of 2 or 3 inches, as the charcoal so placed is acted upon too quickly by the air. This being done, the door B may be shut, and the damper pulled out

Coinage. about 2 inches; but the same precautions required in the case of cast-iron pots are unnecessary with regard to those of wrought iron. In an hour or an hour and a half, the pot will have gradually attained a red heat, and then it is ready to receive the charge of silver. Soon after the silver is placed in the pot, the alloy necessary by computation to bring the whole mass to standard is added, and at the same time a quantity of coarsely pulverized charcoal is put in, sufficient to cover the surface of the metal when in a state of fusion, so that it should be protected from the action of the air, and thereby obviate any unnecessary refinement by oxidation of the alloy. When the silver is completely and properly melted, it is thoroughly stirred with an iron stirrer, so that the whole may be of a uniform mixture; and the degree of casting heat is ascertained by the surface of the metal being clear and bright; for, as the heat escapes rapidly through the pot when taken from the furnace, and as some time elapses before the whole contents can be poured off, the metal would set in the pot, or be cast too cold, if the required temperature were not previously attained. The pot is then taken out of the furnace by the crane (the fuel having been first forced into the ash-pit, by removing some bars from either side of the grate), and conveyed to the pouring machine, by which its contents are cast into the moulds.

Fig. 3 is the crane, supported by a strong column of cast-iron X., which is firmly fixed in masonry beneath the floor. The gibbet of the crane, marked WY, is cast in one piece: it has a collar at *e*, which fits upon a pivot formed at the upper end of the column X. At the lower part of the gib is a collar, which embraces the column near its base. On these two supports the gib turns freely round, so that its extremity W may be placed over either of the furnaces BB. The wheel work of the crane is supported in two frames *z z*, which are fixed to the gib by three bolts: it consists of a cog-wheel *c* upon the end of the barrel on which the chain winds, and a pinion *b*, which gives motion to the cog-wheel. The axis of the pinion has a winch or handle *a* at each end, to turn it round. The chain *d* from the barrel is carried up over the pulley at *e*, which is fitted in a part of the gib immediately over the pivot at the top of the column X. The chain then passes over the pulley W at the end of the gib, and has the tongs VT suspended to it. These are adapted to take up the pot between the hooks or claws T at the lower ends. The two limbs are united by a joint (like shears), and the upper ends V are connected with the great chain by a few links. The pot has a projecting rim round the edge, and an ear on each side into which the tongs fit, by which the pot is lifted out of the furnace. The pot being wound up to the required height by turning the handle *a*, the gib of the crane is swung round to bring the pot over the pouring machine, and it is lowered down into it for the convenience of swinging the crane round a worm fixed upon the column X at O; and a worm or endless screw is mounted in the frame *z* to work in the teeth of the wheel. When the screw is turned by a winch on the end of the spindle, it will cause the gib to move round on the column.

Fig. 2 represents that part of the pouring machine in which the pot is placed. M is an axis which is mounted in the frame of fig. 1, by the pivots at its ends. To this axis is fixed a cradle which receives the pot. The cradle is jointed together so as to open and shut, and the screw *m* draws the parts together until they closely embrace the pot. L is an arched rack, forming a continuation of the principal bars of the cradle. When the cradle is in its place, as in fig. 1, the rack L is engaged by a pinion K, and can therefore be elevated, so as to pour out the metal at a lip or spout which is made in the edge of the pot for that purpose. The axis of the pinion K is turned by means of a winch D, with a train of wheels DE, FG, and HI. The man who turns this winch stands before the pot, so as to see what he is doing. The frame of the pouring machine is sufficiently evident from the figure. It is so made as to leave an open space beneath for the carriage containing the moulds. Coinage.

Fig. 4 is a separate view of a pair of ingot moulds. The two parts R and S put together form a complete mould, as shown in fig. 5. The upper edge or mouth is a little enlarged to facilitate the pouring of the metal. The part R has the bottom and one side formed on it, and the other half S has one side formed on it. The moulds are of cast iron, nicely planed and fitted together.

Since these drawings were made at the instance of the late Mr Robert Mushet, first clerk, melter, and refiner to the mint, great changes and improvements have been introduced with regard to the moulds for casting silver bars for coinage. Originally one kind of bar only was cast, as represented by the mould fig. 4; and this, being rolled, was subsequently cut into fillets by a circular pair of shears. Bars are now cast for almost every denomination of coin of about an inch in thickness, 22 inches long, and of width just sufficient to allow of two pieces, after rolling, to be cut out diagonally from the width. By this means a great saving of metal is secured in the manufacture, and at the same time there is less variation in the weight of the pieces cut out, as there exists greater uniformity in the fillets or plates.

Though the bars are required to be of dimensions exactly proportionate to the coins to be made, it is not in all cases necessary to have separate and distinct moulds for that purpose; because a mould of a larger size may be reduced to a smaller by gauges inserted at the side of the moulds, or, as is now more perfectly done, by notches on the moulds themselves, equivalent to the diminution required, which throw forward one part of the mould when it comes in contact with the side bars, running from one end of the carriage to the other, as at *p* and *q*. In this manner a half-crown mould may be converted into a shilling; and a sixpenny mould into a fourpenny, &c.

Plate CLXXXIII., fig. 1, exhibits the carriage into which a row of these moulds is placed vertically, as shown at fig. 4; and after being arranged they are screwed closely together by screws at the sides of the carriage. The carriage, or frame itself, is supported on four wheels QQ, which run upon a railway. PP is a rack fixed on the carriage; in this rack a cog-wheel N acts; the cog-wheel is turned by a pinion, which has a handle O fixed upon it. By turning this handle the carriage is moved along the railway; and in this manner any one of the moulds (4) can be brought under the spout of the pot (2); then by turning the handle D the pot can be raised up and inclined, so as to pour the metal into the mould until it be full. Before the moulds are set up in the carriages, they are previously heated simply by sprinkling ignited charcoal over them; and before the metal is poured in they are well oiled with a sponge of tow fixed on an iron rod.

By the agency of this pouring machine, the whole contents of the pot, exceeding 400 lbs. of silver, can be poured off in a few minutes; and it is found by experience that the bars cast by it are as smooth, regular, and compact, as if they had been cast by the hand. But there is necessarily more spillage, prevented now in a great degree by side pinions fixed at the bottom of the carriages, which enable the moulds to be exactly adjusted to the varying curve of the metal as it flows from the spout of the pot. There are generally three or four carriages of moulds in daily use, so as to carry off the contents of four pots = 1600 lbs.; and when these are filled and the pots returned to their respective furnaces, the carriages are unscrewed, the silver bars taken out, quenched in water, and laid regularly upon a bench, where they are marked and numbered in their order: they are then trimmed, *i.e.* the rough edges cut off, and from each pot of 25 to 30 bars three specimens are

Coinage. cut, one from the beginning, the middle, and end of the casting, which serve for assay trials, and which are put up in slips of paper and delivered to the master of the mint. The bars are then weighed in piles of about 100 lbs. each and registered in a book; and are locked up until an order is received to deliver them to the coining department.

In the silver melting-house there are eight melting furnaces, two cranes, and two pouring machines. Each crane stands in the centre of four furnaces, freely commanding the centre of each, and conveys the pots to the pouring machine. The eight furnaces may be worked three or four times daily, with an adequate supply of moulds and workmen; but generally four are found ample to keep pace with an ordinary coinage. If the eight furnaces were put in work, and the pots charged only three times a-day, then about 10,000 lbs. weight of silver could easily be melted in eight or nine hours, and with greater economy of labour and fuel, and far less waste of silver, than by any other process. When the operation is performed skilfully, and the metal not retained too long in the fire, it has been found that the oxidation of the alloy is less than it would be if melted in a black-lead pot, or in a larger pot of iron, and the silver dipped out, as in the Paris mint, where copper is added from time to time to the fused metal in such proportions as shall compensate for the destruction of the alloy.

When the melting department was carried on under a contract, with fixed rates of payment, the melter bore all the waste arising from the various operations, and at the end of each year made up his account with the master of the mint, and made good all deficiency from that source. His situation was, therefore, one of considerable risk and responsibility; and as his profit or income depended on the proceeds of his office, deducting the various expenses, as well as losses, it was obviously his interest to conduct the business in the most economical manner. But the contract system having terminated, at the instance of modern ideas of improvement, the whole charges and expenses of this department are now borne by the government, and at the end of each quarter the account is made up and the loss of precious metal written off.

The assays of the gold and silver bars, referred to before, upon which the standard coin is manufactured, were formerly made or tried in the mint by the Queen's assay-master, who became responsible for the quality of the whole coinage; but under the new system the assays are sent by the master of the mint to persons out of the mint for examination, who are nominally attached to the establishment, but without any responsibility whatever. For this work they are paid a fee of 2s. 6d. for each assay; and when the coinage is considerable, very large emoluments are paid to these assayers, which has increased the expense of this branch beyond what it formerly was.

The master of the mint, on receiving the reports of the assays, orders the bullion which is represented by them to be delivered over for coinage, condemning such pots or bars as he finds may deviate from the standard beyond a certain amount; and these are either remelted with some addition of alloy or fine gold, or simply combined and mixed together. From some cause not ascertained, the amount of work so condemned exceeds that under the old system, and thereby enhances the cost of the coinage.

Operation of rolling. The first process to which the bars of gold and silver are subjected is that of flatting, rolling, or laminating, in the rolling-mill. Both descriptions are rolled cold; but as the operation hardens the metal, making it liable to crack at the edges, at a certain stage the bars are cut into shorter pieces, and are annealed in a reverberatory furnace, quenched suddenly in water, and cleaned with dilute acid. They are then passed repeatedly through the rollers, and gradually reduced to the thickness of the coin required.

Fig. 6. is an elevation of one pair of rollers, and the wheel-work for giving motion to them. A is the upper, and B the lower roller: CC are the standards of the cast-iron frame which supports them. Each of these standards has an opening in it to receive the bearing-brasses for the pivots of the rollers. The upper roller is suspended in brasses regulated by the large screws FF, which admit of the rollers being placed at a greater or less distance asunder. This is shown by the separate figure of one of the screws; *h h* are the brasses, and *k* the hole to receive the pivot of the roller. On the upper part of the screw a collar *f* is fitted; and from this two bolts *g g* descend, and are fastened to the brasses *h h* with nuts beneath. By these the roller is suspended; but by turning the screw round, the brasses rise or fall. The brasses *h h* are fitted very accurately into the grooves or openings in the standards CC. Coinage.

For the convenience of turning both screws round together, each has a cog-wheel F fixed on the upper end of it. These are turned by two worms HH, fixed on a common axis, having a handle G in front. See the plan, fig. 8. By turning this handle the upper roller is either raised or lowered as required, but will always remain parallel to the lower one. The two standards CC are firmly bolted down to the ground-sills DD, which are of cast iron, and are imbedded in the masonry EE. These standards are moreover united by bolts *a*. At the upper part S is a cross bar fixed between the standards to support a small table or platform, on which the metal is placed when it is to be presented to the rollers.

The rollers are put in motion by a steam-engine. The crank of the engine has a cog-wheel upon it, which turns a pinion. Upon the axis of this is a very heavy fly-wheel, which turns with great velocity. On the end of the same axis there is a pinion which turns a large wheel M, and this gives motion to a long shaft NN, which extends beneath the rollers, and is continued a sufficient distance in the same direction to turn other rollers which are omitted in the drawing. At L a wheel is fixed on this shaft to turn the upper roller A, by means of a wheel K, supported in the standards *k k*, and its axis is connected with a short shaft *r* I *r*, with the square or the end of the roller A: *r r* are the sockets by which the shafts are joined, admitting of a little yielding when the roller is raised.

The wheel O is fixed on the shaft N, to turn the lower roller B, by means of the wheel P; but the wheels P and O do not touch, being of smaller diameters, and an intermediate wheel is applied on one side, so that its teeth engage with both the wheels O and P. In this manner the two rollers A and B are made to turn round in opposite directions, and then their adjacent surfaces will move together. The wheel P is supported in standards *p p*, and its axis R is connected by a shaft Q with the lower roller B.

In the rolling-room there are two long shafts connected with the fly-wheel of the steam engine, running parallel to each other at a convenient distance, which drive various smaller rollers, and shears to cut the bars.

Fig. 7 is a gauge to ascertain the thickness of the plates, which are reduced by the operation of the rollers. It consists of two steel rulers fixed fast together at one end, and at the other end a certain distance asunder, forming an opening between them which gradually diminishes to nothing. The sides of the rulers are graduated; and in using this gauge to ascertain the thickness of a piece of plate, the edge of the plate is applied to the opening between the rulers, and the divisions of the rulers show the distance it will go into the mouth or opening before it fits tight, and the thickness is ascertained by the number of the divisions.

Plate CLXXXV., figs. 3 and 4, represent a machine, or pair of circular shears used in cutting copper into plates or slips of a convenient width; formerly used in much the same

Coinage. manner to cut the plates of silver from the rolling mill but this is now superseded by improvements introduced into the mode of casting bars of various dimensions, as before described.

LL is a strong iron frame screwed down to the ground-sills of the mill, so that the cog-wheel D will be immediately over the shaft which turns the rolling-mill, and can be turned by a cog-wheel upon that shaft. The cog-wheel D is fixed upon a horizontal axis BB, supported in the frame LL. AA is a similar axis placed at the top of the frame, and turned round by a cog-wheel C, which engages with the wheel D. On the extreme end of each axis A and B a wheel or circular cutter E and F is fixed. The edges of these cutters lie in close contact laterally, and overlap each other a little. Whilst they are turning round, if the edge of a plate of metal is presented to them it will be cut or divided just in the same manner as by a pair of shears. H is a narrow shelf upon which the plate is supported when pushed forwards to be cut, and G is a guide fixed upon the shelf: the edge of the plate of metal is applied against this guide when about to be cut. The guide is moveable, and the distance at which it stands back from the cutting edges or line of contact of the two cutters EF, determines the breadth of the slip of metal to be cut off.

Fig. 7, Plate CLXXXV., represents a pair of finishing rollers, viewed at the end of the frame, in order to show the manner of adjusting them; for it is only in those parts that they differ from the great rollers. The letter *a* shows one of the pivots or centres of one of the upper rollers, which is accurately fitted in a collar of brasses; which collar is held down in a cell at the top of the standard by a cap *d*, with two bolts and nuts. These are not intended for the adjustment of the rollers, as in the former instance—the lower roller being moved for this purpose. The pivot *b* of the lower roller is received in a brass bearing, which is moveable in the opening in the standard frame. The brass rests upon a wedge *e*, fitted in a cross mortice through the standard. By forcing the wedge farther in the brass of the lower roller, it will be moved nearer to the upper roller. The standard at the other end of the rollers is made in the same manner, and the wedges of both must be moved at the same time. To give them motion, a screw *f* is fitted into each wedge, and upon these screws are worm-wheels *g*, which are both moved by worms cut upon a horizontal axis that extends across from one side of the frame to the other, having a handle at the end by which to turn it round, and give motion to the screws and wedges both in an equal degree: *l* is the table on which the metal is laid to present it to the rollers.

Plate CLXXXIV. contains drawings of an ingenious and beautiful machine, invented by the late Sir John Barton, comptroller of the mint,—the object and purpose of which was to give a greater degree of accuracy to the thickness of the plates of metal. It is a draw-bench for drawing the slips of metal between dies, or steel cylinders, so as to destroy the inequalities of the plates after they have left the rolling-room. The operation is similar to wire-drawing.

Figs. 1, 2, and 3 represent a small machine for thinning the ends of the slips of metal, in order to enable them to enter between the dies through which the whole plate is to be drawn. It is a small pair of rollers, which are shown on a large scale in fig. 1; A is the upper roller, and B the lower, which has three flat sides as represented; C shows the slip of metal put between the rollers; D is a stop adjustable in the line of motion of the slip of metal C. Fig. 2 is an end view, and fig. 3 a side view, of the frame or machine in which the rollers are mounted. AB are the rollers, which are made to turn round together by pinions *ab*. F is a large cog-wheel, fixed on the end of the axis of the lower roller. This cog-wheel is turned by a pinion G, fixed on an axis extended across the machine, and having a fly-wheel fixed on one end, and at the other a drum H, to receive an endless strap, by which the machine is put in motion: a crank is formed on the middle of this axis, and a rod *d* is joined to the crank to connect it with the moving blade K of a pair of shears, of which the other blade L is fixed to the frame. The distance of the rollers is regulated by a screw *cc* at the top of each standard. These screws have pinions at the top of them, and are turned round by another pinion placed between them, and engaging the teeth of both pinions, so as to give motion to the two screws at the same time, when the middle wheel is turned round by a cross handle fixed to the top of it. If the slips of metal to be put into this machine are not exactly square at the ends, they are cut off smooth and even by the shears, which keep constantly moving; and at the same time slices of metal are cut from each side diagonally, so as to narrow the point of intrusion. The end of the slip is then presented between the rollers, not on that side which would draw it in between the rollers, as in common rolling, but on the opposite side; and when one of the flat sides of the lower roller comes opposite to the upper roller, then the piece of metal can be pushed forward between the two until the end stops against the *stop* D, as in fig. 1; and as both rollers turn round, and the flat side of the lower one passes by, the cylindrical parts of the roller will take the plate between, and roll or press it thinner at that end which is between the stops and the point of contact of the rollers. Coinage

Fig. 5 is a perspective view of the drawing machine at work.

Figs. 7 and 8 represent a section, to show how the plate of metal C is drawn between the dies by the tongs, fig. 7.

Fig. 4 is a section of the steel dies. They are two cylinders AB of steel, very hard, and turned with extreme smoothness and exactness. These are fitted into two sliders DD, and are held fast by clamp-pieces EE screwed against them. The cylinders are very accurately fitted into their beds in the slides, so that the steel shall be firmly supported, and prevented from bending or turning round, and presenting but a small portion of their circumference against the slip of metal. The sliders D are fitted into a box, figs. 8 and 9: they fit flat on the bottom of the box, and two clamps FF are screwed against the sliders to confine them to the box. The lower slider is supported by two screws *ff*, and the upper slider is forced down by a large screw G, having a cog-wheel fixed on the top of it, with a pinion and lever to turn the screws round very slowly, and regulate the distance between the dies. H is a clamping nut, fitted upon the screw, to avoid any tendency to shaking. The sliders are also bound fast sidewise, by screws tapped through the sides of the box, the points of which press upon steel plates between them and the sliders. In order to render the contact between the points of the screws supporting the under slider, and the point of the adjusting screw forcing the upper slider, still more complete—two extending screws are introduced at the ends of the dies between the sliders, by which a sufficient degree of contact to overcome the spring of the materials may be secured before the dies come into action on the slip of metal.

The box with the dies is fixed at one end of a long frame, as shown in fig. 5. This frame supports two axes AA, one at each end. Upon these axes wheels are fixed to receive the endless chains BB, moving along a sort of trough or railway formed on the top of the frame. The chains are kept in motion by a cog-wheel C, fixed upon the axis most remote from the box of dies. This cog-wheel is turned by a pinion D, on the axis of which is a wheel E; and this wheel is turned by a pinion F, on the axis of the drum G, moved by an endless band proceeding from some of the wheels in the mill, and which is thrown in and out of gear at pleasure by the tightening roller. The plate of metal is drawn through the dies by the chain, with a pair of tongs,

Coinage. figs. 6 and 7; and *ab* are the two jaws of the tongs, united to each other by the pin *c*. This has a small roller or wheel fitted on each end to run upon the railway on the top of the frame: *dd* are a similar pair of wheels, the axle of which is connected with two links *ee*; this axle passes between the tails of the tongs, but is not fixed to them. The ends of the links have a double hook formed on them, as shown at fig. 7. The tongs run upon their wheels immediately over the endless chain, so that, when the end of the links *ee* is pressed down, one of the hooks catches on a cross pin of the chain, as in fig. 7. The axle of the wheels *dd*, acting between the inclined parts of the tails of the tongs, tends to throw them asunder, and, at the same time, the jaws of the tongs bite with very great force, while the links *ee* draw the tongs along with the chain B B. The links are carried a long way beyond the axle of the wheels, and have a sufficient weight *h* fastened to them, which will lift up the hooked end *f*, and disengage it from the chain, except when there is a considerable strain on the tongs.

To use this machine, let us suppose a man to take hold of the tongs by the handle *r*, when disengaged from the chain, and push the tongs forward towards the box of dies. The tongs run freely upon their wheels, and the jaws open when moved in that direction, because two small pins *ii* are fixed across between the links, and acting on the outside of the tails of the tongs close them together, and thus open the jaws at the same time. The tongs are pushed up close to the box with the dies, and the jaws enter a recess N, fig. 8, formed for that purpose. Then with the other hand a plate or slip of metal is taken, previously made thin by the rollers, fig. 1, and introduced between the dies (on the opposite side), and also between the jaws of the tongs, which are open. The man who holds the tongs now takes the handle *s*, fixed on the back of them, and holds it fast, whilst with the other hand he draws the handle *r*, at the end of the links, away from the tongs. This has the effect of closing the mouth of the tongs upon the slip of metal. At the same time that he depresses the handle *r*, the hook at the end of the links *ee* will be caught by the first cross pin of the chain which comes beneath them. This puts the tongs in motion; but the first action is to close the jaws and bite the plate of metal with great force, in consequence of the axle-tree of the wheels being placed between the inclined planes of the tongs. When the tongs have thus closed on the metal, they move along with the chain, and draw the plate through the dies, which, operating upon the thicker parts of the plate with greater effect than upon the thin, reduce the whole to an equal thickness. When the whole length is drawn through, the strain upon the tongs is instantly released, and the weight lifting up the hook at the other end of the links, they are ready to be again advanced to the dies to draw another plate. The frame, fig. 5, contains two pairs of dies, and the same wheel serves for both.

The plates so drawn are cut up into shorter lengths, and out of each piece a blank is cut by a hand-cutter and weighed, and if on this trial the plate is found accurate, it is sent to the cutting-out machine; but if the blank indicates too much weight, the slip of metal is passed through a pair of rollers to reduce it.

The slips of metal produced from this machine are considerably more uniform in thickness than when finished at the adjusting rollers, consequently the individual pieces are made more nearly to the standard weight, which was the chief object contemplated by the inventor. There must be also a great saving of damaged blanks, or spoiled pieces, accruing from the use of this ingenious machine.

The plates of metal thus prepared by the draw-bench are cut out into circular pieces nearly the size of the intended coins; two pieces being cut out of the width of the plate, diagonally. This is done by the cutting-out press, fig. 1, Plate CLXXXV. CCCC is a cast-iron frame fitted on a stone basement. E is the screw, fitted through the top of the frame, which moves the slider F. At the lower end of the slider a steel punch *a* is fixed, having a diameter exactly equal to that of the pieces to be cut out. C is the steel die, which has a hole in it of a proper size to fit the steel punch: *d* is a box with screws for adjusting the die, so that the hole in it be exactly beneath the punch. Coinage.

The slider F is fitted into a socket G, which so guides it that it shall descend correctly into the hole in the die: *b* is a piece of iron fixed at a small distance above the die *c*, which has a hole through it to admit the punch. The use of it is to hold down the piece of metal when the punch rises, otherwise the piece would stick to the punch.

On the upper end of the screw a piece Q is fixed, and an arm projects from it with a weight P at the end; and it is this weight that gives the necessary momentum to punch out the blank. D is a spindle fixed upon the piece Q in the line of the screw, supported in a collar A at the upper end, and above the collar a lever DGF is fixed; at one extremity of this lever there is a roller F acted upon by projecting teeth, which are fixed in the rim of a large horizontal wheel turned round by a steam-engine. This action is explained by fig. 2, which is a horizontal plan of the upper part of the axis. SS is a part of the rim of the large wheel, and T one of the projecting cogs, which, when the wheel turns in the direction of the arrow, will take the roller F at the end of the lever FD, and turn the lever round in that direction, winding up the screw and elevating the punch at the same time. This action also draws a rod H, connected with the lever by a joint, while the other end of this rod is connected with a bended lever, from the other arm of which a rod descends having a piston fixed to it. This piston is fitted into a close cylinder, and hence when it is elevated it makes a vacuum in the cylinder, and the pressure of the atmosphere on the piston causes a reaction. The instant that the roller F escapes or slips off from the tooth I, the reaction of the piston draws the joint H back, and makes the screw turn round in that direction, causing the punch to descend into the die; and in this manner it will pierce out a blank from a plate of silver or gold, laid upon the die, exactly of the same size as the punch. When the machine requires to be stopped, a catch K is allowed to rise up and hook the lever G, so that it cannot return by the action of the exhausted cylinder and pierce the plate. This catch is shown in fig. 8. At K it is moveable on a joint *l*, and is thrown upwards by a spring *k*. To this spring a cord O is fastened, and the lower end of the cord has a treadle attached to it. The boy who applies the plates of metal to the machine places his foot upon the treadle, and draws down the spring and the catch K, and then the machine will make a cut every time that a cog T of the great wheel S passes by; but if he relieves the treadle, then the spring *k* lifts up the catch K, as in fig. 8; and when the end of the lever G comes over the catch, it will be caught by it and held fast from returning by the action of the exhausted cylinder. The joint *l* of the catch is made at the top of a long lever *l* N, of which *m* is the centre pin, when the lever G is detained by the catch K: if the end N of the lever is drawn towards fig. 1, it draws the lever G still farther, so that the roller F will be raised quite clear of the tooth T of the great wheel; and thus prevents any unnecessary wear of the machinery when the process is stopped.

Twelve of the cutting-out presses, fig. 1, are arranged in a circle round the great wheel SS, which is turned by a steam-engine, and has a large fly-wheel fixed upon the same axis, just above the wheel S, to regulate the motion. The air-cylinders are concealed within hollow pilasters, which ornament the walls of the room: the rod H is jointed to a piece *h*, fitted to slide upon the lever FG, and moved by the screw I, so as to allow it to be fixed at any required distance from the centre, and give a greater or less effect to

Coinage. the reaction of the exhausted cylinder. R, fig. 1, is a strong wooden spring, against which the balance-weight P strikes to stop its motion, when it has made its required stroke to pierce the plate of metal.

This machine was invented by Boulton of Soho, but in mechanical contrivance it is esteemed to be far behind the age.

The blanks, after being cut out by this machine, are carried to what is technically called the sizing-room, where each piece of gold is accurately weighed in a small pair of scales, and rung on a sounding iron, while the silver blanks are tested by taking the average weight of a certain number of pieces. In this operation a remedy or allowance is taken on each piece of gold, and if the blanks exceed that weight or fall short of it, they are rejected for melting, no rasp or file being, as formerly, allowed to adjust them to the standard weight. This remedy having been recently reduced by one half, the amount of spoiled pieces has greatly increased, to the prejudice of the public expenses, and, as far as we can see, without any countervailing advantage. Extrem accuracy, like gold, may be purchased too dear.

Nothing could be more clumsy, inartificial, or unscientific, than the mode pursued for so many years in sizing or weighing the blank pieces; but now we have the satisfaction to note, amongst other minor improvements in the mint (so far behind the age in mechanical invention), the introduction recently of a series of beautiful and highly-finished weighing machines, which reject both heavy and light pieces with great precision; but as these do not properly come under the subject of coinage, we shall refrain from wearying the reader with a minute description of them, or the principles on which they are constructed.

Operation of milling The next operation is that of milling or raising the edge of the blanks after they have left the sizing-room, to prevent the coins being clipped or filed—a fraud commonly practised upon the ancient money made before the introduction of milling and lettering round the edge. The construction of the milling-machine will be easily understood upon the inspection of figs. 5 and 6, Plate CLXXXV., the former being an elevation, and the latter a plan of the same. The parts which operate upon the blank-piece consist of two steel bars or rulers, *dd* and *ee*, the adjacent edges of which are cut or fluted. The bar *ee* is immoveable, being fastened down by two clamps *hh* to a cast-iron plate DD, forming the base of the whole machine; the other bar *dd* is prevented from rising by the pieces *gg*, but has the liberty of moving backwards and forwards in the direction of its length, and is guided in such movement by laying half its thickness in a groove formed in the plate DD. A rack CC is fixed to the moving ruler which engages the teeth of the wheel B, mounted on an axis lying across at right angles to the ruler, and supported at its ends by two standards rising up from the plate DD. On one end of this axis a handle is fixed to give motion to the machine. The ruler *ee* can be made to approach nearer to or recede farther from the ruler *dd* by the two screws *ff*, so as to be taken in different sized pieces between them. The operation of the machine is very simple. Two blanks being placed between the edges of the rulers, the handle A is turned round half a turn, which moves the ruler *dd* endwise sufficient to mark the blank all round the edge. The two milled pieces being then taken out, and two others inserted between the rulers, the handle is turned round in an opposite direction, which carries the ruler *dd* back again to the position in which it first stood, and thus two more pieces are marked. This description may suffice to illustrate the principle of the marking-machine. But by gradual improvement several practical alterations of great importance have been introduced; and the machines have been multiplied in number, and increased in efficiency, to keep pace with the great coinages of modern times. They are now worked by steam, and many pieces are marked at the same time with great rapidity, while one man suffices for attendance on each machine. By means of Coinage. a hopper fixed above the machine the blanks are supplied, and the machine feeds itself, the marked pieces falling into a vessel placed beneath.

By the various operations described, the blanks are found Annealing. to have acquired a great degree of hardness, overcome in the following manner, so as to prepare them to receive the impression of the die. The blanks are placed regularly in rows in a case of iron which contains 2804 gold pieces, and a wrought-iron cover is placed over them, and carefully luted round the edges with soft clay, to exclude the action of the outward air: the case is then hoisted by a pulley and tongs and placed on a small carriage running in grooves, which is consigned to a reverberatory furnace, where it is allowed to remain till the blanks have attained a dull-red heat. It is then taken out by the same apparatus, and the contents are emptied into copper cullenders, which are placed over a fire in a boiler containing a very weak solution of sulphuric acid; and the blanks are then well washed or rinsed in cold water. On the action of the hot acid, the pieces are not only relieved from all oil and stains on the surface, but as regards gold, it assumes the bright colour of fine gold, while it gives to silver a dull or frosted appearance, supposed to add to the beauty of the coins when stamped. In the process a minute portion of the alloy is dissolved from the surface by the acid. As copper is more easily acted upon by acids, the blanks of that metal are allowed to remain for some time in a very weak mixture of cold acid and water, which gradually removes the stains and restores the colour. The blanks having been thoroughly dried, first by riddling them in warm saw-dust, and then by turning them over a slow fire, they are prepared for the next process, which constitutes them coins of the realm.

Plate CLXXXVI. is a coining or stamping press, of which Operation of stamping. eight exist in the mint. Fig. 1 is an elevation of the press; CCB is a strong cast-iron frame, firmly screwed down upon a stone basement by the screws *ee*; the upper part B is perforated perpendicularly to receive the screw DD. One of the steel dies which strike the coin is fixed to the lower end of this screw by a box 4, and the other die is fixed in a box 6, fastened down upon the base of the press. The heavy balance-weights RR are fixed on the top of the screw, which, being turned round, presses the upper die down upon the blank piece of coin which is laid upon the lower die, and gives the impression—a sufficient force being obtained from the momentum of the loaded arms RR. The motion is communicated to the screw by a piece A, which ascends to the ceiling of the coining-room, and is worked by an engine, with machinery placed in the apartment over the coining-room. A steam-engine of 10-horse power exhausts a large air-chamber, and forming a vacuum, gives motion to an air-engine which works a series of air-pumps communicating with the machinery of the stamping-presses; and it is found that the movement communicated in this manner is more equable and regular than by a common condensing engine, necessary in machinery where the different movements, as in the stamping-presses, require to be extremely regular and exact both in time and motion.

Eight presses, similar to fig. 1, are placed in a row upon the stone basement, and strong oak pillars are erected at intervals upon the basement which reach to and support the ceiling. Each press is contained between four such pillars, and iron braces are fixed horizontally from one pillar to another on the opposite side. These braces support blocks of wood, against which the ends RR strike, to stop them from moving farther than necessary, as, without such precaution, the hard steel dies would sometimes come in contact and be broken. The piece of blank coin is contained within a steel ring or collar whilst it is stamped, and this preserves its circular figure. Being a little larger in diameter than the collar, it is by the blow forced into the col-

Coinage. lar, and spreading, receives the impression on the edge from the collar. The ring or collar is shown of a large size at W in fig. 5. V is a three-pronged spring, which always bears the ring upwards; the opening through the ring W is made to fit upon the neck of the lower die T, fig. 6. When the ring is dropped upon the neck of the die, the upper surface of the ring and of the die will be in one plane. The ring admits of being raised up upon the neck, and will then form a recess or cell just adapted to receive a piece of money. The collar W is made to rise and fall upon the neck of the die by means of the levers GG, fig. 5; these are fitted upon centre pins or joints in a large ring *gg* placed on the outside of the box, fig. 6, containing the lower die, and is fixed fast upon it, as shown at 5 and 6, fig. 1, by damping the screws *gg*. The levers GG are forked at the outer ends to admit studs at the lower ends of iron rods EE, which rise up through holes in the solid metal of the press, and are united to a collar G fitted on the upper part of the screw D. When the screw of the press is turned back, and the upper die raised up, the rods elevate the outside ends of the short levers G, while the inside ends depress the ring. A blank piece of money being laid upon the die, and the screw turned to bring the upper die upon it ready to stamp the impression, the levers G are released, and the triple spring V lifts the collar up, so that it surrounds the blank, and in this state the blow is struck. Immediately after, the press returns by its recoil, and then the levers G force the collars down upon the neck of the die and leave the piece free. The lower die is fixed in a box, fig. 6, by force screws *tt*, which admit of adjusting it with precision beneath the upper die. The box, fig. 6, is screwed down upon the base of the press by four screws. The upper die is shown at S, fig. 3, which explains how it is fastened to the screw; *vv* are four screws by which the die is held in the box, fig. 3. The box is fitted into a ring or collar, as shown by the dotted lines F; see also fig. 1. The arms of the collar F are attached to the rods EE by two nuts at each end, and this makes the collar F and the box 3 always follow the screw, and keep a close contact with the end of the screw which enters into a cell in the top of the box, fig. 3, but leaves the screw at liberty to turn round independently of the box.

Fig. 2 is a ring fastened by its screws *w w*, to the screws of the press; a claw V descends from the ring and enters the cavity *o*, in the edge of the box, fig. 3, which cavity is near three times as wide as the claw V, and therefore allows the screw to turn round for a certain distance without turning the box, fig. 3; but beyond the limits of this motion the screw and die will turn together. The intention of this is to press the upper die down upon the coin with a twisting or screwing motion; but if the die should rise up with a similar motion, it would abrade and destroy the fine impression; for this reason the notch *o* is so wide as to allow the screw to return and raise the die from immediate contact with the coin before it begin to turn round with the same motion as the screw.

Fig. 4 is a box screwed over the box for the upper die, as shown in fig. 1, in order to keep the latter firm in its cell.

The great screw of the press is made cylindrical at the upper and lower ends, as may be seen at DD, fig. 1, and these ends are accurately fitted in collars, bound tight by the screws *a a*. The real screw or worm part concealed within the solid metal case B, has no other office than to force the die down, the guidance laterally being effected by the collars *a a*.

It now remains to show by what contrivance the press is made to remove the pieces when stamped, and to feed itself with fresh blanks, so as to maintain the operation continuously.

Fig. 1, HIK, is a lever, of which I is the fulcrum, supported on a bar Q, fixed vertically from the cheek of the press, and kept steady by a brace *h*. The upper end of the lever is actuated by a sector T (see fig. 7), fixed upon the screw D. When the screw turns round, the groove in the sector, being of a spiral curve, will move the end H of the lever to and from the screw; and the lower end K of the lever being longer, it moves a considerable distance to and from the centre of the press; *b* is a socket or groove in a piece of metal fixed to the perpendicular bar Q, and the upper end of the lever H is guided in this groove to prevent any lateral deviation. Coinage.

The lever K gives motion to a slider L, fig. 8, supported in a socket O, screwed against the inside cheek of the press, and the slider 8 is directed exactly to the centre of the press, and on the level of the upper surface of the die.

Figs. 8, 9, and 10, represent three views of the slider and socket. NMO is a kind of trough in which the slider runs. This slider is formed of two pieces hollowed out on the sides, which are put together, and the two pieces are held together by screws. O is the part by which the socket is fastened to the press. The slider is a thin steel plate *p* (see also fig. 10); it is made in two pieces, P and *p*, united by the joint *q*. The extreme end is formed with a circular cavity; and when the two limbs shut together as represented, they will grasp a piece of money between them, and hold it by the edge; but if the limbs be separated, the piece will drop out. The limb *p* of the slider is opened or shut by the same movement which moves the slider endwise in its socket. Thus a plate L is applied flat beneath the socket MN, having an edge turning up, and applying to the upright edge of the socket. A pin is fixed into this edge, and is embraced by the fork at the lower end of the lever K, fig. 1. By this means the sliding piece L is made to move on the outside of the socket N; and is kept in its place by a fillet *k*, fig. 9, screwed to the upright edge of L, while the fillet enters a groove formed along the upper surface of the socket N.

The sliding piece L is made to move the steel slider within the socket, by means of three studs which project upwards from the bottom plate of L, fig. 10, at *r r s*, and pass through grooves in the bottom plate of the slider, so as to act upon the steel slider P, in the manner shown at fig. 10. The left-hand piece *r* is received into an opening in the middle of the slider P, fig. 10. The other two studs *r* and *s* include the shank of the limb *p* between them, and these studs are cut inclined, so that when the piece L is moved to the right, the studs *r s* will close the limb *p* until they are shut, and then the studs will carry the slider forward; but if the sliding piece L is moved to the left, its studs will first close the limbs, and then draw back the slider. On the top of the socket N, a tube M is placed, intended to contain the blanks to be coined. The tube is open at the bottom of the slider, and the pieces rest upon it. When the screw of the press is screwed down, the slider P draws back to its farthest point, and the circle formed at the end between its limbs comes exactly beneath the tube M; the limbs being open, a blank piece of coin drops down into the circle of the slider, then the screw of the press, in returning, moves the lever HIK and the piece L; this again acts by its studs upon the moveable limb *p*, and closes it upon the blank piece. The studs, having now found a reaction, push the slider P forwards in its socket, and carry the piece of coin forward upon the die, as shown in fig. 1, while at the same time it will push off the piece that has been struck. The screw having now arrived at its highest position, begins to descend, and the slider L to return; but the first action of the studs of the sliding piece L is to open the limb *p*, and then the slider withdraws, leaving the piece of money placed upon the die. As the screw of the press descends, the ring W, fig. 5, rises up to inclose the piece as before mentioned, whilst it receives the stroke, and the slider P at the same time returns to take another piece from the tube M in the same manner as before described

Coinage.

By these ingenious and effective contrivances, each coin is perfectly stamped with one blow of the press; and the quickness and nice adjustment of the various movements are such, that each press can coin or stamp between 60 and 70 pieces a minute.

Fig. 11 is a section to show the manner of mounting the lower die for a coining press. V is a piece of metal or box as it is placed upon the base of the press, held down by a ring with screws *t*, which holds it fast, but admits of lateral adjustment. In the top of the box is a hemispherical cavity to receive the hemisphere W; the upper side of which is flat, and the die T is placed upon it to hold the die down; it has a small projecting rim at the lower edge, and a rim X is screwed upon the outer edge of the box V, which binds the die down. The object of this plan is, that the die may always bear fairly to the money which is to be struck.

Figs. 12 and 13 represent a divided collar for striking money with letters round the edge. X is a very strong piece of iron, having a circular opening through the centre. Into this six segments *w w* are fitted, and a circular space or opening W is left in the centre, the size of the piece of money to be impressed. The inner edges of these segments are engraved with the letters or device required to be impressed on the edge of the piece. The segments are fitted in the piece X, by centre pins *y*, fig. 12, upon one of which pins each segment can rise in the manner of a centre. The intention of this is to have a piece of money placed on the die within the space W; and when the pressure is made upon the piece, the die descends some space, and by this motion the segments close together around the edge of the coin, and leave the impression on it. When all the segments come into one plane, the die becomes firmly seated, and the metal receives the stroke which makes the impression on its surfaces. The die is suspended in a sort of cup, which rises and falls with the screw, nearly the same as the collar F in fig. 1.

Disposal of the coined money.

During the process of coining, a man in attendance continually inspects specimens of the coins as they issue from the press, in order to detect any fault or blemish in the dies, while another is engaged in examining the money collected from the presses in wooden trays, who throws out for melting any pieces imperfectly stamped, &c. The coin so examined is weighed up in what are called journey-weights; the gold in 15 lbs. and the silver in 60 lbs. troy; and before delivery, the former are passed through the weighing machine to detect finally any pieces deviating too much from the standard weight.

On appointed days the coins, placed in bags of the weight before mentioned, are then delivered over to the office of receipt, in the mint office, where they again undergo inspection by the proper officers, and are pyxed.

Process of pyxing.

By the process of pyxing, as it is technically called, the weight and fineness of the coined money is determined before it is delivered to the importer or to the public. It consists in taking from every journey-weight of gold and silver a pound in tale promiscuously, which is weighed in an accurate balance, the plus or minus over or under the standard weight being declared by the weigher, and recorded by the clerk. This determines within certain limits whether the money has been made within the remedy allowed by law. From the same pound weight of silver or gold, two pieces are taken, the one for the master of the mint, to be assayed, in order to test the fineness of the whole coin; the other for subsequent examination at the general trial of the pyx; and the coins so taken, one from each journey or bag, are sealed up in a packet, and put into a chest, called the pyx-box, locked up under the separate keys of the master and comptroller, there to remain until the general trial of the pyx referred to. When the assay-trial of the piece has been examined and proved to be of the legal standard, which, in this case, is taken as the average of the whole journey-weight, the master of the mint authorizes the money to be delivered to the importers of the bullion, who give a proper receipt for the same. Coinage

The general trial of the pyx takes place at irregular periods before a jury selected by the lord chancellor, and comprehends an examination by weight and assay of all the money coined during a given time; and the verdict delivered by the foreman of the jury to the chancellor relieves the master of the mint from further responsibility as regards the past. While the company of moneyers were intrusted with the coinage of the money, the trial of the pyx was uniformly favourable to their skill and accuracy, as well as to the skill and vigilance of that important and responsible check officer, the Queen's assay-master; but as no trial has yet (1854) taken place under the new system, we are unable to draw any conclusion from it, either in point of skill or accuracy.

The company of moneyers, like the melter, carried on their business by a contract or agreement with the master of the mint for the time being, by which they were bound to make good all waste or loss accruing in their department, as well as to supply labour and materials. Now salaried officers conduct the various operations connected with coinage, the government taking upon itself the general expenses, the risk, and responsibility; and all waste in manufacture or loss from other causes is borne by the public, and defrayed out of the treasury. Formerly, the moneyers and melter gave heavy bonds of security to the master of the mint, as a guarantee against loss. Now no security whatever is exacted from any officer acting under the master, except from the person employed in superintending the melting department.

Under these circumstances, it is a question which time alone can solve, whether the government can manage an establishment like a mint (which, after all, is only a manufactory), as safely and economically as if carried on by contracts or agreements at moderate rates of payment.

Method of making the dies.

It remains for us briefly to describe the method pursued in making the dies for coinage.

An original die is engraven upon a piece of soft cast steel of the size of the money to be coined. The device or design is, of course, cut into the steel, and its depth is proportionate to the relief ultimately wanted upon the coin. When the engraving is finished, the die, or matrix, as it is called, is hardened; a process requiring considerable care and attention. It frequently happens, that in this process, either from the steel being faulty or heated to excess, the die flies in pieces, and the whole labour of the artist is lost. When, however, the matrix proves to be perfect, it is placed in the multiplying die press, which works in every respect like a coining press, but is moved by men. An impression is taken from the matrix upon a blank die of cast steel, similar to the mode of impressing the money. The blank die is fixed as the lower die of the coining press, and by working the screw of the press, which has very long and heavily loaded arms, the matrix is made to strike the blank die with great force, and bring its impression in *relief* upon the surface. The hardness, by compression of the steel, is so great, that a perfect impression of the engraving cannot be obtained without annealing the die, perhaps twice or thrice in an iron pot with animal charcoal, allowing it to cool gradually. An impression taken in this way is called a puncheon die. When the engraver has given all the delicate outlines of the original to it, it is hardened in the same manner as its original, and used to give the impression to blank dies by a similar process; but in this case the impression is *sunk*, instead of being in *relief*. These are the dies employed to stamp the money.

The puncheon by which the die is stamped is therefore hard, and the blank die soft steel. The process of hardening is effected by immersing the puncheon in cold water after being heated; that of softening, by placing the dies in a pot covered with animal charcoal in a furnace, and then

Coir || Coke.

allowing them to cool slowly and gradually in the pot. The blank dies are formed of cylindrical pieces of steel nicely turned and polished, having one end square and the other of a conical shape. By the first blow given by the press the cone has disappeared, and the impression becomes visible on the surface. Several blows of the press are required to perfect a die; and between each the die is softened in the manner before described. After the first blow, the die is taken to a turning-lathe to shave off the rim of metal round the impression, so as to allow the second blow to deepen the impression without spreading the steel.

The amount of work done by the dies varies exceedingly; depending, first, on the quality of the steel, and, secondly, on the character of the metal to be stamped, which differs in hardness or softness according to the nature of the alloy contained in it.

By the officer presiding over the die department, an accurate register is kept of all dies manufactured, and he accounts also to the master of the mint for all matrixes, puncheons, and dies destroyed, as well as made, in the mint; so that none be surreptitiously used or carried away. A very large collection of the various dies used in the coinage of money, from an early period, is kept in the mint, affording to the connoisseur an interesting record of the progress of engraving in England. Coke.

As a record of the coinage of the mint we append the following table, derived from authentic sources, which will be found useful:—

By a return made by the company of moneyers to a committee of the House of Commons in the year 1837, it appears that the amount of gold coined from 1558 to 1830, was L.154,762,335, 1s. 10d., and of silver, L.39,139,581, 0s. 8d.

An Account of all Gold and Silver coined at the Royal Mint from the 1st of January 1816 *to the 31st December* 1853.

Year.	Gold Coinage.			Silver Coinage.			Year	Gold Coinage.			Silver Coinage.		
	L.	*s.*	*d.*	*L.*	*s.*	*d.*		*L.*	*s*	*d*	*L.*	*s.*	*d.*
1816	..	.	..	1,805,251	16	0	1835	1,109,718	8	10	146,665	4	0
1817	4,275,337	10	0	2,436,297	12	0	1836	1,787,782	5	5	497,719	4	0
1818	2,862,373	10	0	576,279	0	0	1837	1,253,088	8	2	75,385	4	0
1819	3,574	9	3	1,267,272	12	0	1838	2,855,364	15	0	174,042	0	0
1820	949,516	0	10½	847,717	4	0	1839	504,310	14	3	390,654	0	0
1821	9,520,758	13	9½	433,686	0	0	1840	.	.	..	207,900	0	0
1822	5,356,787	12	6	31,430	7	1	1841	378,472	10	0	89,641	4	0
1823	759,748	10	0	285,271	16	0	1842	5,977,051	18	2	192,852	0	0
1824	4,065,075	0	0	282,070	16	0	1843	6,607,849	10	0	239,580	0	0
1825	4,580,919	0	0	417,535	16	0	1844	3,563,949	7	6	610,632	0	0
1826	5,896,461	7	6	608,605	16	0	1845	4,244,608	10	6¾	647,658	0	0
1827	2,512,636	17	6	33,019	16	0	1846	4,334,911	17	6	559,548	0	0
1828	1,008,559	2	6	16,288	3	1	1847	5,148,440	0	0	125,730	0	0
1829	2,446,754	12	6	108,259	16	0	1848	2,451,999	10	1	35,442	0	0
1830	2,387,881	2	6	151	16	0	1849	2,177,955	1	1	119,592	0	0
1831	598,547	5	0	33,696	5	8	1850	1,491,836	17	9	129,096	0	0
1832	3,737,065	10	0	145	4	0	1851	4,400,411	4	9	87,868	6	0
1833	1,225,269	13	6	145	4	0	1852	8,742,270	12	11	189,596	12	7
1834	66,949	12	5	432,775	4	0	1853	11,952,391	5	11	701,544	14	3
							Total Coinage,	L.121,246,628	7	9	L.14,837,046	12	8

R. M—T.

COIR, a kind of yarn manufactured from the fibrous husk of cocoa-nuts, and formed into cordage, coarse sail-cloth, mats, &c. It is chiefly made in India.

COKE, charred pit coal. See Coak.

Coke, *Sir Edward*, was born at Mileham, county of Norfolk, February 1, 1551. His father was a bencher of Lincoln's Inn, and died in 1561. From the grammar-school of Norwich Edward Coke removed to Trinity College, Cambridge, where he studied for three years. He began his legal education at Clifford's Inn, London, in 1572, and was called to the bar in 1578. He had scarcely begun to practise when he was appointed reader at Lyon's Inn by the society of the inner temple; and from the able manner in which he argued the delicate cases of Lord Cromwell and Edward Shelley, his reputation as a lawyer became so great that there was scarcely a single case before the court of king's bench in which he was not concerned. In 1586 he was chosen recorder of Norwich, and he afterwards held the same office for the city of London during the year 1592. When the plague broke out in the metropolis, he was solicitor-general and reader of the Inner Temple; and on retiring from the city was accompanied as far as Romford by an escort of upwards of 50 members of the temple. In 1594 Coke was preferred to the office of attorney-general, to the great chagrin of the Earl of Essex, who had expected to secure that appointment for his protégé Lord Bacon. Coke's success on this occasion drew down upon him the hatred and ill-will of his illustrious rival, and was the beginning of a feud which lasted with little intermission till the death of Bacon. The published correspondence of that philosopher is filled with reiterated expressions of discontent at his failure, and allusions equally bitter and unjust to the new attorney-general. In 1593 he was elected member of parliament for the county of Norfolk, and was chosen speaker to the House of Commons as soon as it convened. He retained his office of attorney-general till 1606, and was thus crown lawyer in the management of those important trials for treason which were so frequent after the enforcement of the penal laws against Roman Catholics in the reign of Queen Elizabeth. In the conduct of these, he has been charged with unnecessary cruelty in the torture and gratuitous insolence in the examination of the accused, and with conducting the prosecutions too much in a spirit of religious zeal. His behaviour at the trial of Raleigh, above all, has been singled out and branded as peculiarly outrageous. When the prisoner was defending himself with that dignity and calmness which never forsook him in the most pressing emergency, Coke, failing in his attempt to browbeat the accused, lost his temper and his presence of mind, and began to indulge in personal invective against him. He then wound up a long sarcastic address with the long-remembered phrase, "Thou hast an English face, but a Spanish heart." His conduct, however, must be estimated according to the fiery temper of the times in which he lived,

Coke.

and not according to the temper of our own; and while undoubtedly he is to be blamed for his overbearing demeanour and asperity, it must be remembered that his zeal and severity were never made subservient to the promotion of his own interests at court, and that no influence whatever could prompt him to swerve from the line of duty. In 1606 he was named chief-justice of the common pleas; and in 1613 he was promoted to the chief-justiceship of the king's bench. He had not long held this office when new honours began to pour in upon him. A few days after his elevation to the chief-justiceship, he was by a special order from the king advanced to the dignity of a privy-councillor. In the following year the university of Cambridge evinced its sense of the lustre conferred upon it by its old alumnus, and appointed him high steward. The chief-justiceship Coke owed to the influence of Bacon, who suggested the promotion of his rival avowedly for the purpose of corrupting his fidelity and rendering him subservient to the wishes of the king. In this, however, he was disappointed, as Coke was not long of giving notable proofs of his independence. The king, as is well known, attached much importance to the "divine" right. In 1615 a preacher was brought to trial for treason, for having in his possession a manuscript sermon in which it was alleged that the royal prerogative was denied. After a patient hearing Coke decided, much to the king's disgust, that the accused was guiltless. In that same year the base murder of Sir Thomas Overbury was brought to light, and Coke displayed so much zeal in the prosecution of the noble murderers, that the king, whose hands were not clean in the matter, was highly offended. Finally, Coke's independence in the case of *Commendams* (1616), in which he refused to be guided by the views of the royal prerogative as propounded by the king himself, compelled his adversaries to seek occasion for his removal from office. The immediate pretext for his dismissal was this:—A barrister, pleading in the court of common pleas, had let fall some expressions which had been reported to the king as throwing doubt upon the royal prerogative, which his majesty watched over with such jealous care. The king immediately issued orders that the case should be stopped and no farther proceedings instituted without his warrant. The judges immediately met to consider the king's message, and came to a resolution that it was *ultra vires* on the part of the king to interfere with them in the fulfilment of official duties. Enraged at this, James ordered them to appear before him at the council-table, and severely rebuked them for their refractory behaviour. Eleven out of the twelve, overawed by the king's authority rather than convinced by his arguments, acknowledged themselves in the wrong, and implored pardon. The twelfth, who was Sir Edward Coke, far from allowing himself to be brow-beaten by the king, maintained the legality of his procedure, and denounced the king's conduct as an interference with the administration of justice, and a violation of the law of the land. In consequence of this bold language, he was summoned before the council to give an account of his administration, and in November following was summarily dismissed from office. Attempts were made to convict him of malversation of office as attorney-general; but his defence was so masterly and complete that even his enemies had to declare themselves satisfied, and the charges against him were abandoned. Finding that his personal integrity was unimpeachable, Coke's enemies now did their best to make out against him a case of official incompetence. He was now summoned to answer twenty-eight objections to principles purporting to be contained in his "Book of Reports." On these points he gave such complete satisfaction to his judges, that the prosecutors dropped the case. It is a significant fact that Sir Henry Montague, who succeeded Coke in office, was expressly warned by the lord chancellor Egerton to avoid the faults of his predecessor, who had been removed for his excessive popularity. The marriage of his daughter with Sir John Villiers, however, paved the way for his reconciliation with the king, and he was soon afterwards received into considerable favour at court. Towards the close of the year 1617, he was reinstated as a member of the privy-council and employed in many important public services. In 1620 he was returned as a member of parliament for the borough of Liskeard, Cornwall; and probably to avenge the harassing attacks that were constantly made on him by the court party, he threw all his influence into the scale of the constitutional opposition. At this the king was highly incensed; and previous to the issue of the general pardon in 1621, he stipulated that Coke should be exempt from the benefits of the act, and caused him to be committed to the Tower. Coke was released from confinement in August 1622, but at the same time arbitrarily ordered to withdraw from court and live in retirement at Stoke Pogeis during the pleasure of the king. On the accession of Charles I. Coke was returned as a member of parliament; and though prevented from holding his seat by an expedient of the king, who appointed him sheriff of Buckinghamshire, the house refused to issue a new writ to supply his place. In 1628 he was returned simultaneously by the counties of Buckingham and Suffolk; and taking his seat for the former, he rendered valuable service to his country by the vigour with which he defended constitutional right, and the sagacity with which he directed the measures of the liberal party. Though now far advanced in years, he exerted himself with all the energy of youth in his various parliamentary duties. He made himself particularly conspicuous in framing the celebrated "Bill of Rights," which, chiefly by his indefatigable zeal and perseverance, was got safely through the House of Lords. The last act of his public life was to denounce the Duke of Buckingham, whose policy he exposed as the cause of much present and prospective misery to the country. At the close of the session he retired from public life, and spent the most of his time in revising and maturing those works which have perpetuated his fame as the great oracle of English law. He died September 3, 1633, repeating with his last breath the words, "Thy kingdom come, thy will be done;" and was buried in the church of Titeshall, Norfolk.

In 1582 Coke married the daughter of John Paston, Esq., by whom he received a handsome fortune; and in 1598 he was again married to the widow of Sir William Hatton, daughter of Thomas Lord Burleigh. It was on this latter occasion that having been arraigned before the archbishop's court for irregularity in solemnizing his marriage without license or proclamation of banns, he escaped by pleading *ignorance of the law*. Of Sir Edward Coke's "learned and laborious works on the laws," it has been observed that they "will be admired by judicious posterity, while Fame has a trumpet left her, or a breath to blow therein." These are, 1. his Reports, in 13 parts, 1600, folio; 2. a Speech and Charge at the Norwich Assizes; 3. his Institutes, of which the best editions are the thirteenth, fourteenth, and fifteenth, by Hargrave and Butler, 1788, 1789, and 1794; 4. a Treatise of Bail and Mainprize, 1637, 4to; 5. Reading on the Statute of Fines, 27 Edw. I., 1662 4to; 6. Complete Copyholder, 1640, 4to.

Colaba.

COLABA, in Hindustan, the name applied to the southern portion of Lighthouse Island, the northern division of which called Old Woman's Island is joined to the Island of Bombay by a causeway overflowed at high water. The lighthouse is situate at the southern extremity of the island: its lantern is 150 feet above the level of the sea. Colaba is the seat of an observatory, established for the purpose of taking magnetic and meteorological observations. It also contains a church. This building is of recent erection, and the circumstances connected with its origin are at once extraordinary, and honourable to the motives of its

Colaba || Colapoor.

founders. The want of provision for religious worship was one which had long been felt, and the desire of keeping in remembrance the services and sufferings of their brave countrymen during the late war in Scinde and Afghanistan, was a feeling deeply seated in the hearts of the British residents. After much consideration it was resolved to gratify it, not by a monument simply commemorative of the dead, but by a building which, while it effected the object just named, should supply to the living the means of approaching Him in whose hands are the issues of battles. Such is the brief and interesting history of the church of Colaba. Since the death of its chief, the whole territory has been added to the British possessions. (E. T.)

COLAIR LAKE, a lake of Hindustan, to the S. of Ellore, in the Northern Circars, which is formed by the overflowings of the Krishna and Godavery, and extends 47 miles in length from W. to E., and 14 in breadth from N. to S. During the rainy season the whole of this space is overspread with water, excepting 60 or 70 islets, in which the inhabitants remain: but during the remainder of the year the whole is dry, and in many places well cultivated. The waters of this lake are distributed in many channels over the adjacent country. A project for the drainage of this lake is in contemplation; the effect of which when carried out will be to render the entire bed available for tillage, and capable of affording support to a population of 7000. The centre of the lake is in Lat. 16. 40., Long. 81. 20. (E. T.)

COLAPOOR, a small Mahratta state on the western coast of India, situate between the 16th and 18th degrees of N. Lat. It is bounded on the S. by the Bombay collectorate of Belgaum; on the E and N. by Sattara; and on the W. by Sawunt Warree and the British collectorate of Rutnagherry. The country is well watered by many rivers, and is favourable to the production of rice, of which great quantities are cultivated. About the year 1670, this country was overrun by the celebrated Sevajee; and in 1684 by the armies of Aurungzebe, who ravaged the country and burned the town of Vingorla. In 1804 the maritime trade of India was greatly annoyed by pirates, who issued from the ports of the rajah; and they were in consequence blockaded by the East India Company's cruisers, and payment was demanded for all the damage which had been occasioned by their piracies. At the same time two of the most daring depredators took refuge with the rajah, after their predatory bands had been dispersed by General Wellesley. He was in consequence informed that he would be held responsible for the good behaviour of those persons to whom he had granted an asylum, and that unless he restrained their depredations his own territory would be invaded. This intimation had little effect, and the system of piracy was not effectually suppressed until 1812, when the fort and harbour of Malwan with the remaining maritime possessions of Colapoor were ceded to the British. In 1822 Abba Singh the rajah of Colapoor was murdered, and a long course of misgovernment followed, attended by aggressions on the neighbouring chieftains who had been taken under British protection. Recourse to military operations was thus rendered indispensable; and though hostile proceedings were subsequently arrested by the submission of the rajah, the renewed oppression of the protected chieftains ultimately compelled the British to take military occupation of the country. In 1829, a new treaty was concluded with the rajah, and the British troops were withdrawn. From 1839 to 1842 the state of Colapoor was distracted by intestine feuds, which in 1844 broke out into open rebellion. This being put down by force of arms, the entire management of the state was assumed and thenceforward exercised by the British government in the name of the rajah, whose authority still continues in abeyance. The town of Colapoor, distant S.E. from Bombay 185 miles, is in Lat. 16. 42., Long. 74. 18. (E. T.)

COLAR, a town of Hindustan, in the native state of Mysore. The place is defended by a strong mud fort and deep ditch, and contains about 700 houses, many of which are inhabited by weavers. It was the birthplace of Hyder Ali. A handsome mausoleum was erected to his memory by his son; and near it a mosque and a college of Mussulman priests. Lat. 13. 8., Long. 78. 10. (E. T.)

Colar || Colbert.

COLARBASUS, a Gnostic of the second century, who carried out the doctrine of his master, Valentinus, in regard to the gradation of æons. He based his system on the letters of the Greek alphabet, in which he regarded Christ as the alpha and omega. His followers were called Colarbasians.

COLBERG, a fortified seaport-town of Prussian Pomerania, government and 25 miles W. of Coslin, on the right bank of the Persante, which falls into the Baltic about a mile below the town. The principal buildings are the cathedral, town-house, citadel, and aqueduct by which the town is supplied with water. Besides several churches and hospitals, Colberg contains a gymnasium, workhouse, house of correction, exchange, and orphan asylum. The chief manufactures are woollen cloth, salt, and spirits. Besides valuable salmon and lamprey fisheries, the town possesses a considerable trade. Pop. (1849) including military, 9480.

COLBERT, JEAN BAPTISTE, Marquis of Segnelay, one of the greatest statesmen that France has produced, was born at Paris in 1619. He was descended from a respectable family of Scottish extraction who resided at Rheims in Champagne. His grandfather is said to have been a wine-merchant, and his father at first followed the same occupation, but afterwards became clerk to a notary. In 1648, his relation Jean Baptiste Colbert, lord of St Pouange, preferred him to the service of his brother-in-law Le Tellier, secretary of state; and here he soon became distinguished by his diligence and exactness in the execution of the commissions intrusted to his care. One day his master sent him to Cardinal Mazarin, who was then at Sedan, with a letter written by the queen mother, and ordered him to bring it back after that minister had seen it. Colbert carried the letter, and refused to return without it, though the cardinal treated him roughly, used various arts to deceive him, and obliged him to wait several days for the document. Some time afterwards, when the cardinal returned to court, and found himself in want of a secretary or amanuensis, he desired Le Tellier to furnish him with a fit person for that employment; and Colbert having been presented to him, the cardinal, who had some remembrance of the young man, desired to know where he had seen him. Colbert was afraid of putting his eminence in mind of Sedan, lest the recollection of his importunity in demanding the queen's letter should renew the cardinal's anger; but the cardinal, whose insight into character was very great, was so far from disliking him for his fidelity to his former master, that he received him on condition that he should serve him with equal zeal.

Colbert applied himself wholly to the advancement of his master's interests, and gave so many marks of his diligence and skill that the cardinal afterwards made him his steward. He accommodated himself so dexterously to the inclinations of the minister, by retrenching his superfluous expenses and otherwise, that he was intrusted with the management of the lucrative trade of selling benefices and governments. It was by Colbert's counsel that the cardinal obliged the governors of frontier places to maintain their garrisons out of the contributions they had exacted; a suggestion with which Mazarin was extremely pleased. He was sent to Rome to negotiate the reconciliation of Cardinal de Retz, for which the pope had showed some concern; and to persuade his holiness to consent to the disincameration of Casto, according to the treaty concluded with his predecessor Urban VIII. Mazarin had so high an

Colchester.

opinion of Colbert's abilities, and was so strongly impressed with a sense of his faithful services, that at his death in 1661 he earnestly recommended his protégé to Louis XIV. as the most proper person to regulate the finances, which at that time stood in great need of reformation. Louis accordingly made Colbert intendant of the finances. The latter applied himself to their regulation, and succeeded in his object, although it procured him many enemies. France is also indebted to this minister for establishing her trade with the East and West Indies.

In 1664 Colbert became superintendent of buildings, and from that time applied himself to enlarging and adorning the royal edifices, such as the palace of the Tuilleries, the Louvre, St Germain, Fontainebleau, and Chambord. In the same year he founded the Academy of Inscriptions, and in 1666 the still more celebrated Academy of Sciences. France also owes to Colbert all the advantages she has derived from the canals which connect the Mediterranean with the Atlantic; a work begun in 1666, and finished in 1680.

In 1669 Colbert was made secretary of state, and intrusted with the management of naval affairs; and his services in this department were commensurate with the confidence reposed in him. He suppressed several useless offices; and perceiving the king's zeal for the extirpation of heresy, he shut up the chamber instituted by the edicts of Paris and Rouen. He proposed several new regulations concerning criminal courts, and was extremely severe to the parliament of Toulouse for obstructing the measures he took to carry these improvements into execution. His main design in reforming the tedious methods of proceeding at law, was to give the people more leisure to apply themselves to trade; for the advancement of which he procured an edict, erecting a general insurance office at Paris for merchants and others. In 1672 he was appointed minister of state; but in the midst of public business he was careful never to omit any opportunity of promoting the interest and aggrandizement of himself and family. He had six sons and three daughters, all of whom he married to persons of rank; thus wisely securing his fortune by powerful alliances. See FRANCE.

This great minister died of the stone Sept. 6, 1683, in his 64th year. In his last moments he was attended by Bourdaloue; and when his wife attempted to talk to him of public affairs, he repulsed her, saying, "Vous ne me laisserez donc pas même le temps de mourir." He was of middle stature, his mien low and dejected, his air gloomy, and his aspect stern. He slept little, and lived temperately. He was of slow conception, but spoke judiciously of everything after he had once comprehended it. He filled the most important offices with high reputation and credit; and his influence diffused itself throughout every department of the government. Colbert proved himself a wise, active, public-spirited minister, attentive to the interests of his master, the happiness of the people, the progress of arts and manufactures, and, in short, to everything that could advance the credit and interest of his country. Though an enlightened patron of science and literature, Colbert was not himself an author. The work entitled *Le Testament Politique de Colbert*, published in 1694, is a compilation by another hand, in imitation of the *Testament Politique du Cardinal de Richelieu*.

COLCHESTER, a municipal and parliamentary borough and market-town of England, county of Essex, on the Colne, here crossed by three bridges. It stands on the Eastern Counties railway, 51 miles N.E. of London. The borough is governed by a mayor, 6 aldermen, and 18 councillors, and returns two members to parliament. Registered electors (1851–2) 1258. Pop. (1851) 19,443. It is supposed to be the *Camalodunum* of the Romans; and there are few places in the kingdom where more Roman antiquities have been discovered. It was taken from the Danes in 921 by Edward the Elder, who founded the castle; and in the reign of Edward III. it sent five ships to the blockade of Calais. It was ravaged by the plague in 1348, in 1360, and again in 1665. In 1648 it was taken by Lord Goring for Charles I.; but was retaken by Fairfax after a siege of 11 weeks, when Sir C. Lucas and Sir C. Lisle were put to death, and the castle itself dismantled. The walls which surrounded the town, forming an oblong of about 108 acres, with 4 gates and 3 posterns, and about 7 feet thick, still exist in part. Remains of the castle, built of flint and Roman brick, are still to be found; and among them are parts of the tower, Norman gateway, sally-port, and chapel. The remains of the church of St Botolph's priory, founded in the early part of the twelfth century, present fine specimens of Norman architecture. Several of the churches and chapels are elegant buildings. It has also a free grammar-school with a scholarship at St John's College, Cambridge, town-hall with jail underneath, corn exchange, house of correction, theatre, library, botanic garden, savings-bank, gas and water works, several hospitals and alms houses, bank, a large distillery, and literary, medical, and other societies. Baize was formerly made in the town to a considerable extent, but this branch of industry has been superseded by the manufacture of silk. The oyster fishery is extensively carried on. Vessels of 150 tons come up the river to Hythe, a suburb, and the port of Colchester. In 1852, 683 vessels of 52,329 tons (of which 657 vessels of 50,281 tons were in the coasting trade) entered; and 336 vessels of 16,174 tons (of which 305 vessels of 13,866 tons were in the coasting trade) cleared at the port. On 31st December 1852, 187 sailing vessels, under 50 tons = 3950 tons, 65 sailing vessels above 50 tons = 7156 tons, and 1 steam vessel of 23 tons, were registered as belonging to the port.

Colchicum Autumnale || Colchis.

COLCHICUM AUTUMNALE, meadow saffron, or autumn crocus, a plant of the natural order Melanthaceæ, is largely collected for medicinal use in this country. (See BOTANY, vol. v., p. 213.) Its infusion is well known as a powerful remedy for gout, and has long been celebrated in France under the name of *Eau Médicinale*. The cormus or bulb, and also the seeds, are used in medicine, and have a strong, persistent, bitter taste. Its medicinal virtues appear to be derived from a peculiar alkaloid, which has been termed *colchicia*. The best preparation is the wine of colchicum, prepared by digesting eight ounces of the seeds in forty ounces of sherry for about a week, shaking the vessel daily, and pressing out the liquor. The usual dose is from 10 to 50 drops taken in water. It possesses intense activity as a poison. The plant derives its name from Colchis in Armenia, where it is said to have abounded. See Christison "*On Poisons*," and *Pharmacopœia Edin.*

COLCHIS, in *Ancient Geography*, a nearly triangular district of Asia Minor, at the eastern extremity of the Black Sea, was bounded N. by the Caucasus, which separated it from Asiatic Sarmatia, E. by Iberia and the Moschici Montes, S. by Armenia and part of Pontus, and W. by the Euxine. The ancient district is represented by the modern province of Mingrelia, and part of Abasia.

The name of Colchis is first found applied to this country by the Greek poets Æschylus and Pindar. Its original name was Æa, and it is first mentioned in connection with Æetes its mythical king, father of the sorceress Medea. Colchis was celebrated in Greek mythology as the destination of the Argonauts, and the residence of Medea. Its early history is involved in the greatest obscurity. At a remote period it seems to have been incorporated with the Persian empire, though the inhabitants ultimately erected their territory into an independent state; and in this condition it was found by Alexander the Great, when he invaded Persia. From this time till the era of the Mithridatic war nothing is known of the history of Colchis. At the time of the Roman invasion it seems to have paid a nominal hom-

Colchis ‖ Cold

age to Mithridates, and to have been ruled over by Machares the second son of that monarch. On the defeat of Mithridates by Pompey, Colchis became a Roman province, of which Aristarchus was appointed governor. After the death of Pompey, when Cæsar was pursuing his Egyptian and Spanish conquests, Pharnaces the son of Mithridates rose in rebellion against the Roman yoke, subdued Colchis and Armenia, and made head, though but for a short time, against the Roman arms. After this, Colchis was incorporated with Pontus. The Colchians are not again alluded to in ancient history till along with the Abasci they joined Chosroes I. king of Persia, in his war with Marcian.

Colchis was inhabited by a number of tribes whose settlements lay chiefly along the shore of the Black Sea. The chief of these were the Lazi, Moschi, Apsilæ, Abasci, Sagadæ, Suani, and Coraxi. These tribes differed so completely in language and appearance from the surrounding nations, that the ancients themselves originated various theories to account for this phenomenon. Herodotus, for example, believed them to have sprung from the relics of the army of Sesostris, and thus identified them with the Egyptians. Though this theory was not generally adopted by the ancients, it has been defended, but not with complete success, by some modern writers. From the first named of these tribes, the Lazi, the country took its name of Terra Lazica, under which designation it was latterly known.

Colcothar ‖ Cold.

COLCOTHAR, the brownish-red oxide of iron which remains after the distillation of the acid from the sulphate of iron. It is used for polishing glass and other substances, and is known by artists under the denomination of crocus, or crocus Martis.

COLD.

It is often disputed whether cold has any actual existence, or should be considered as merely the privation of heat. Nor is that question of a modern date. Plutarch attempted to discuss it, in his tract *De primo frigido;* and the reasonings which he there employs, though abundantly vague, are yet curious. Cold, he says, affects the senses as well as heat; and it is not less active, since it condenses and consolidates bodies. He therefore inclines to the opinion, that cold is a distinct and independent power in nature. With the Stoic philosophers, he regards air as by its constitution cold and dark; and hence water drawn from a well freezes on being exposed to the atmosphere, while rivers overshadowed by high banks seldom freeze, and even where their surface congeals, the heat is not exhaled, but only driven down nearer the bottom.

The diminution of heat.

It is contrary to sound physics to admit more principles than are indispensably required, and this argument alone may be sufficient for the rejection of cold as a distinct power in nature. What we term cold, in reference to our feelings, is merely the diminution of heat; but the existence and materiality of heat rest on a very different foundation. The introduction of heat into a body is accompanied by the infusion of a certain extrinsic repulsive force, and its passage through the mass is connected with a series of depending internal motions, which imply the regular expenditure of time and velocity. The contraction which follows on the diminution of heat is due to the mutual attractive powers of the particles of the substratum, now exerted with less opposition. That expansion, again, which some fluids manifest in the act of congelation, proceeds from the operation of the principle of crystallization, with the recondite nature of which we are still unacquainted.

Concentration of cold by reflection.

The notion that cold has a separate and independent existence, appears, however, to receive some countenance from the elegant experiment of collecting and concentrating the frigorific impressions in the focus of a metallic reflector. This curious fact, which is one of the oldest in physical science, has lately been revived, and combined with circumstances of peculiar interest. The experiment was first mentioned about the year 1590, by Baptista Porta, in the enlarged edition of his *Magia Naturalis*, when the four books of which it originally consisted were augmented to twenty, at the very time that his ingenious countryman Sanctorio had invented and applied to medical purposes the air thermometer. Porta relates, that if a shut eye be held in the focus of a speculum, before which is placed a ball of snow, intense cold will be felt on the eye-lid.[1] Cavalieri, the celebrated discoverer of infinitesimals, in his work on the conic sections, printed in 1632, and entitled *Lo Specchio Ustorio*, extended the experiment to all impressions which he conceived to be propagated in straight lines, not only to those of heat and cold, but to those of sound, and even smell.[2] It was afterwards frequently repeated at Florence, by the Academy del Cimento, with the important addition of the thermometer, which that learned body had the merit of introducing into practice. Similar experiments were next performed by Mariotte in France.

Unsatisfactory results.

Specula and burning glasses appear in the sequel to

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[1] Si quis candelam in loco, ubi spectabilis res locari debet, apposuerit, accedet candela per aërem usque ad oculos, ut illos calore, et lumine offendet; hoc autem mirabilius erit, ut calor, ita frigus reflectitur, si eo loco nix objiciatur, si oculum retigerit, quia sensibilis, etiam frigus percipiet.

[2] Cavalieri mentions that, with a spherical speculum made of lead, and indifferently polished, he was able to inflame dry substances by the reflexion of a charcoal fire; and that, with a deep truncated parabolic speculum, badly polished, he produced the same effect in the open focus, from a small fire of wood at the distance of five feet. Esperienza di questo hò fatto io, che con vno Specchio sferico di piōbo ancor mal polito, hò acceso il fuoco nella materia anda al fuoco di carboni; e di più l'hò fatto con la superficie parabolica, cioè con vn cánone parabolico, che hauea il suo foco vicino alla cima, essendo esso specchio parabolico trōcato pur nella cima, qual' era di stagno, e mal polito, tal che opponendolo al fuoco, ò alla fiamma di ben poca legna, nella distanza di tre braccia, ponendo la mano lì, dou'era la parte trōcato, et il foco della parabola, non vi si potea sostenere, anzi vi s'accese fuoco; la qual cosa potria alcuno applicare al riscaldameto delle stanze, ò alle distillationi. Pp. 85, 86.—In general, says this ingenious mathematician and philosopher, the same form of speculum which concentrates light and heat must likewise collect cold, which spreads from its source, from a mass of snow for instance, in straight lines. The hyperbola is, therefore, the figure which he thinks the best adapted for the purpose; and he proposes this for condensing the smells radiated from an odoriferous substance. Hora dunque basterà quello, che si è detto di sopra intorno al lume, e calore, *potendo noi nell'istesso tempo intendere le medesme cose anco per il freddo, che dilatádosi dal corpo freddo ad ogni positione per linea retta, e perciò nell' infinite linee, che si partono dal corpo freddo, come dalla neue*, essendoui dentro le parallele, che sono vnite dallo specchio parabolico, e le diuergenti, che sono vnite dall' elittico, e le conuergenti vnite dall' iperbolico, con opporre alcun di questi specchi ad vna massa di neue, ò di ghiacco, sentiremo nel loro foco essere il freddo fatto molto gagliardo, ma per questo effetto sarà più atto l'iperbolico di tutti, come quello, che raccoglierà maggior quantità di linee fredde; e questo basti ancora circa il freddo, potendosi forsi in vn certo modo creder, *che talle effetto accadesse anco intorno à gli odori, prouando noi dilatarsi pur quelli dalli corpi odoriferi verso ogni banda.* Id. p. 128.

Cold. have been allowed to fall into great neglect. We find scarcely any mention of their application to physical researches, till, after the lapse of more than half a century, Kraft repeated, at St Petersburg, during the severe winter of 1740, the frigorific experiment of the Italian philosophers, with a reflector belonging to the cabinet of the Imperial Academy. Ambitious to operate on a grand scale, he selected three huge blocks of clear ice, nearly of a cubical form, each side being two, four, and five feet; but, to save the trouble of transporting them, he carried the speculum out of doors. No sensible effect, however, was then perceived by him, though he used the air thermometer on account of its extreme delicacy. In 1744, this academician again resumed the observation, and with scarcely better success, having obtained only a doubtful cold of three degrees. The cause of the failure was evidently his performing the experiment out of doors, and not in a warm room. The blocks of ice had, by long standing, acquired almost the same temperature as their ambient medium. Had the air happened to become suddenly colder, they might, from their relative condition, have excited impressions even of heat, and thus have perplexed philosophy for many years afterwards.

Such unsatisfactory results, from the action of a mass of ice of above a ton weight, seem for a long time to have shaken the belief in former experiments; and the subject was almost forgotten, when Pictet of Geneva, in 1781, repeated the original observation, on a small scale, indeed, but with entire success. Since that time a pair of brass reflectors, with a wire case for holding charcoal or snow, has been deemed an essential apparatus in every physical cabinet. The concentration of cold in the focus of a speculum always excites surprise; and the experiment is often exhibited with a sort of mysterious air, as if it established, or at least rendered probable, the distinct and material existence of cold; but, in fact, it is not more difficult to conceive the impressions of cold to be collected than those of heat. Both those impressions are only relative to the temperature of the atmosphere, which serves as the medium of their transmission. The one process terminates with the deposition of a portion of heat, the other with its abstraction.

Resumed by Pictet.

Sources of cold. The diminution of heat, or the increase of cold, is produced in nature under four different circumstances: 1. By the obliquity or absence of the sun; 2. by the tenuity of the higher atmosphere; 3. by the evaporation which takes place in dry air; and, 4. by the chilling impression shot downwards from a clear and serene sky.

Obliquity of the sun. 1. In our temperate climates the thermometer in winter very seldom descends fifteen degrees on Fahrenheit's scale, below the point of congelation; but in the higher latitudes the intensity of the cold is often far greater. In the northern parts of Sweden and Russia, the rivers and ordinary lakes are frozen to the depth of several feet; wine, and even ardent spirits, become converted into a spongy mass of ice, and, as the cold still augments, it penetrates the living forests, and congeals the very sap of the trees, which occasionally burst from this internal expansion with tremendous noise. The Baltic Sea has been repeatedly covered with a solid floor of ice, capable of transporting whole armies, with all their stores and engines of war. Those waters, indeed, are only brackish; but the more northern ocean itself has often been frozen to a very considerable thickness. In Siberia and Hudson's Bay, and even in the northern provinces of Sweden, mercury has been at some times observed contracted by exposure into a solid semi-metal; and, consequently, the cold which then prevailed must have exceeded seventy-one degrees, or thirty-nine below the commencement of Fahrenheit's scale.

Cold.

2. In elevated tracts the increase of cold is very striking. Even at an altitude of three miles and a half, the air is generally sixty-eight degrees colder than at the level of the sea. On the summit of the Andes, therefore, a thermometer would often sink perhaps under the beginning of Fahrenheit's scale; and it seems probable that mercury would naturally freeze in winter on the top of Mont Blanc. Mountains are hence regarded as the grand stores or depositaries of cold in the milder climates. In every country, therefore, the air of subterraneous caves, and the water of deep springs or wells, are during the summer months comparatively cold. Hence the obvious advantage of cellars, in addition to their preserving an uniform temperature, which is so favourable to the ripening of the liquors deposited in them. But the air at the bottom of an open and very deep pit must be colder than the mean state of the ground; for in all the changes which take place at the surface, the cold air will descend, and the warm air still float over the mouth of the pit. The wealthier classes of antiquity were accustomed, accordingly, to cool the wine for their tables by suspending it for some time in a bucket let down near the surface of profound wells.

Elevation of the place.

3. Evaporation is a natural process, by which heat is powerfully abstracted by the exhaling moisture, while this assumes a gaseous constitution in the act of combining with dry air. The fact seems to have been known in the warm regions of the East at a very early period of society, suggested probably by the familiar use of a rude unglazed pottery for all culinary purposes. The Egyptians, and other inhabitants of the sultry shores of the Levant, have, from the remotest ages, cooled the water for drinking in their porous jars. Athenæus reports, from a history of Protagorides, that King Antiochus had always a provision for his table prepared in that way. The water having been carefully decanted from its sediment into earthen pitchers (ὑδρείαις κεραμείαις), these were transported to the highest part of his palace, and exposed to the clear and keen atmosphere (ἐξαιθριαζουσιν), two boys being appointed to watch them the whole night, and kept constantly wetting their sides. This labour of sprinkling the surface of the jars seems to have been afterwards spared, in consequence probably of the adoption of a more porous kind of earthenware. Galen, in his *Commentary on Hippocrates*, relates, that he witnessed the mode of cooling water, which was practised in his time, not only at Alexandria, but over all Egypt. The water having been previously boiled, was poured at sunset into shallow pans (ἀγγοις ὀστρακινοις), which were then carried to the house-tops, and there exposed during the whole night to the wind; and, to preserve the cold thus acquired, the pans were removed at day-break, and placed on the shaded ground, surrounded by leaves of trees, prunings of vines, lettuce, or other slow-conducting substances.

Evaporation.

The bottles or bags made of goat-skins, in which the wandering Arabs are wont to carry their scanty provision of water, allowing a small portion of the liquid to transude and exhale, render it by consequence comparatively cool, and better fitted to mitigate or allay the intolerable thirst created in traversing their sandy deserts. In Guinea, it is customary to fill gourds or calabashes with water, and suspend them all night from the outer branches of trees.

The Moors introduced into Spain a sort of unglazed earthen jugs, named *bucaros* or *alcarrazas*, which, being filled with water, present to the atmosphere a surface constantly humid, and furnish by evaporation, during the dry and hot weather, a refreshing beverage. The same practice has been adopted by degrees in various parts of the south of Europe. In India, during certain months, the apartments are kept comparatively cool, by dashing

Cooling vessels called *alcarrazas*.

Cold.

water against the matting of reeds or bamboos which line the doors and outside of the walls. Even the more luxurious mariners, in their voyages between the tropics, are accustomed to cool their wines by lapping the bottle with wet flannel, and suspending it from the yard or under the cabin windows. In all such cases the effect is accelerated, though not augmented, by the swiftness of the current of air. What have been called *Egyptian coolers*, and lately produced by our potters, are less perfect in their operation. Being very thick, they require only to be soaked in water, and the evaporation from their surface cools the adjacent air. On the inside, however, where the bottle is placed, the action, in consequence of the confined humidity, must be enfeebled. In damp weather, these vessels, it is evident, are entirely useless.

Indian mode of collecting ice.

The natives of India likewise are enabled, by directing a skilful process of evaporation, to procure for themselves a supply of ice during their short winter. In the upper country, not far however from Calcutta, a large open plain being selected, three or four excavations are made in it, about thirty feet square and two feet deep, and the bottom covered to the thickness of nearly a foot with sugar canes or dried stalks of Indian corn. On this bed are placed rows of small unglazed earthen pans, about an inch and quarter deep, and extremely porous. In the dusk of the evening, during the months of December, January, and February, these are filled with soft water previously boiled and suffered to cool; when the weather is very fine and clear a great part of the water becomes frozen during the night. The pans are regularly visited at sunrise, and their contents thrown into baskets which retain the ice. These are now carried to a conservatory, made by sinking a pit fourteen or fifteen feet deep, lined with straw under a layer of coarse blanketing. The small sheets of ice are thrown down into the cavity, and rammed into a solid mass. The mouth of the pit is then closed up with straw and blankets, and sheltered by a thatched roof.

Impressions showered from a clear sky.

4. It was stated in the article CLIMATE, that impressions of cold are constantly showered down from a clear and azure sky. These effects are no doubt more conspicuous in the finer regions of the globe. Accordingly, they did not escape the observation of the ancients, but gave rise to opinions which were embodied in the language of poetry. The term *αηρ* was applied only to the grosser part of the atmosphere, while the highest portion of it, free from clouds and vapour, and bordering on the pure fields of æther, received the kindred appellation of *αιθρια*. But this word and its derivatives have always been associated with ideas of *cold*. We have seen that the verb *εξαιθριαζω* is used by Athenæus to signify the cooling of a body by exposure under a serene sky. Homer uses the term *αιθρος*, in speaking of the reception of his hero, when overcome with *cold* and toil.[1] The same poet of nature applies the epithet *αιθρηγενης* or *αιθρηγενετης*, or *frigorific*, to Boreas, the north wind.[2] The chorus in the *Antigone* of Sophocles deprecates the pelting storm, and likewise the cold (*αιθρια*) of inhospitable frozen tracts.[3] The word *αιθριος* is employed by Herodotus to signify a chill as well as a dry atmosphere.[4] Of the same import is the expression in Horace, *sub Jove frigido*.

Their intensity in the finer climates.

In the finer climates, especially, a transpiercing cold is, therefore, felt at night under the clear and sparkling canopy of heaven. The natives carefully avoid exposing themselves to this supposed celestial influence; yet a thin shed of palm leaves may be sufficient at once to screen them from the scorching rays of the sun, and to shelter them against the chilling impressions rained from the higher atmosphere. The captains of the French gallies in the Mediterranean used formerly to cool their wines in summer by hanging the flasks all night from the masts. At daybreak they were taken down and lapped in several folds of flannel, to preserve them in the same state. The frigorific impression of a serene and azure sky must undoubtedly have concurred with the power of evaporation in augmenting the energy of the process of nocturnal cooling practised anciently in Egypt, and now systematically pursued in the higher grounds of India. As the chilness accumulated in the ground is greatest in clear nights, when the moon shines brightest, it seemed very natural to impute this effect partly to some influence emanating from that feeble luminary. It was long imagined that the lunar beams are essentially cold; and some philosophers, at no remote period, have attempted even to prove the fact by experiment. Mr Boyle, though he rejected judicial astrology, was yet disposed to admit the notion of stellar influences.

Cold.

Cooling with snow.

The obvious mode of cooling water, or other liquids, by the infusion of ice or snow, was practised in the warmer countries from the earliest ages. It is even mentioned in the Proverbs of Solomon, "*As the cold of snow in the time of harvest*, so is a faithful messenger to them that send him." Aristotle, presuming that the finer parts of water are dissipated by congelation, maintained that it is pernicious to drink melted snow. This speculative opinion seems not, however, to have been regarded by the ancients. Theocritus calls snow-water an *ambrosial drink*, *ποτος αμβροσιος*. Xenophon mentions the practice of cooling wine by the addition of snow. It is related by the historians of Alexander the Great, that in his Indian expedition, when he laid siege to the city of Petra, he commanded thirty pits to be dug and filled with snow, which was covered over with oak branches. The luxurious Romans had excavations regularly formed for keeping snow the whole year, chaff and other light substances being employed to preclude from it the access of heat. But as the snow preserved in this way could not escape being soiled, instead of mixing it directly in the drinking cup, a more refined practice was introduced of surrounding the silver goblet which contained the liquor with a mass of the melting snow. This improvement was ascribed to the profligate emperor Nero. Similar modes of storing up snow have been adopted in all the warm countries. The caves on the sides of Mount Ætna are considered as natural magazines for supplying a material which is not only carried down to Palermo and Messina, but even shipped to the island of Malta. The Italians formerly cooled their wine by setting the large glass flasks containing it in wide vessels of wood or cork, the intervening space being filled with snow on which water was poured.

Cooling with nitre.

Saltpetre or nitre being almost a natural production of the East, its property of rendering water cold by solution was probably known from a very remote period to the oriental nations. This process of cooling is described in the *Institutes* of Akbar as the discovery of that enlightened prince, who governed India with parental mildness from the year 1560 to 1605. One part of nitre is directed to be thrown into a vessel containing two parts of water; and a gugglet of pewter or silver filled with pure wa-

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[1] Αιθρη και καματῳ δεδμημενον ηγεν ες οικον. *Odyss.* lib. xiv. 318.

[2] Ὡς δ' ὁτε ταρφειαι νιφαδες Διος ικποτωνται,
Ψυχραι ὑπαι ῥιπης αιθρηγενιος Βορεαο. *Iliad.* lib. xix. 357–8.
Και Βορεης αιθρηγενετης, μεγα κυμα κυλινδων. *Odyss.* lib. v. 296.

[3] δυσαυλων παγων αιθρια
και δυσομβρα φευγειν βιλη. *Antigone*, 357.

[4] Θερμοτερον γαρ δη εστι το ὑδωρ της τε αιθριας και της δροσου.
Euterpe.

Cold.

ter, and having its mouth close stopped, is then stirred quickly in the mixture for the space of a quarter of an hour.

Introduced into Italy.

The frigorific property of nitre was probably first communicated from India or Persia to Europe, and seems to have become known to the Italians about the middle of the sixteenth century. As early as the year 1550, all the rich families in Rome cooled the liquors for their tables by dissolving that salt in water. Into a vessel of cold water the nitre was gradually added in the proportion of a fourth or fifth part, while a globular bottle with a long neck, containing the wine or water to be cooled, was whirled rapidly round its axis. The salt, being afterwards recovered by crystallization, would always serve the same purpose again with undiminished effect. In India every family of distinction keeps a domestic, whose sole employment is to cool liquors by this process; but nitre being cheap in that country, it is used in larger proportions, and the water charged with it is allowed to become a perquisite of the operator.

Cooling by saline powders.

The application of salts to produce cold was extended by Boyle, and afterwards more successfully by Fahrenheit. About the commencement of this century, Mr Walker of Oxford, and Professor Lowitz of St Petersburg resumed the subject, and produced compound saline powders possessed of intense frigorific power. The solution of salts in water expanding that liquid, augments its capacity for heat, and consequently depresses its temperature. This effect is likewise the greater in proportion to the quantity of saline matter which can be dissolved. But after water is saturated with one species of salt, it can still absorb some portion of another. Hence the frigorific effects of solution are always increased by employing a compound dry powder. Nitre and sal-ammoniac, or the nitrate of potash and the muriate of soda, in equal parts, added in the form of a dry powder to three parts by weight of water, will sink Fahrenheit's thermometer forty degrees. But equal parts of the muriate of ammonia and of the nitrate of potash, with one part and a half of the sulphate of soda or common Glauber's salt, will cool down three parts of water forty-six degrees. A still greater effect, amounting to fifty-seven degrees, is produced by dissolving equal parts of the nitrate of ammonia and of the carbonate of soda in one part of water. The frigorific action is in general augmented by throwing the desiccated powder into dilute acid instead of water. Thus three parts of the phosphate of soda, and two parts of the nitrate of ammonia, joined to rather more than one part of weak nitric acid, will sink the thermometer seventy-one degrees.

Principle of evaporation.

These changes induced on the temperature of the liquid menstruum are no doubt considerable, yet they are still only transient, and the process requires some address and manipulation, not always readily attained. But the principle of evaporation, when rightly understood, leads to a far easier mode of cooling liquids, which may be prolonged at pleasure. A close investigation of that principle, at the very commencement of his philosophical labours, has conducted Professor Leslie through the whole train of his discoveries on the subject of refrigeration. The process of evaporation had not then been examined with attention. The depression of temperature which always accompanies it was hastily supposed to be proportional to the rate with which the moisture is dissipated, and to be therefore augmented by every circumstance that can accelerate this effect. If water, contained in a porous vessel, expose on all sides its surface to a current of air, it will cool down to a certain point, and there its temperature will remain stationary. The rapidity of the current must no doubt hasten the period of equilibrium, but the degree of cold thus induced will be still the same. A little reflection may discover how this happens. Though the humid surface has ceased to grow colder, the dispersion of invisible vapour, and the corresponding abstraction of heat, still continues without intermission. The same medium, therefore, which transports the vapour, must also furnish the portion of heat required for its incessant formation. In fact, after the water has been once cooled down, each portion of the ambient air which comes to touch the evaporating surface must, from its contact with a substance so greatly denser than itself, be likewise cooled to the same standard, and must hence communicate to the liquid its surplus share of heat, or the difference between the prior and the subsequent state of the solvent, which is proportional to the diminution of temperature it has suffered. Every shell of air which encircles in succession the humid mass, while it absorbs, along with the moisture which it dissolves, the measure of heat necessary to convert this into steam, does at the same instant thus deposit an equal measure of its own heat on the chill exhaling surface. The abstraction of heat by vaporization on the one hand, and, on the other, its deposition at the surface of contact, are therefore opposite contemporaneous acts, which soon produce a mutual balance, and thereafter the temperature induced continues without the smallest alteration. A rapid circulation of the evaporating medium may quicken the operation of those causes; but so long as it possesses the same drying quality, it cannot in any degree derange the resulting temperature. The heat deposited by the air on the humid surface becomes thus an accurate measure of the heat spent in vaporizing the portion of moisture required for the saturation of that solvent at its lowered temperature. The dryness of the air is therefore, under all circumstances, precisely indicated by the depression of temperature produced on a humid surface which has been exposed freely to its action.

Cold.

Hygrometer.

Guided by these views, Mr Leslie was enabled to construct a correct *hygrometer*, that should indicate the *dryness* of the air, from the diminution of temperature which a small body of water, exposed on all sides, suffers by evaporation. His efforts again to improve this instrument led him next to the invention of the *differential thermometer*, which was converted into an hygrometer by having one of its balls covered with cambric, lint, or tissue paper, capable of being easily wetted. Reduced to such a delicate and commodious form, it detected with the utmost precision, and under all circumstances, the relative condition of the air in regard to dryness.

Cooling effected by the presence of absorbents.

It appears that absorbent substances, exposing a broad surface, are capable of assimilating to their previous state the air confined over them. Flannel, for instance, which has been intensely dried, will support a remarkable degree of dryness in a close receiver. The trap-rock and compound clays, brayed into a coarse powder, and desiccated before a strong fire, will exert a more powerful and extended action. But dried oat-meal will act with equal energy, and for a longer time. Of the saline substances, the muriate of lime absorbs moisture with the greatest and most protracted force. After it has become drenched with humidity, it may likewise be recovered again, though the process of restoring it unaltered is rather troublesome. But the best and most powerful absorbent is the concentrated sulphuric acid, or the oil of vitriol of commerce, which continues for a long time to attract moisture with almost undiminished force, and possesses besides the valuable property, after it has become charged with humidity, of being easily restored again by the application of heat to its original strength.

Mode of proceeding.

To cool water in any climate or state of the atmosphere, we have only therefore to put it into a small porous vessel,

Cold. presenting on all sides a humid surface, and to suspend this within a close wide cistern, of which the bottom is covered with a layer of sulphuric acid. The broad surface of the acid absorbing the moisture as fast as it diffuses itself through the confined air, keeps that medium constantly at a point of extreme dryness, and thus enables it to support, with undiminished vigour, the process of evaporation.

In practice, the cistern or refrigeratory, having a broad cylindrical form, from twelve to sixteen inches in diameter, and composed of dense well-glazed earthenware (see Plate CLXXXVII. fig. 7), is placed in a cellar or other cool place, and charged with sulphuric acid to the height of about half an inch from the bottom. One of the porous earthen pots, being filled up to the lip with water fresh drawn from the well, is set upon a low porcelain stand in the middle of the cistern, to which the lid or cover is then carefully adapted. In the space of from three to perhaps five hours, the cooling is nearly completed, and the pot should now be removed; for though the water will be kept at the same degree of coldness as long as it remains shut up within the refrigeratory, the acid would be unnecessarily weakened by the incessant absorption of moisture.

Extent of this power. The production of cold is greater when the cistern is large, or when a small pot is used, insomuch that the effect will be diminished one half if the humid surface should equal that of the acid, the opposite actions of such surfaces inducing an exactly intermediate state with respect to dryness and moisture in the condition of the aërial medium. The power of evaporation is also diminished in the low temperatures. Thus, if the atmosphere were at 95° by Fahrenheit, the water within the refrigeratory might be cooled down 36°, or brought to 59°; but if the thermometer be at 50°, the water can be cooled only 18°, which brings it to the freezing point. This seems to be a very convenient property, since the power of the refrigeratory is always the greatest at the season when its application is most wanted.

It is easy, therefore, by such means to cool water in our climate at all times to near the freezing point, and, even under the torrid zone, to reduce it to the temperature of 60°, which in those regions is sufficient perhaps for essential comfort.

By supplying a succession of porous earthen pots, the acid will continue to act with scarcely diminished force, till it has absorbed half its weight of moisture; during which time it will have assisted in cooling about fifty times that quantity of the water exposed to evaporation. At this stage the dilute acid should be drawn off, and a charge of concentrated acid again introduced into the refrigeratory.

Its use for domestic purposes. This method of procuring cold, it will readily be perceived, could be employed with advantage for various domestic purposes. For instance, butter may in summer be kept cool for the table, by putting it, after being washed with water, into a wet porous pot, and shutting this up for a couple of hours in the refrigeratory. To cool wine sufficiently, one bottle only is used at a time in the smallest refrigeratory. A sheath of stocking or flannel, previously soaked in water, being drawn over the body of the bottle, it is laid in a reclined position on one of the porcelain sliders, near the surface of the acid, and allowed to remain shut up during the space of three or four hours.

The refrigerating combination here employed produces its effect, by a sort of invisible distillation carried on by the play and circulation of the included air. The minute portions of moisture which successively combine with the contiguous medium, must abstract from the mass of water as much heat as would support them in the state of vapour, or would in ordinary cases convert them into steam. This vapour again being conveyed through the air, is attracted by the sulphuric acid, and, recovering its liquid constitution, deposits the heat which it had borne away. The acid is therefore warmed at the expense of the water subjected to evaporation, and the whole performance of the apparatus consists in a mere transfer and interchange of condition. Cold.

CONGELATION

Congelation. Is the passage of any substance from the liquid to the solid form, in consequence of the abstraction of heat. The conversion of water into ice could not fail to draw the notice of men in all ages. The minute and divided fragments of the same production, which descend from the clouds in the shape of snow or hail, displayed the various powers of nature. The ancients imagined that water which has lain for ages in a frozen state acquires at last a permanent consolidation. They extended accordingly the name of ice (*κρυσταλλος* or *crystal*) to the pure and pellucid kind of quartz which often occurs on the sides of lofty mountains, near the boundary of perpetual congelation.

Water loses its air in the act of freezing. It was early remarked that melted ice has the lightness and quality of boiled water. In fact, the portion of air combined with ordinary water is discharged in the act of freezing, as well as in that of boiling. Water thus deprived of its air is therefore prepared for a readier congelation. The ancients accordingly, we have seen, always boiled the water which they designed afterwards to cool. Aristotle relates, in his *Meteorology*, that the fishermen who cast their nets in the waters of Pontus, used to carry in close vessels boiled water, for the purpose of sprinkling the reeds, that these might quickly freeze together, and cease to disturb the fish by their rustling noise. The expulsion of air from water during the progress of congelation, was afterwards fully proved by Mariotte, one of the earliest members of the French Academy of Sciences. If two wine glasses, filled, the one with water from the well, and the other with water recently boiled, be exposed to the frost, the ice of the latter will seem almost uniformly pellucid, while the ice of the former will appear charged with small air-bubbles crowding towards the centre of the mass, to which they are driven by the advance of the congelation.

That congelation shoots at angles of 120 degrees, was first observed in the beginning of the seventeenth century by the great Kepler; and this ardent and inventive genius, in an elaborate dissertation, which he printed as a new year's present, investigated the various forms and modifications of the icy crystals. The subject was next discussed by Des Cartes and Bartholinus, and about a century afterwards resumed by Mairan, and may be considered as a step towards the general theory of crystallography, which has been since reared by the patience and ingenuity of Haüy.

Imperfect congelation. Other liquids, such as vinegar, dilute mineral acids, weak spirits, and saline solutions, are likewise capable of being frozen; but they yield an ice distinctly different from that of pure water, resembling an aggregation rather than an uniform solid, and wanting consistency, strength, and clearness. The frost appears to seize on the water only, and to fill the compound liquid with close spicular shoots, entangling the stronger acid or brine in their interstices. It was a mistake, therefore, to assert that the ice of sea-water is really fresh. In the process of melting, some portion of the brine may probably flow off, but the residue still is always brackish. This fact is even positively stated by the missionary Crantz, in his accurate account of Greenland. The very intelligent and enterprising navigator Mr Scoresby reckons the specific gra-

Cold.

vity of the spongy salt-water ice to be ·873, while that of fresh-water ice amounted to ·937.

Artificial congelation discovered in Italy;

The ancients were altogether unacquainted with artificial congelation, and with any cold, indeed, below that of freezing. The application of nitre to the cooling of water seems, before the close of the sixteenth century, to have suggested to the Italians the experiment of mixing it with snow. A very intense degree of cold was thus generated, capable of converting speedily into solid ice a body of water contained in a smaller vessel immersed in the dissolving mixture. Sanctorio, who may be regarded as the father of modern physics, mentions, in his *Commentary on Avicenna*, that he produced the same effect by employing common salt instead of nitre, in the proportion of the third part of the snow, and had repeatedly performed the experiment in the presence of a numerous auditory.

and gradually communicated to the rest of Europe.

From Italy this discovery was gradually communicated over the rest of Europe. In the course of the seventeenth century iced creams, fruits, and various confitures, were first produced on the tables of the luxurious. The famous coffeehouse, *Procope*, was founded at Paris in 1660, by a Florentine of that name, a vender of lemonade, who was very successful in the art of preparing rich ices. Thirty years afterwards the use of such artificial delicacies in that city had become quite common.

Rendered more intense.

The cold resulting from the addition of saline powders to snow or pounded ice, depends on the powerful attraction of those salts, which restores the frozen mass to its liquid form, and therefore augments its capacity for heat. Fahrenheit fixed the commencement of his thermometrical scale at the temperature of the compound of salt and snow, conceiving it to be the lowest possible; but much lower degrees of cold are now produced. One part of the muriate of soda, or purified common salt, being added to two parts of dry snow or pounded ice, will sink the thermometer five degrees below zero. One part of sal-ammoniac, and two of common salt, joined to five parts of snow, will bring it seven degrees lower; but equal parts of the nitrate of ammonia and common salt, joined to two parts and a half of snow, will depress the thermometer twenty-five degrees below the freezing point.

Still more intense cold might be produced, if the ingredients were, before their mixture, cooled down to congelation. Thus five parts of the muriate of lime, added to four parts of snow, will sink the thermometer to forty degrees below the beginning of the scale, or the limit of freezing mercury; and if the muriate of lime were crystallized, the effect would be ten degrees more. The same extreme energy is exerted on adding four parts of dry caustic potash to three parts of snow.

The mineral acids likewise, in a diluted state, produce similar effects. Two parts of weak sulphuric acid, joined to three of snow, will sink the thermometer to twenty-three degrees below zero. The muriatic and nitric acids, in nearly the same proportions, will depress it from four to seven degrees more. By repeating the applications, therefore, a most intense cold may be created; yet, to succeed completely, a skilful manipulation is required. The saline matters should be reduced to a fine powder, and the freezing mixtures should be made in very thin vessels, not larger than will barely hold them. In this way, by successive stages of cooling, Mr Walker once obtained the enormous cold of ninety-one degrees below the commencement of Fahrenheit's scale.

The mere evaporation of some very volatile liquids is sufficient to produce excessive cold. Thus, if a thermometer, having its bulb covered with lint, be dipped in the common or sulphuric ether, it will, on exposure to the air, sink perhaps thirty or forty degrees. This effect is augmented under the receiver of an air-pump. If a narrow thin tube of glass, filled with water, and cased on the outside with lint soaked in ether, be suspended above the pump, and the exhaustion quickly made, a cylinder of ice will be formed.

Cold.

The same property is manifested in a higher degree by a singular liquid, discovered by Lampadius in 1796, by distilling a mixture of pyrites and charcoal. It was called at first the *alcohol of sulphur*, but now more appropriately the *sulphuret of carbon*. According to Dr Marcet, who has completed the investigation of its properties, a thermometer having its bulb covered with lint wetted by this liquid, and held in the open air, will sink not fewer than sixty degrees; but if the same experiment be performed within the exhausted receiver of an air-pump, the alcohol of the barometer will even descend to eighty-two degrees below zero. It must be observed, however, that these effects produced by the evaporation of ether, and of the sulphuret of carbon, are quite evanescent, and that the receiver becomes soon charged with their fumes, which then prevent any farther action. Those fumes likewise corrode the valves of the pump, and soon render it quite useless. Neither ether, therefore, nor the sulphuret of carbon, could be applied in practice with any sort of advantage to the production of ice, even on the smallest scale.

New mode of artificial congelation.

We have now to relate a discovery which will enable human skill to command the refrigerating powers of nature, and, by the help of an adequate machinery, to create cold and produce ice, on a large scale, at all seasons, and in the hottest climates of the globe; but to explain this interesting subject with greater clearness and accuracy, it is requisite to trace the successive advances which conducted to the result. Where a conclusion appears simple, the careless observer is apt to suppose it easily attained; yet, though sound philosophy tends always to simplification, the rare quality of simplicity is scarcely ever the flash of intuition, but the slow fruit of close and patient investigation. In pursuing the researches with his hygrometer, Professor Leslie was early induced to inquire into the condition of the higher atmosphere, and its relations to humidity. He thus detected a fact of great importance in meteorology, and pointing at various ulterior views.

Investigation of its principles.

As rarefaction enlarges the capacity of air for heat, so it likewise augments the disposition to hold moisture; at the same time that the removal of the ordinary pressure facilitates the expansion of the liquid matter, and its conversion into a gaseous form. Accordingly, if the hygrometer be suspended within a large receiver, from which a certain portion of air is quickly abstracted, it will sink with rapidity. In summer, the additional dryness thus produced amounts to about fifty hygrometric degrees each time the air has its rarefaction doubled; so that, supposing the operation of exhausting to be performed with expedition, and the residuum reduced to a sixty-fourth part, the hygrometer would mark a descent of 300°. But this effect is only momentary, for the thin air very soon becomes charged with moisture, and, consequently, ceases to act on the wet ball of the hygrometer. The cold, however, excited on the surface of that ball, by such intense evaporation, will have previously frozen the coating.

The increased power of aqueous solution which air acquires as it grows thinner, being ascertained and carefully investigated, the object was to combine the action of absorbent with the transient dryness produced within a receiver by rarefaction. The sentient ball of the hygrometer being covered with dry salt of tartar, the instrument first indicated increasing dryness, and afterwards, as the rarefaction proceeded, it changed its course, and marked humidity. The same variation of effect nearly was ob-

Cold

served when the hygrometer had been wetted as usual with pure water, and a broad saucer containing the mild vegetable alkali was placed on the plate of the air-pump. It was thus proved that the action of this imperfect absorbent is soon overpowered by the tendency to vaporization in attenuated air, and that, beyond a certain limit, it surrenders its latent moisture.

Mr Leslie resolved, therefore, to try the effect of sulphuric acid, whose peculiar energy as an absorbent he had, under other circumstances, already ascertained; but various incidents prevented him, for a considerable time, from resuming his philosophical inquiries. At last he began those projected experiments, and was almost immediately rewarded by the disclosure of a property, the application of which blazed on his fancy. In the month of June 1810, having introduced a surface of sulphuric acid under the receiver of an air-pump, he perceived with pleasure that this substance only superadded its peculiar attraction for moisture to the ordinary effects resulting from the progress of exhaustion; and, what was still more important, that it continued to support with undiminished energy the dryness thus created. The attenuated air was not suffered as before to grow charged with humidity; but each portion of that medium, as fast as it became saturated by touching the wet ball of the hygrometer, transported its vapour to the acid, and was thence sent back denuded of the load, and fitted again to renew its attack with fresh vigour. By this perpetual circulation, therefore, between the exhaling and the absorbing surface, the diffuse residuum of air is maintained constantly at the same state of dryness. The sentient ball of the hygrometer, which had been covered with several folds of wetted tissue paper, was observed, at an early stage of the operation, suddenly to lose its blue tint and assume a dull white, while the coloured liquor sprung upwards in the stem, where it continued for the space of a minute stationary, and again slowly subsided. The act of congelation had therefore at this moment taken place, and the paper remained frozen several minutes, till its congealed moisture was entirely dispersed. Pursuing this decisive intimation, the hygrometer was removed, and a watch-glass filled with water substituted in its place. By a few strokes of the pump the whole was converted into a solid cake of ice, which being left in the rare medium, continued to evaporate, and, after the interval of perhaps an hour, totally disappeared. A small cup for holding the water was next adopted, and the whole apparatus gradually enlarged.

First applied.

Efficient power nearly the same at all temperatures.

The powers both of vaporization and of absorption being greatly augmented in the higher temperatures, the same limit of cold nearly is in all cases attained by a certain measure of exhaustion. When the air has been rarefied 250 times, the utmost that, under such circumstances, can perhaps be effected, the surface of evaporation is cooled down 120 degrees of Fahrenheit in winter, and would probably sink near 200 in summer. Nay, a far less tenuity of the medium, when combined with the action of sulphuric acid, is capable of producing and supporting a very intense cold. If the air be rarefied only 50 times, a depression of temperature will be produced, amounting to 80 or even 100 degrees of Fahrenheit's scale.

Mode of proceeding.

We are thus enabled, in the hottest weather, to freeze a mass of water, and to keep it frozen, till it gradually wastes away, by a continued but invisible process of evaporation. The only thing required is, that the surface of the acid should approach tolerably near to that of the water, and should have a greater extent; for otherwise the moisture would exhale more copiously than it could be transferred and absorbed; and, consequently, the dryness of the rarefied medium would become reduced, and its evaporating energy essentially impaired. The acid should be poured to the depth perhaps of half an inch, in a broad flat dish, which is covered by a receiver of a form nearly hemispherical; the water exposed to congelation may be contained in a shallow cup, about half the width of the dish, and having its rim supported by a narrow porcelain ring, upheld above the surface of the acid by three slender feet. (See fig. 1 and 2, Plate CLXXXVII.) It is of consequence that the water should be insulated as much as possible, or should present only a humid surface to the contact of the surrounding medium; for the dry sides of the cup might receive, from communication with the external air, such accessions of heat as greatly to diminish, if not to counteract, the refrigerating effects of evaporation. This inconvenience, however, is in a great measure obviated, by investing the cup with an outer case at the interval of about half an inch. If both the cup and its case consist of glass, the process of congelation is viewed most completely; yet when they are formed of a bright metal, the effect appears on the whole more striking. But the preferable mode, and that which prevents any waste of the powers of refrigeration, is to expose the water in a pan of porous earthenware. If common water be used, it will evolve air bubbles very copiously as the exhaustion proceeds; in a few minutes, and long before the limit of rarefaction has been attained, the icy spiculæ will shoot beautifully through the liquid mass, and entwine it with a reticulated contexture. As the process of congelation goes forward, a new discharge of air from the substance of the water takes place, and marks the regular advances of consolidation; but after the water has all become solid ice, which, unless it exceed the depth of an inch, may generally be effected in less than half an hour, the circle of evaporation and subsequent absorption is still maintained. A minute film of ice, abstracting from the internal mass a redoubled share of heat, passes, by invisible transitions, successively into the state of water and of steam, which, dissolving in the thin ambient air, is conveyed to the acid, where it again assumes the liquid form, and, in the act of combination, likewise surrenders its heat.

Cold

In performing this experiment, the object is generally to seek at first to push the rarefaction as far as the circumstances will admit. But the disposition of the water to fill the receiver with vapour being only in part subdued by the action of the sulphuric acid, a limit is soon opposed to the progress of exhaustion; and the included air can seldom be rarefied above a hundred times, or till its elasticity can support no more than a column of mercury about three tenths of an inch in height. A smaller rarefaction, perhaps from ten times to twenty times, will be found sufficient to support congelation after it has once taken place. The ice then becomes rounded by degrees at the edges, and wastes away insensibly, its surface being incessantly corroded by the play of the ambient air, and the minute exhalations conveyed by an invisible process to the sulphuric acid, which, from its absorbing the vapour, is all the time maintained above the temperature of the apartment. The ice, kept in this way, suffers a very slow consumption; for a lump of it, about a pound in weight and two inches thick, is sometimes not entirely gone in the space of eight or ten days. During the whole progress of its wasting, the ice still commonly retains an uniform transparent consistence; but, in a more advanced stage, it occasionally betrays a sort of honeycombed appearance, owing to the minute cavities formed by globules of air, set loose in the act of freezing, yet entangled in the mass, and which are afterwards enlarged by the erosion of the solvent medium.

Moderate rarefaction sufficient to maintain the ice.

But almost every practical object is attained through far inferior powers of refrigeration. Water is the most

Cold. easily frozen, by leaving it, perhaps for the space of an hour, to the slow action of air that has been rarefied only in a very moderate degree. This process meets with less impediment; and the ice formed by it appears likewise more compact, when the water has been already purged of the greater part of its combined air, either by distillation or by long-continued boiling. The water which has undergone such operation should be introduced as quickly as possible into a decanter, and filled up close to the stopper, else it will attract air most greedily, and return nearly to its former state in the course of a few hours.

Elegant mode of freezing. The most elegant and instructive mode of effecting artificial congelation, is to perform the process under the transferrer of an air-pump. A thick but clear glass cup being selected, of about two or three inches in diameter, has its lips ground flat, and covered occasionally, though not absolutely shut, with a broad circular lid of plate glass, which is suspended horizontally from a rod passing through a collar of leather (see fig. 6, Plate CLXXXVII.) This cup is nearly filled with fresh distilled water, and supported by a slender metallic ring, with glass feet, about an inch above the surface of a body of sulphuric acid, perhaps three quarters of an inch in thickness, and occupying the bottom of a deep glass basin that has a diameter of nearly seven inches. In this state the receiver being adapted, and the lid pressed down to cover the mouth of the cup, the transferrer is screwed to the air-pump, and the rarefaction, under those circumstances, pushed so far as to leave only about the hundred and fiftieth part of a residuum; and the cock being turned to secure that exhaustion, the compound apparatus is then detached from the pump, and removed to some convenient apartment. As long as the cup is covered, the water will remain quite unaltered; but on drawing up the rod half an inch or more, to admit the play of the rare medium, a bundle of spicular ice will, after the lapse perhaps of five minutes, dart suddenly through the whole of the liquid mass; and the consolidation will afterwards descend regularly, thickening the horizontal stratum by insensible gradations, and forming in its progress a beautiful transparent cake. On letting down the cover again, the process of evaporation being now checked or almost entirely stopped, the ice returns slowly into its former liquid condition. In this way the same portion of water may, even at distant intervals of time, be repeatedly congealed and thawed successively twenty or thirty times. During the first operations of freezing, some air is liberated; but this extrication diminishes at each subsequent act; and the ice, free from the smallest specks, resembles a piece of the purest crystal.

Progress of congelation. This artificial freezing of water in a cup of glass or metal affords the best opportunity of examining the progress of crystallization. The appearance presented, however, is extremely various. When the frigorific action is most intense, the congelation sweeps at once over the whole surface of the water, obscuring it like a cloud: but, in general, the process advances more slowly; bundles of spiculæ, from different points, sometimes from the centre, though commonly from the sides of the cup, stretching out and spreading by degrees with a sort of feathered texture (see fig. 4). By this combined operation, the surface of the water soon becomes an uniform sheet of ice. Yet the effect is at times singularly varied; the spicular shoots, advancing in different directions, come to inclose, near the middle of the cup, a rectilineal space, which, by unequal though continued encroachment, is reduced to a triangle; and the mass below, being partly frozen, and therefore expanded, the water is gradually squeezed up through the orifice, and forms by congelation a regular pyramid, rising by successive steps; or, if the projecting force be greater, and the hole more contracted, it will dart off like a pillar. The radiating or feathered lines which at first mark the frozen surface are only the edges of very thin plates of ice, implanted at determinate angles, but each parcel composed of parallel planes. This internal formation appears very conspicuous in the congealed mass which has been removed from a metallic cup, before it is entirely consolidated. Sea-water will freeze with almost equal ease, but it forms an incompact ice, like congealed syrup, or what is commonly called *water-ice*. Cold.

When cups of glass or metal are used, the cold excited at the open surface of the liquid extends its influence gradually downwards. But if the water be exposed in a porous vessel, the process of evaporation, then taking effect on all sides, proceeds with a nearly regular consolidation towards the centre of the mass, thickening rather faster at the bottom, from its proximity to the action of the absorbent, and leaving sometimes a reticulated space near the middle of the upper surface, through which the air, disengaged by the progress of congelation, makes its escape.

Singular modification of the process. When very feeble powers of refrigeration are employed, a most singular and beautiful appearance is, in course of time, slowly produced. If a pan of porous earthenware, from four to six inches wide, be filled to the utmost with common water till it rise above the lips, and planted above a dish of ten or twelve inches diameter, containing a body of sulphuric acid, and then a broad round receiver placed over it; on reducing the included air to some limit between the twentieth and the fifth part of its usual density, according to the coldness of the apartment, the liquid mass will, in the space of an hour or two, become entwined with icy shoots, which gradually enlarge and acquire more solidity, but always leave the fabric loose and unfrozen below. The icy crust which covers the rim, now receiving continual accessions from beneath, rises perpendicularly by insensible degrees. From each point on the rough surface of the vessel, filaments of ice, like bundles of spun glass, are protruded, fed by the humidity conveyed through its substance, and forming in their aggregation a fine silvery surface, analogous to that of fibrous gypsum or satin-spar. At the same time, another similar growth, though of less extent, takes place on the under side of the pan, so that continuous icy threads might appear vertically to transpierce the ware. The whole of the bottom becomes likewise covered over with elegant icy foliations (see fig. 5). Twenty or thirty hours may be required to produce those singular effects; but the upper body of ice continues to rise for the space of several days, till it forms a circular wall of near three inches in height, leaving an interior grotto lined with fantastic groups of icicles. In the meanwhile, the exfoliations have disappeared from the under side, and the outer incrustation is reduced, by the absorbing process, to a narrow ring. The icy wall now suffers a regular waste from external erosion, and its fibrous structure becomes rounded and less apparent. Of its altitude, however, it loses but little for some time; and even a deposition of congealed films along its coping or upper edge seems to take place at a certain stage of the process. This curious effect is owing to a circumstance which, as it serves to explain some of the grand productions of nature, particularly the *icebergs* of the arctic circle, merits particular attention. The circular margin of the ice, being nearer the action of the sulphuric acid than its inner cavity, must suffer, by direct evaporation, a greater loss of heat; and, consequently, each portion of thin air that rises from the low cavity, being chilled in passing over the colder ledge, must deposit a minute corresponding share of its moisture, which instantly attaches itself and incrusts the ring. Whatever inequalities existed at first in the surface of the ice, will hence continually increase.

Artificial congelation best performed on a large scale.

Artificial congelation is always most commodiously performed on a large scale. Since the extreme of rarefaction is not wanted, the air-pump employed in the process admits of being considerably simplified, and rendered vastly more expeditious in its operation. Two or three minutes at most will be sufficient for procuring the degree of exhaustion required, and the combined powers of evaporation and absorption will afterwards gradually produce their capital effect. In general, plates of about a foot in diameter should be preferred, which can be connected at pleasure with the main body of the pump. The dish holding the sulphuric acid is nearly as wide as the flat receiver; and a set of evaporating pans belongs to it, of different sizes, from seven to three inches in diameter, which are severally to be used according to circumstances. The largest pan is employed in the cold season, and the smaller ones may be successively taken as the season becomes sultry. On the whole, it is better not to overstrain the operation, and rather to divide the water under different receivers, if unusual powers of refrigeration should be required. As soon as the air is partly extracted from one receiver, the communication is immediately stopped with the barrel of the pump, and the process of exhaustion is repeated on another. In this way, any number of receivers, it is evident, may be connected with the same machine. If we suppose but six of these to be used, the labour of a quarter of an hour will set as many evaporating pans in full action, and may, therefore, in less than an hour afterwards, produce nearly six pounds of solid ice. The waste which the water sustains during this conversion is extremely small, seldom indeed amounting to the fiftieth part of the whole. Nor, till after multiplied repetitions, is the action of the sulphuric acid considerably enfeebled by its aqueous absorption. At first that diminution is hardly perceptible, not being the hundredth part when the acid has acquired as much as the tenth of its weight of water. But such influence gains rapidly, and rises with accelerated progression. When the quantity of moisture absorbed amounts to the fourth part by weight of the acid, the power of supporting cold is diminished by a twentieth; and, after the weights of both these come to be equal, the refrigerating energy is reduced to less than the half. Sulphuric acid is hence capable of effecting the congelation of more than twenty times its weight of water, before it has imbibed near an equal bulk of the liquid, or has lost about the eighth part of its refrigerating power. The acid should then be removed, and concentrated anew by slow distillation.

Congelation might be connected with the steam-engine.

When the exhaling and absorbing surfaces are rightly disposed and apportioned, the moderate rarefaction, from twenty to forty times, which is adequate to the freezing of water, may be readily procured by the condensation of steam. In all manufactures where the steam-engine is employed, ice may, therefore, at all times be formed in any quantity, and with very little additional expense. It is only required to bring a narrow pipe from the condensing vessel, and to direct it along a range of receivers, under each of which the water and the acid are severally placed. These receivers, with which the pipe communicates by distinct apertures, may, for the sake of economy, be constructed of cast iron, and adapted with hinges to the rim of a broad shallow dish of the same metal, but lined with lead to hold the acid.

Congelation of mercury

The combined powers of rarefaction and absorption are capable of generating much greater effects than the mere freezing of water. Such frigorific energy, however, is at all times sufficient for effecting the congelation of mercury. Accordingly, if mercury, contained in a hollow pear-shaped piece of ice, be suspended by cross threads near a broad surface of sulphuric acid under a receiver; on urging the rarefaction, it will become frozen, and may remain in that solid state for the space of several hours. But this very striking experiment is easily performed without any foreign aid. Having introduced mercury into the large bulb of a thermometer, and attached the tube to the rod of a transferrer, let this be placed over the wide dish containing sulphuric acid, in the midst of which is planted a very small tumbler nearly filled with water. After the included air has been rarefied about fifty times, let the bulb be dipped repeatedly into the very cold but unfrozen water, and again drawn up about an inch; in this way it will become incrusted with successive coats of ice, to the thickness perhaps of the twentieth part of an inch. The water being now removed, the pendant icicle cut away from the bulb, and its surface smoothed by the touch of a warm finger, the transferrer is again replaced, the bulb let down within half an inch of the acid, and the exhaustion pushed to the utmost. When the syphon-gage has come to stand under the tenth of an inch, the icy crust starts into divided fissures, and the mercury, having gradually descended in the tube till it reach its point of congelation, or 39 degrees below zero, sinks by a sudden contraction almost into the cavity of the bulb; and the apparatus being then removed and the ball broken, the metal appears a solid shining mass, that will bear the stroke of a hammer.

Still greater cold created.

But a still greater degree of cold may be created, by applying the same process likewise to cool the atmosphere which encircles the apparatus itself. A glass matrass was blown nearly of a hemispherical shape, its bottom quite flat, and about three inches in diameter, and its neck about half an inch wide and cut square over. The whole was covered with a coat of patent lint, which takes up water very copiously. A portion of sulphuric acid was next introduced, forming a layer of perhaps a quarter of an inch thick; and a spirit of wine thermometer, having its bulb also cased with wetted lint, was then inserted within the matrass, a brass ring attached to the tube securing it in the right position. Things being thus arranged, the matrass or flat bottle, with its thermometer, was placed on a slender stool with glass feet, about an inch above the sulphuric acid in the broad basin, and the large receiver luted over it. The air was then partly extracted, till the gage came below one inch. In a few minutes the lint was frozen entirely, and looked white. After an interval of a quarter of an hour, to allow time for the evaporation of that icy coat to cool down the interior apparatus, the pump was again urged, and the exhaustion pushed to about three tenths of an inch. In a short while the inclosed thermometer sunk not fewer than 180 degrees, and remained stationary till the ice had wasted away.

It is obvious, therefore, that the refrigerating powers could be pushed still further by a judicious combination of the apparatus. An idea of the mode of proceeding may be formed from the inspection of figure 8. It would be easy to show that the maximum effect is obtained, when the dimensions of the successive cases rise in a geometrical progression. The action, however, is not doubled for each additional case, but increased rather more than one half.

Simpler mode of congelation,

These plans are difficult in the execution, and, though they enlarge our conceptions of the extent of the descending scale of heat, yet they furnish merely speculative results. A very important practical improvement has been lately made in the process of artificial congelation. Sulphuric acid is certainly a cheap and most powerful agent of absorption; but the danger in using such a corrosive liquid, especially by unskilful persons, formed always a serious obstacle to its general adoption. Mr Leslie had

Cold ‖ Colding-ham.

early noticed the remarkable absorbent quality of our mouldering whinstone or porphyritic trap; and in April 1817 he substituted that material, grossly pounded and dried before a kitchen fire, instead of sulphuric acid, and actually froze a body of water with great facility. This earth will attract the fiftieth part of its weight of moisture before its absorbent power is reduced to the one-half, and is hence capable of freezing the sixth part of its weight of water. It may be repeatedly dried, and will, after each operation, act with the same energy as at first.

by dry pounded whinstone

or parched oatmeal.

But an absorbent still more convenient and powerful afterwards occurred to Mr Leslie; namely, *parched oatmeal*. With a body of oatmeal of a foot in diameter, and rather more than an inch deep, he froze a pound and a quarter of water, contained in a hemispherical porous cup. The meal is easily dried and restored again to its action. In a hot climate the exposure to the sun alone might prove sufficient. By the help of this simple material, therefore, ice may easily and safely be produced in any climate, and even at sea.

Cold ‖ Colebrooke

Other substances could no doubt be employed as absorbents. But, except the muriate of lime, or what is called the *oil of salt* desiccated, none hold out any prospect of success. Dried common salt will barely effect congelation, and stucco, or the sulphate of lime, deprived of its water of crystallization, which might seem to promise a powerful absorption, has scarcely any efficacy whatever.

EXPLANATION OF PLATE CLXXXVII.

Fig. 1 represents a large air-pump intended for the purpose of freezing water, consisting of six receivers, each of them having a broad glass saucer for holding sulphuric acid, and a small porous earthen cup containing the water.

Fig. 2, a section of the above, showing the communication between the receivers and the body of the pump.

Fig. 3, the lever key for opening and shutting the cocks.

Fig. 4, the more ordinary appearance of the surface of the water in the porous cup, at the moment when the act of congelation begins.

Fig. 5, the very singular kind of ice, striated, columnar, and cavernous, which, under a slight rarefaction, but in cold weather, rises slowly and changes its form by degrees, while part of the remaining water is drawn through the substance of the cup, and covers the outside with a thick icy collar above those irregular foliations.

Fig. 6 represents an elegant mode of almost instantaneously freezing within a transferer. Above the saucer of the sulphuric acid is placed a glass cup holding water; and the air having been previously exhausted, and the instrument detached from the pump, on pulling up the rod, the water, now left exposed to the most powerful evaporation, quickly runs into spicular ice, which gradually increases and consolidates into a pure transparent mass. The lid being let down again upon the glass cup, the action ceases, and the ice returns slowly to the state of water.

Fig. 7, a refrigeratory for cooling water at all times to a moderate degree, without the operation of an air-pump; a body of sulphuric acid lying at the bottom of the pan, while a porous vessel containing water is set in the centre of the refrigeratory, and the air is confined about it by replacing the lid.

Fig. 8 exhibits a system of vessels for producing spontaneously great cold. It consists of a series of leaden or pewter vessels, placed one within the other, and whose surfaces form a descending geometrical progression, being covered externally with soft wet lint, and holding each of them a portion of sulphuric acid. The powerful evaporation maintained by this arrangement causes the interior vessels to become successively colder, and thus augments by a repeated multiplication the final effect. Placed under the receiver of the air-pump, this system of evaporating vessels, with no very high degree of exhaustion, and at all seasons, excites ultimately the most intense cold yet produced, far exceeding what is required for the congelation of mercury. (J. L.)

COLDEN, Cadwallader, born in 1688, was the son of the parochial clergyman of Dunse, in Berwickshire. He studied medicine at Edinburgh; and in 1708 emigrated to Pennsylvania, where he practised as a physician. His "Remarks on Animal Secretions" were published on his return to Britain, and gained him some reputation. In 1718 he settled at New York, and became lieutenant-governor of that state. He published a good *History of the Five Indian Nations*, and an essay *On the Yellow Fever so fatal at New York in* 1743. But his favourite study was botany; and in the *Acta Upsalensia* for 1743-4 there appeared his *Plantæ Novæboracensis*, containing descriptions of numerous American species of which more than 200 were then new. He died at Long Island in 1776.

COLDINGHAM, supposed to be the *Colonia* of Ptolemy, and called by Bede the city Coldana and of Colud (*Coludum*), is situated on the borders of Scotland, about two miles from Eyemouth, and once was famous for its convent. This was the oldest nunnery in Scotland, for here the virgin-wife Etheldreda took the veil in 670; but, from the ancient name *Coludum*, it should seem that it had previously been inhabited by the religious order called *Culdees*. In 870 it was destroyed by the Danes; but its name is rendered memorable by the heroism of its nuns, who, to preserve themselves inviolate from those invaders, cut off their lips and noses; and having thus rendered themselves objects of horror, were, with their abbess Ebba, burnt in the monastery by the disappointed savages. In 1098 King Edgar founded on its site a priory of Benedictines in honour of St Cuthbert, and bestowed it on the monks of Durham.

COLDSTREAM, a border town of Scotland, in Berwickshire, 15 miles W. of Berwick, on the north bank of the Tweed, here crossed by a bridge of five arches. It is irregularly built, but being situated on the principal thoroughfare between England and Scotland, it has a considerable trade. Near the town is the ford of the Tweed, by which the Scotch and English armies crossed in former times. The "Coldstream Guards" are so named from having been raised here by General Monk in 1659-60. Coldstream, like Gretna Green, is celebrated for its irregular marriages. In the vicinity is Lennel House, a seat of the Earl of Haddington. Pop. (1851) 2238.

COLE, William, an eminent botanist, was born at Adderbury, Oxfordshire, about A.D. 1626, and studied at Merton College, Oxford. He afterwards removed to Putney, and published *The Art of Simpling*,—and *Adam in Eden*, or *Nature's Paradise*. Upon the restoration of Charles II. he became secretary to Dr Duppa, bishop of Winchester; but died two years after, at the age of 37.

COLEBROOKE, Henry Thomas, an eminent oriental scholar, the third son of Sir George, the second baronet of that name, was born in 1765. He was educated at home; and when only fifteen he had made considerable attainments in classical and mathematical studies. From the age

Coleraine ‖ Coleridge.

of twelve to sixteen he resided in France; and in 1782 was appointed to a writership in India. About a year after his arrival there he was placed in the Board of Accounts in Calcutta; and three years later he was removed to a situation in the revenue department at Tirhoot, where he pursued his studies in Eastern science and literature. In 1789 he was removed to Purneah, where he investigated the resources of that part of the country, and published his "Remarks on the Husbandry and Commerce of Bengal," in which he advocated a free trade between Great Britain and India. After eleven years' residence in India, Colebrooke began the study of Sanscrit; and to him was confided the translation of the great digest of Hindu law, which had been left unfinished by Sir William Jones. After filling a number of important offices, and publishing some works on oriental literature, including a Sanscrit grammar and dictionary, he returned to London, where he died, March 18, 1837. He was a director of the Asiatic Society, and many of the most valuable papers in their Transactions were communicated by him.

COLERAINE, a municipal and parliamentary borough and market-town of Ireland, county of Londonderry, on the Bann, 4 miles from its mouth, and 145 miles N. of Dublin. The town stands upon both sides of the river, which is here crossed by a very handsome stone bridge of three arches 288 feet in length by 32 in breadth. The principal part stands on the east bank, and consists of a central square called the "Diamond," and several diverging streets; the portion on the west side is called the Waterside or Killowen. It has two parish churches, two Roman Catholic chapels, townhall, market-house, endowed school, national model school, savings-bank, gas-works, and work-house.

The linen trade has been long extensively carried on here, particularly a fine description known as "Coleraines." Soap, candles, and leather are also manufactured; and the salmon and eel fisheries are actively prosecuted. It returns one member to parliament. Constituency (1853) 246. Population (1851) 5920. The mouth of the river, which was obstructed by a bar, has of late years been so much improved that vessels of 200 tons can now discharge at the quay of Coleraine. A government survey has just been completed (1854), with a view of still farther improving the navigation of the river. The principal trade is carried on through Port Rush, at the mouth of the Bann, where the harbour is formed by two moles, with an entrance of 200 feet wide, an area of 8 acres, and a depth of from 15 to 20 feet at the wharfs. In 1852, 551 vessels of 114,156 tons entered the port. Gross custom duties collected, L.6080.

COLERIDGE, Samuel Taylor, "the most imaginative of modern poets," was born in the year 1772, at Ottery St Mary, Devonshire. He was the son of the Rev. John Coleridge, vicar of Ottery. His father was a man of learning, and of singularly amiable qualities, but tinctured with some of that eccentricity of habit and manner which characterised his youngest son. Coleridge wore in childhood many of those features of mind, which, in his after life, ripened into good or evil. He was dreamy, solitary, and disinclined to the usual amusements of children. Losing his father in very early life, he obtained, by the kindness of a friend, a presentation to Christ Church Hospital. He made extraordinary advances in scholarship; and amassed a vast variety of miscellaneous knowledge, but in the random desultory manner which displayed already the instability of purpose, that caused the future failure of his genius in the accomplishment of the great objects which its capacities fitted it for achieving. During this period, imprudent bathing, an exercise of which he was immoderately fond, sowed the seeds of those bodily maladies which not only impaired the efficiency of his genius, but which unconsciously allured him into the unhappy and insidious habit that completed the destruction of his constitution, and unhinged the structure of his mind. One conspicuous feature of his intellect at Christ Church was its strong tendency to metaphysical speculation. The young enthusiast feared not to gauge the profoundest questions, till his school-boy pride rejoiced in the dignity of infidelity. These notions were most judiciously, as he himself confesses, whipped out of him by his able but stern instructor, the Rev. James Bowyer, a gentleman, for whose services in his intellectual education Coleridge frequently records his affectionate gratitude. His reputation at Christ Church promised a brilliant career at Cambridge. This university he entered in 1790, in his nineteenth year. But the same desultory, unordered habit of mind he had displayed in early life, followed him to Jesus College. His incapability of economy involved him in debt; the immaturity of his speculations urged him into Unitarian opinions in religion. In the midst of his university career, afflicted with that bias towards melancholy, with which the poetical temperament, especially when coupled with an irritable bodily habit, is so often cursed, and dejected with the spectacle of unrealised hopes of college honours, he suddenly left Cambridge. After wandering for a day or two in London, having bestowed his last pence on a beggar, he recklessly enlisted, under an assumed name, in a regiment of horse. Discovered at length, and rescued from this degradation by his friends, he resumed his position at College. In 1794 he became acquainted at Oxford with his future relative Southey, and a warm friendship soon ripened between the young poets. Their position was in one respect similar, as Southey was forfeiting the honours of Oxford from his adoption, like Coleridge, of a Unitarian creed. Both had embraced, with enthusiasm, during the preceding two or three years, the ideas of "liberty" promulgated by the French revolution; and at Bristol, where Coleridge had joined Southey, they formed the resolution, along with a third poet, Lovel, of founding what they termed a Pantisocracy, or Republic of pure freedom, on the banks of the Susquehanna. The three poets married in 1795 three sisters, the Misses Fricker of Bristol; but the marriages upset the pantisocratic scheme, for which they had been intended as part preparation. The good sense of Southey, not to mention want of funds, exploded the idea; and Coleridge, who had settled at Clevedon, near Bristol, was thrown on his literary resources. After some attempts at publication, and the projection of extensive plans of occupation and industry, tired of his village retirement, he removed to Bristol, and appeared as the editor, or rather writer, of the "Watchman," a weekly political journal; but his indolent irregularity caused the extinction of his work at the tenth number. Failing in expectation of employment in the London press, he retired in the latter months of 1796, to a cottage at Nether Stowey, in Somerset, at the foot of Quantock Hills, on the grounds of Mr Poole, a gentleman whose friendship he has affectionately commemorated. Through this friend's means he became acquainted with Wordsworth and the two Wedgewoods. His name was soon associated with that of Wordsworth in the publication of the "Lyrical Ballads;" and a mutual resolution of the poets to write a play produced Coleridge's tragedy "Remorse." This was the most happy period of his life. His poetical faculty, which had budded in his sixteenth year, was ripened under the genial impulses of nature, friendship, and domestic affection. The first part of Christabel belongs to this year. He pursued his favourite metaphysical studies, oscillating between system and system, and his speculations were soon to receive new and important impressions from travel in Germany with Mr Wordsworth. Coleridge had accepted in 1798 the office of Unitarian

Coleridge

Coleridge. preacher to a congregation in Shrewsbury, and had actually preached his first sermon—of which Hazlitt has recorded a glowing account—when the "generous and munificent" offer of a life annuity from the two Wedgewoods extricated him from his Unitarian engagements, and enabled him to set out with Wordsworth for Germany. He was industrious in the study of the literature and philosophy of that country, and may be regarded as the introducer of German philosophy to the notice of British scholars. Shortly after his return, Coleridge and his family settled for some years with Southey, at Keswick, in the neighbourhood of Wordsworth. Meantime his opium-eating habit, into which he had been originally seduced from its apparent medicinal effects, had undermined his health, and in search of convalescence he went to Malta in 1804. He was appointed temporary secretary to Sir Alexander Ball, governor of that island. He returned by Italy to England in 1806. From this period till nearly 1816 he lived a wandering life—now with his family, now with one friend, again with another; sometimes lecturing, occasionally publishing. Letters and anecdotes injudiciously, if not cruelly, in reference to the poet's surviving relations, exposed to the world in Cottle's "Reminiscences," give a melancholy insight into Coleridge's condition during these years from the tyranny of opium. The capital defect in his character was want of will: the habit, which he could see, as it were a visible enemy, destroying his own happiness and that of those dearest to him, entangling him in meanness, deceit, and dishonesty, he could not summon resolution to resist. His letters and memoranda exhibit his sense of his slavery in words that might draw tears. In 1816, he placed himself under the care of Mr Gilman, surgeon, Highgate. With this generous family the poet resided till his death in 1834. He was cherished with affectionate solicitude, surrounded by friends who hung with rapture on his miraculous conversation. It is deeply to be regretted that his noble genius was to a great extent frittered in conversation, which he could pour forth unpremeditatedly for hours in unintermitted streams of vivid, dazzling, original thinking. "Did you ever hear me preach?" said Coleridge to Lamb. "I never heard you do anything else," was his friend's reply. Certainly through this medium he watered with his instruction a large circle of discipleship; but what treasures of thought has the world lost by Coleridge's unwillingness to make his pen the mouth-piece of his mind! Some of his most important prose works, however, appeared during this period. Before his death, Gilman relates, he had succeeded in emancipating himself from his opium chain (see his "Prayer," Cottle, p. 483); but 1816 closes the portion of Coleridge's biography which is the property of the public; neither Gilman nor Cottle pass this boundary.

Coleridge's prose works embrace many of the subjects most interesting to mankind—theology, history, politics, the principles of society; another sphere of his labours, partly oral and partly written, was literature and its criticism: a third comprehended logic and the transcendental metaphysics. These subjects occur in singular juxtaposition in more than one of his books. Independently of his Lectures and his contributions to periodicals, Coleridge's opinions were conveyed chiefly in "The Friend," his "Lay Sermons," his "Biographia Literaria," "Aids to Reflection," "Constitution of the Church and State," &c. Most of these works are fragmentary, or, at least collectively, they exhibit only part of his system of opinions, for Coleridge lived upon the future. His poetical works, consisting of "Juvenile Poems," "Sybilline Leaves," Odes, Ballads, Dramas, Translations, &c., exhibit the same feature of splendid incompleteness. After his death, collections were made of his "Table-talk," and other "Literary Remains," that rescued from oblivion much of his mind that is valuable.

The intellect of Coleridge is to be estimated rather by Coleridge. that of which it was capable, which it contemplated, and which it suggested, than by that which it achieved. Thrown upon life, poor and unsupported except by the benevolence of private friends, the inspired "charity boy," in his mission as the Apostle of Ideas, had a severe contest to fight. The friend of no party, he was obnoxious to all. Coleridge's bark sailed between the Scylla and Charybdis of the Edinburgh and Quarterly Reviews. It is to his credit, and to that of Southey and Wordsworth, that, in the face of a hostile age, they vindicated the freedom of poetical, political, and philosophical conscience; that, like the Scottish baron of old, they did "bide their time;" for all of them have left on the age that is succeeding an impress that will not soon be effaced. The literary fortitude of Coleridge under the continually-expressed conviction of the unpopularity of his writings is admirable. What would he not have achieved if this impassible fortitude had been animated by the aggressive vigour of industry and action so necessary in all who promulgate systems! The whole labours of Coleridge present the appearance of an unfinished city: the outline of the streets exhibits only how splendid they might have been; the basement of a pillar shows how gorgeous might have been its capital. A small, compact, complete beauty of poesy or of thought, pains us with the reflection that it stands surrounded by mere fragments of a similar promise. His works resemble a Californian valley, out of which may be dug in hundreds solid lumps of priceless gold from among materials useless or inappreciable. Besides the absence of a resolute will, another defect in the structure of Coleridge's mind was want of exactness. He had no capacity, he confesses himself, in the retention of facts: his mind was at home in the outline of generic ideas. Hence, while it could frequently chalk that outline with astonishing sagacity and philosophical accuracy, when it descended into the natural history of fact it frequently is found in "wandering mazes lost." This feature of the poet's intellect, in relation to theology, is illustrated with great clearness by the Rev. N. Porter in the American "Bibliotheca Sacra" (Vol. iv. No. 13). At an early period of his university career he lamented his distaste for the study of mathematics. Demonstrative and exact science lay beyond the dominion of his will; his was the logic of passion and imagination, as well as of the schools. His discussions often indicate this complexion of his reason. His own statement of his feelings in groping for religious truth through thorny regions of thought is, that "his head was with Spinosa and Leibnitz, while his heart was with Paul and John." The transcendental philosophy of Germany, acting on a mind of this semi-romantic temperament in inquiry, produced results resembling those of, as it were, metaphysical opium-eating. His metaphysical writings, encumbered with terminology, and algebraic symbols, stretching out into vast impalpable shadows, are frequently ungraspable as Ixion's cloud. And the haughty or embarrassed[1] pretence (at the conclusion of vol. i. Biog. Lit., edit. 1817) that the age was unripe for the appreciation of his philosophical teachings, and his proud "Intelligibilia non intellectum adfero," are unworthy of a literary patriot, who should, for the objects of his mission, "make himself all things unto all men," and whose bread, if he had it to give, "cast upon the waters, would be found after many days." The bread he has left has been found, and to good purpose. His reputation has risen throughout Great Britain; and America, which is the empiric of all principles evolved by European physics or philosophy, has had her poetry, her philosophy, and even her theology, deeply tinctured by Coleridge.

With his ardent benevolence and desire for the moral and intellectual elevation of humanity, was mingled much

[1] See Blackwood's Magazine, April 1840.

of a species of academic contempt for the myriads of God's immortal and intelligent creatures, commonly characterized as "the masses." With the fear of the French revolution before him, he seems to have viewed them as "dogs of war," with innate tendencies to turn upon and rend society, especially when society deigned to cast before them her pearls of instruction and philosophy. He seems to have deemed that they should be nourished with food convenient not so much for themselves as for the peace and prosperity of the "clerisy" and "special state" whom he appoints their overseers; that an episcopal crook and an act of Parliament are the keys to the whole duty of man as a unit in the "masses;" that scholarship and philosophy walk in silver slippers in a higher sphere, and that learning is degraded when it is popularized. "From a philosophical populace, good Lord deliver us," is, if we remember rightly, one of his expressions of this contempt. If he wrote only for philosophers, who can wonder that he should complain of a somewhat unappreciating audience?

The increasing celebrity of Coleridge caused the agitation of a somewhat painful question—his alleged literary plagiarism. This was first hinted by Mr De Quincey in Tait's Magazine, September 1834.

The accusation was corroborated and extended by Professor Ferrier in Blackwood, April 1840; and it is still farther confirmed and extended by Sir W. Hamilton (in his notes to the Works of Dr Reid, p. 890), whose indignation is great against the "literary reaver of the 'Hercynian brakes,'" and who mercilessly convicts Coleridge of ruthless and universal plagiarism, except where his ignorance prevented him from entering, and of blundering on subjects with which the poet professed to be most familiar. The defence by his friends is timid, and scarcely enters within the sphere of legal evidence, while even his accusers absolve him in general from deliberate and premeditated dishonesty; yet, withal, with the air of mere tribute to his known talents and celebrity. The specific accusations are the following: that literal or ornamental translations from German poets, and these too in celebrated passages of Coleridge, are found unacknowledged for years after they were published among his poetical works; that whole pages of literal or interpolated translation occur, chiefly in the "Biographia Literaria," from the works of his German contemporary Schelling; that besides this he assumes as his own the theories of that philosopher and of others, and that Coleridge left a branch of his work unfinished exactly at the point where Schelling leaves him unaided; nay, it is hinted, in the face of his own loud reclamation, that his principles of the criticism of Shakspeare are possibly to be put to the credit of Schlegel. His friends (especially his nephew and son-in-law, the late Rev. Henry Nelson Coleridge, in a prefatory discourse to the recent edition of the "Biog. Lit.") extricate him from a moral delinquency, by urging the known carelessness of his habits, the extent of his studies, and the defect of order in their arrangement; his custom of note-taking, which threw among his papers the thoughts of others, which his negligence or his recollection afterwards failed to recognise as not his own; again, there is urged the folly of which he would be convicted in wilfully concealing his obligations to writers the knowledge of whom he was pressing on the attention of his countrymen.

Coleridge more than once disclaims the imputation of vanity, but he also hints the idea that he has cause to be vain. If vanity is to be reckoned among the features of his mind, and much of his writing indicates this, while it is not inconsistent with the child-like simplicity ascribed to him, he may have been tempted, on the one hand, to the over-statement of his claims to certain thought-property belonging to others; and, on the other, to the under-statement of his actual verbal obligations to them. That Coleridge expected accusations of plagiarism is evident from his earnest reclamations against the suspicion of that crime. The vast extent of his line of thinking, often imperfectly defined as it was, would frequently come in contact with parallel lines of thought which he met with in his studies, matured and stereotyped by publication. He would feel impatient at seeing complete what had dawned as an outline in his own mind: he would entertain something like the feeling of having been defrauded of his property, and the present vivid impression, derived from his author, would be stamped on his own imperfect outline as the result of realized thought. In short, a process would take place in his intellect resembling that of Byron's baron in Mazeppa, who had pondered over the glories of his ancestors,

> "Until, by some confusion led,
> He thought their merits were his own."

The miscalculation of vanity, excusable, except in respect to the manner in which he has talked (see Hamilton's Reid, p. 890), and is alleged to have talked of others (for his former best friends accuse him of traduction; see Southey's letter in Cottle's Reminiscences, p. 407), and carelessness, superinduced by his acknowledged habits of mind, seem to constitute the amount of Coleridge's plagiaristic guilt. He was at least generous of his own stores; his nephew, indeed, inserts this circumstance as part of his apology; if he took from others, he was lavish to others far beyond the mark of his own appropriations; if he was "appetens alieni," he was also "profusus sui." This, though no more abstractly justifiable in Coleridge than in Catiline, is so far blameless in the case of the former, that his "appetentia" was undeliberate and unintentional.

Coleridge's whole mind was imbued with the love of truth and of beauty; for truth he wandered through the mazes of all philosophy, and wherever he found her, he grappled her to his soul with hooks of steel. When an extended horizon of Christianity enabled him to see the real position of his Socinian opinions, he embraced unchangeably with his whole heart "the truth as it is in Jesus." The very obscurities of Coleridge are "dark with excessive bright;" from his intense feeling of the beautiful, they are "golden mists" that rise from the morning of a pure heart; or they are lucid seas whose very depth prevents the eye from penetrating its extent. His prose style is disfigured by turgidity, and the affected use of words. His written humour is ponderous and unwieldy.

He was capable of immense services to poetry; but in this, as in other spheres of labour, he lived on the future; and Coleridge's future was a bad bank on which to draw; its bills were perpetually dishonoured. The conspicuous features of his poetry are its exquisite and original melody of versification, whose very sound chains the ear and soul; the harmonious grouping and skilful colouring of his pictures; statuesqueness and purity of taste in his living figures, and truth, in luxuriance or in simplicity, in majesty or in smallness, in his descriptions of nature. In sentiment, he opens with charming artlessness his own bosom in sorrow and in joy; this, it may be remarked, is a feature characteristic of the poetry of our own age above all that have preceded. There exists in general a decided contrast between the simplicity and lucidness of Coleridge's poetical style of expression, and the involved cloud-like fashion of his prose. Apart from his German translations and his dramas, there are few compositions of any extent complete in the works of Coleridge. "Christabel" is a fragment—a beauteous strain creeping in the ear, mysterious yet enrapturing as a celestial melody; but the import of whose language we scarcely comprehend, while we feel its sweetness. Capriciously it ceases in a moment, and leaves us in the position of Ariel's admirers in the tune played by the picture of nobody. The "Ancient Mariner" is, apart from certain defects in machinery, a composition the stature of whose idea "reaches the sky," and stretches its arms into

other worlds; but it vanishes from the reader's grasp in a huddled conclusion—a moral utterly partial, like that of "Christabel," when viewed in reference to the piece as a whole. "Cain," the promise of a Titanic birth, and "Kubla Khan," a literal dream of oriental glory, withered in the blight of an unexecuting will. But how exquisite in their completeness are the "Hymn to Mont Blanc" (though, by the bye, this is one of the accused pieces), "Love," the "Odes," and many lesser jewels! He often expends his genius on trifles; and, even in his greater efforts, it is to be regretted that his idealism has placed much of his poetry beyond popular relish or sympathy. His dramatic pieces, like most modern efforts of this class, exhibit rather scenery, poetry, and sentiment, than character; but the surviving fragments of this dramatic criticism show that they need only completeness to be sufficient alone for his immortality. The best tribute to Coleridge's genius consists in its admiration—nay, imitation—by the highest minds among his contemporaries, Byron and Scott, while all must perceive that his melody and his phrascology still murmur in the finest strains that emanate from the present age.

COLEROON RIVER, the northern branch of the Cavery, from which it diverges below the island of Seringham, near Trichinopoli, in Southern India, and falls into the sea at Devicotta, in Lat. 11. 22., Long. 79. 52., after a course of about 92 miles. The entrance of the river is difficult and dangerous of access from a bank called Coleroon Shoal, which stretches 4 or 5 miles to the S.E. An extensive system of canal irrigation, in connection with the waters of this river, has been established by the local government.

COLESHILL, a market-town in Warwickshire, 8 miles E. of Birmingham. It stands on a hill washed by the Cole, which is here crossed by a bridge. It is well built; and the parish church is a handsome Gothic edifice, with a lofty spire, a Norman font, and several monuments. Pop. (1851) 1980.

COLET, JOHN, dean of St Paul's, the son of Sir Henry Colet, knight, was born at London in 1466. His education commenced in St Anthony's school in that city; whence, in 1483, he was sent to Magdalene College, Oxford. After seven years' study of logic and philosophy, he took his degree in arts. About the year 1493 Colet went to Paris, and thence to Italy, in order to improve himself in the Greek and Latin languages, which at that time were imperfectly taught in our universities. On his return to England in 1497, he took orders, and settled at Oxford, where he read lectures gratis on the Epistles of St Paul. At this period he held the rectory of St Dennington in Suffolk, to which he had been instituted at the early age of nineteen; and he was also prebendary of York, and canon of St Martin's le Grand, London. In 1502 he became prebendary of Sarum; in 1505 prebendary of St Paul's; and immediately afterwards dean of that cathedral, having previously taken the degree of doctor of divinity. He was no sooner raised to this dignity than he introduced the practice of preaching and expounding the Scriptures; and soon afterwards established a perpetual divinity lecture, on three days in each week, in St Paul's Church,—an institution which paved the way for the Reformation. About the year 1508, Dean Colet formed his plan for the foundation of St Paul's school, which he completed in 1512, and endowed with estates to the amount of L.122 and upwards. The celebrated grammarian William Lyle was the first master, and the company of mercers were appointed trustees. The dean's religious opinions were so much more liberal than those of the contemporary clergy, that they deemed him little better than a heretic; and on this account he was so frequently molested, that he at last determined to spend the rest of his days in peaceful retirement. To carry this resolution into effect, he built a house near the palace of Richmond; but being seized with the sweating sickness, he died in 1519, in the fifty-third year of his age. He was buried on the south side of the choir of St Paul's, where a stone was laid over his grave, with no other inscription than his name. Besides the preferments above mentioned, he was rector of the guild of Jesus at St Paul's, and chaplain to Henry VIII. Dean Colet, though in communion with the Church of Rome, was an enemy to its superstitions. He disapproved of auricular confession, of the celibacy of priests, and other tenets and ceremonies which have since been rejected by all Protestants. He wrote—*Absolutissimus de octo Orationis partium constructione Libellus*, Antwerp, 1530, 8vo; *Rudimenta Grammatices*, London, 1539, 8vo; *Daily Devotions; Monition to a Godly Life; Epistolæ ad Erasmum;* and Commentaries on different parts of the sacred books; together with a number of smaller theological works.

COLGONG, a town of Hindustan, province of Bahar, and district of Bhagulpore, delightfully situated on the S.E. bank of the Ganges. The surrounding country is well stocked with game of all sorts, from the rhinoceros and tiger to the quail and ortolan. It is 102 miles N.W. from Moorshedabad. N. Lat. 25. 14., E. Long. 87. 17.

COLIBERTS (*Coliberti*), in *Law*, were tenants in socage, and particularly such villeins as were made freemen, but yet had superior lords to whom they paid certain duties, and in that respect they might be called servants, though of a middle condition between freemen and servants.

COLIGNI, GASPARD DE, admiral of France, was born at Châtillon-sur-Loin in 1517. He signalized himself in his youth, during the reigns of Francis I. and Henri II., and was made colonel of infantry and admiral of France in 1552. He was employed by Henri II. in the most important affairs; but after the death of that prince he embraced the reformed religion, and became the chief of the Huguenot Protestant party. He strongly opposed the house of Guise, and rendered this opposition so formidable, that it was thought he would have overturned the French government. On the peace concluded after the battles of Jarnac and Moncontour, Charles IX. deluded Coligni into security by his deceitful favours; and though he recovered from one attempt on his life, when he attended the nuptials of the prince of Navarre, yet he fell in the massacre on St Bartholomew's day, 24th August 1572, and his body was treated with wanton brutality by a fanatical and excited populace. His head was cut off and sent to Catharine de Medici; but his cousin Montmorenci secretly buried the body in the vaults of the chateau of Chantilly. In 1786 his remains were removed by Montesquieu to Maupertuis, where a monument was erected to his memory. History has preserved the name of the wretch who assassinated the admiral. He was a Bohemian or Gipsy, called Bême, whom Guise had employed for the purpose, and who, even on that day of blood, especially distinguished himself by his wanton barbarities. See FRANCE.

COLISEUM, or COLOSSEUM. See AMPHITHEATRE, vol. ii., p. 730; ARCHITECTURE, vol. iii., p. 469; ROME; and LONDON.

COLL, one of the western islands of Scotland, lying off the W. coast of Mull. It is 14 miles in length, with an average breadth of two miles. About one-third is cultivated or in pasture; the rest rocky and barren. Pop. (1851) 1109.

COLLAR (Lat. *collāre*; from *collum*, the neck). Among the ancients, this was sometimes worn as a badge of servitude.

The knights of several orders wear a chain of gold, enamelled, and frequently set with ciphers or other devices, with the badge of the order appended to it. Thus, the collar of the order of the garter consists of S.S., with roses enamelled red, within a garter enamelled blue, to which is appended the figure of St George.

Knights of the COLLAR, a military order in the republic of Venice, called also the order of St Mark, or the Medal.

Collate || College.

The knights wore no particular habit, and were distinguished only by the collar, which the doge put around their neck, with a medal, on which was represented the winged lion of the republic.

COLLATE, to lay together and compare, in order to ascertain the points on which two or more things of a similar kind agree or disagree. It is particularly applied to books and manuscripts.

COLLATERAL, in genealogy, descending from the same stock, but not in the direct line. Thus, uncles, aunts, nephews, nieces, and cousins, are collaterals, or in the same collateral line.

COLLATION, a term in the canon law, signifying a conferring, has been applied in various countries to the ecclesiastical sanction by which a clergyman is admitted to a benefice, whether the act consists in the conferring of the benefice by the ecclesiastical superior, or is merely an admission of the spiritual qualifications of a person otherwise presented. By the practice of England it is limited to the giving or bestowing of a benefice on a clergyman by a bishop, who has it in his own gift or patronage. It hence differs from institution in this, that institution is performed by the bishop upon the presentation of another, and collation is his own gift or presentation; and it differs from a common presentation, as it is the giving of the church to the person, whereas presentation is the giving or offering of the person to the church. But collation supplies the place of presentation and institution, and amounts to the same as institution, where the bishop is both patron and ordinary. Anciently the right of presentation to all churches was vested in the bishop; and now, if the patron neglect to present to a church, this right returns to the bishop by collation. But if the bishop neglects to collate within six months after the elapse of the patron, then the archbishop has a right to do it; and if the archbishop neglects, then it devolves to the king; the one as superior, to supply the defects of bishops, the other as supreme, to supply all defects of government.

COLLATION, in common law, the comparison or presentation of a copy to its original, to see whether or not it be conformable; or the report or act of the officer who made the comparison. A collated act is equivalent to its original, provided all the parties concerned were present at the collation.

COLLATION, in the law of Scotland, the right which an heir has of throwing the whole heritable and moveable estates of the deceased into one mass, and sharing it equally with the others in the same degree of kindred, when he thinks such share will be more than the value of the heritage to which he has an exclusive title.

COLLE, RAFFAELLINO DA, so called from the place of his birth, is by Lanzi mentioned as the probable assistant of Raffaelle in the Vatican and Farnesina; certainly as that of Giulio Romano at Rome, and seemingly also at Mantua. From his remaining works at Urbino, San Sepolcro, Pesaro, Perugia, &c., in several altar pieces, Lanzi considers Da Colle as one of the best masters of the Roman school of Raffaelle. Neither the date of his birth nor of his death are precisely ascertained.

COLLECT, a short comprehensive prayer, adapted to a particular day or occasion. The popes Gelasius and Gregory are said to have been the first who established *Collects*. Despence, a doctor of the faculty of Paris, has written a treatise on *Collects*.

COLLEGE (Lat. *collegium*, from *collega*, a person chosen along with others to a certain office), an association or body of men invested with certain powers or rights, performing certain duties, or engaged in some common employment or pursuit.

Collegium, among the Romans, was applied indifferently to such bodies, whether employed in the offices of religion, government, the liberal, or even the mechanical arts and trades; so that the word signified what is now called a corporation. Both before and under the empire the *colleges* were numerous; as the *college of augurs*, the *college of capitolini*, or of those who had the superintendence of the capitoline games; *colleges* of artificers, carpenters, potters, founders, locksmiths, engineers of the army, butchers, makers of military cassocks, bakers, musicians, &c. &c. The term was likewise applied to various magistrates; thus the tribunes of the plebs were called *collegium tribunorum*, and so forth. Plutarch observes, that it was Numa who first divided the people into colleges, in order that each consulting the interests of his college, and occupying himself therewith, might thus be prevented from entering into any general conspiracy against the public peace. Each of these colleges had distinct meeting-places or halls, and also a treasury and common chest, a register, a person to represent them upon public occasions, and acts of government. They had the privilege of manumitting slaves, of being legates, and of making bye-laws for their own body, provided these did not clash with those of the government. College.

There are various colleges among the moderns, founded on the model of those of the ancients. Such are the three colleges of the empire, viz.—

COLLEGE of Electors, or their Deputies, which formerly assembled in the diet of Ratisbon.

COLLEGE of Princes, or the body of princes, or their deputies at the diet of Ratisbon.

COLLEGE of Cities is, in like manner, the body of deputies which the imperial cities send to the diet.

COLLEGE of Cardinals, or the *Sacred COLLEGE*, a body composed of the three orders of cardinals. See CARDINAL.

COLLEGE is also used for a public place endowed with certain revenues, where the several branches of learning are taught. The establishment of colleges or universities is a remarkable period in literary history. The schools in cathedrals and monasteries confined themselves chiefly to the teaching of grammar, and there were only one or two masters employed in that office. But in colleges, professors were appointed to teach the different parts of science. The first obscure mention of academical degrees in the university of Paris, from which the other universities in Europe have borrowed most of their customs and institutions, occurs A.D. 1215. See UNIVERSITIES.

COLLEGE of Civilians, commonly called *Doctors' Commons*, a college near St Paul's Churchyard in London, founded by Dr Harvey, dean of the arches, for the professors of the civil law. Here also usually reside the judge of the arches court of Canterbury, the judge of the admiralty, of the prerogative court, &c., with other civilians, who live in a collegiate manner, commoning together; whence the appellation of *Doctors' Commons*. Their house being consumed in the great fire, they all resided at Exeter House in the Strand till 1672, when their house was rebuilt in a very splendid manner at the charge of the profession. To this college belong thirty-four proctors, who make themselves parties for their clients, manage their causes, &c. In the common hall the high court of admiralty and the principal spiritual courts are held.

London COLLEGE of Physicians, a corporation of physicians, who, by several charters and acts of parliament of Henry VIII. and his successors, have certain privileges, in virtue of which no man, though a graduate in physic of any university, may, without license, under the said college-seal, practise physic in or within seven miles of London. They have also power to administer oaths, fine and imprison offenders in that and several other particulars, to search the apothecaries' shops, &c., in and about London, to see if their drugs, &c., be wholesome, and their compositions according to the form prescribed by the college in their dispensatory. By the said charter they are also freed from all troublesome offices, such as serving on juries, being constables, keeping watch, providing arms, &c.

College. Of this college there are a president, four censors, eight electors, a registrar, and a treasurer chosen annually in October. The censors have, by charter, power to survey, govern, and arrest, all physicians, or others practising physic, in or within seven miles of London, and to fine, amerce, and imprison them at discretion. The number of fellows was anciently thirty, till Charles II. increased their number to forty; and James II., giving them a new charter, allowed the number of fellows to be enlarged so as not to exceed fourscore; reserving to himself and successors the power of placing and displacing any of them for the future.

Edinburgh College of Physicians was erected on the 26th November 1681. The design of this institution was to prevent the abuses daily committed by foreign and illiterate impostors, quacks, &c. For this reason, his Majesty, at the time mentioned, granted letters patent to erect into a body corporate and politic certain physicians in Edinburgh, and their successors, by the title of the President and Royal College of Physicians at Edinburgh, with power to choose annually a council of seven, one of whom to be president: and these are to elect a treasurer, clerk, and other officers: to have a common seal; to sue and be sued; to make laws for promoting the art of physic, and regulating the practice thereof, within the city of Edinburgh, town of Leith, and districts of the Canongate, West Port, Pleasance, and Potterrow, through all which the jurisdiction of the college extends. Throughout this jurisdiction no person is allowed to practise physic without a warrant from the college, under the penalty of L.5 sterling the first month, to be doubled monthly afterwards while the offence is continued; one half the money arising from such fines to go to the poor, the other to the use of the college. They are also empowered to punish all licentiates in physic within the above-mentioned bounds for faults committed against the institutions of the college; and to fine them of sums not exceeding 40s. On such occasions, however, they must have one of the bailies of the city to sit in judgment along with them, otherwise their sentence will not be valid. They are also empowered to search and inspect all medicines within their jurisdiction, and throw out into the street all such as are bad or unwholesome; and that they may the better attend their patients, they are exempted from watching, warding, and serving on juries. They are, however, restrained from erecting schools for teaching the art of physic, or conferring degrees on any person qualified for the office of a physician; but are obliged to license all such as have taken their degrees in any university, and to admit as honorary members all the professors of physic in the universities of Scotland. These privileges and immunities are not, however, to interfere with the rights and privileges of the apothecary surgeons, in the practice of curing wounds, contusions, fractures, and other external operations.

London College of Surgeons was established by ancient charters, one of which dates as far back as 1st Edw. IV. Its members are empowered to practise freely and without restraint the art and science of surgery throughout all his Majesty's dominions, and are exempt from serving as constables, jurymen, &c.

In the year 1843 this college petitioned the Crown for a new charter to alter the constitution of the college as established by the charters of 1800 and 1823; and a new charter was granted to the college, dated the 14th of September 1843, whereby the number of members of the council was increased from 21 to 24, and a new class of members, called fellows, was created, with extended rights and privileges; the fellows to elect the members of the council from amongst themselves, instead of vacancies in the council being filled up by the council itself; future members of the council no longer to hold office for life, but three of them to go out of office annually. The examiners may now be elected from the fellows; and the future examiners to hold office during the pleasure of the council, and not for life. College.

The two principal sergeant-surgeons to the Crown, and the surgeon-general to the forces no longer entitled to become members of the court of examiners upon the first vacancy after their appointment, in preference to other members of the college.

Under the provisions of the new charter, above 500 of the existing members have been created fellows; and by bye-laws and ordinances passed in pursuance of such charter, all members of the college (present as well as future) are entitled to be admitted to examination for the fellowship after a certain number of years' practice; that is to say, any person who shall have been a member on the 14th day of September 1844, is entitled to be admitted to the examination upon production of a certificate, signed by three fellows, that he has been eight years in practice, and is a fit and proper person to be admitted a fellow; and any person who shall have become a member of the college after the said 14th day of September 1844, is entitled to be admitted to such examination for the fellowship on production of a certificate, that he has a competent knowledge of Greek, Latin, and French, and of the elements of mathematics, and a certificate, signed by three fellows, that he has been 12 years in practice, and is a fit and proper person to be admitted a fellow. All members of the college, future as well as present (as well as other persons), are also entitled to be admitted to examination for the fellowship at any time, upon complying with the bye-laws and ordinances required to be observed by candidates for the fellowship: several members of the college, who were so qualified, have passed the examination, and become fellows of the college accordingly.

Persons not being members of the college, by obtaining the fellowship thereby, become members of the college, and acquire all the rights and privileges of other members.

Edinburgh College of Surgeons. This is an institution by which the surgeons of Edinburgh are incorporated into a royal college. They have the privilege of examining and licensing, if found qualified, all practitioners in surgery within certain bounds.

The examinations conducted by the Board of Examinators of this College may be classed under three heads:—

I.—The Examination for the Diploma of a Licentiate.

The persons holding this diploma are entitled to practise the arts of anatomy, surgery, and pharmacy, within the counties of Edinburgh, Linlithgow, Haddington, Fife, Peebles, Selkirk, Roxburgh, and Berwick. The diploma of licentiate of this College is also admitted by the Army and Navy Medical Boards, and by the East India Company, as a qualification for becoming a medical officer of their several establishments.

The holders of this diploma, though possessing no ulterior statutory privilege, have been by the custom of the country received as practitioners of these arts in every part of Scotland, and, till the passing of the Apothecaries' act of 1815, in every part of England, except London.

II.—The Examination for the Diploma of Fellow of the Royal College.

The candidates for this grade must have previously passed through the examination for the grade of licentiate. The holders of the fellowship are, therefore, entitled to all the privileges of licentiates, and they hold besides an exclusive right of practice within the city and liberties of Edinburgh. All licentiates may become candidates for the fellowship, and are entitled to become fellows on passing the prescribed examination.

No prosecution has been raised for a very long period of time to enforce the rights of the college against any persons for their not possessing either of the above qualifications.

III.—By the regulations of the Medical Board of the Royal Navy, medical officers, before promotion to the rank of full surgeon, are required to pass a second examination before a competent board; and the examinators of this college have been in the habit for many years of conducting such second examinations under the sanction of the navy medical board.

College of Justice, the supreme civil court of Scotland;

College || Collier.

otherwise called *Court of Session*, or *of Council and Session*. See SCOTLAND.

Sion COLLEGE, or the college of the London clergy, has time out of mind been a religious house, sometimes under the denomination of a priory, sometimes under that of a spital or hospital. At its dissolution under 31st Henry VIII. it was called Elson's Spital, from the name of its founder, a mercer, who organized it in 1329. At present it is a composition of both; namely, a college for the clergy within the city of London, who were incorporated in 1631 (in pursuance of the will of the Rev. Thomas White) under the name of the President and Fellows of Sion College, and an hospital for ten poor men and as many women. The officers of the corporation are the president, two deans, and four assistants, who are annually chosen from among the rectors and vicars of London, and are subject to the visitation of the bishop.

College of Heralds, commonly called the *Herald's Office*, a corporation founded by charter of Richard III., who granted them several privileges, such as freedom from subsidies, tolls, offices, &c. They had a second charter from Henry VI.; and a house built near Doctors' Commons by the Earl of Derby in the reign of Henry VII. was given them by the Duke of Norfolk in the reign of Mary. This house has now been rebuilt.

This college is subordinate to the earl marshal of England, and the members are assistants to him in his court of chivalry, usually held in the common hall of the college.

College of Heralds in Scotland, consists of the lyon king at arms, six heralds, and six pursuivants, with a number of messengers.

COLLEGIANTS, a religious sect formed among the Arminians and Anabaptists in Holland, in 1619. They held sacred conventions twice a-year at Rheinsberg, near Leyden. Their leaders were three brothers of the name of Koddeus or Kodde, obscure men in rural life, but pious and well acquainted with their Bibles. Their followers acquired the name collegiants, because they called their assemblies "colleges." The brethren were once very numerous in Holland, Friesland, and West Friesland. They assemble twice a-week; and any one, females excepted, is permitted to expound the Scriptures and to offer up prayer. They baptize by immersing the whole body in water; and admit every one who presents himself, without regard to his sect or opinion, provided he profess his faith in the divinity of the Scriptures, and his resolution to live suitably to their precepts and doctrines.

COLLEGIATE, or COLLEGIAL, church, is one which has no bishop's see, yet has the ancient retinue of a bishop, canons, and prebends. Such are Westminster, Rippon, Windsor, &c., governed by deans and chapters. Collegiate churches, in Scotland, are those where two ministers serve the cure as colleagues; dividing the duty between them in such proportions as may be arranged, and generally preaching alternately.

COLLET (from Lat. *collum* the neck), that part of a ring which encircles the stone. Also the small collar or band worn by the inferior Romish clergy.

COLLIER, JEREMY, a learned English nonjuring divine, born at Stow Qui, Cambridgeshire, in 1650, and educated at Caius College, Cambridge. His first appointment was to the small rectory of Ampton, near St Edmund's Bury, Suffolk, which, after six years, he resigned in order to proceed to London, where in 1685 he was made lecturer of Gray's Inn. But the change of government at the revolution soon rendered the public exercise of his function impracticable. He was committed to Newgate for writing in favour of the dethroned monarch; and again on a charge of carrying on a treasonable correspondence with the enemies of the movement; but he was released on both occasions without trial, by the intervention of his friends. So far did he carry his scruples at this period, that he submitted to confinement rather than make a tacit acknowledgment of the jurisdiction of the court by accepting his liberty upon bail. In the two following years he continued to harass the government by his publications; but for his boldness in granting absolution to Sir John Friend and Sir William Perkins at their execution, he was obliged to flee, and for the rest of his life continued under sentence of outlawry. From that time forward he employed his leisure in literary works, which were less political in their tone. In 1698 he published a short treatise in the style of Prynne's famous Histrio-mastix, entitled a *Short view of the Immorality and Profaneness of the English Stage*, which engaged him in a lengthened controversy with Congreve, Vanbrugh, and the other wits of the day. The book abounds in hypercriticism and in useless display of learning, neither intrinsically valuable nor conducive to the argument. Yet, in the words of Mr Macaulay, "when all deductions have been made, great merit must be allowed to the work. There is hardly any book of that time from which it would be possible to select specimens of writing so excellent and so various. To compare Collier with Pascal would, indeed, be absurd; yet we hardly know where, except in the *Provincial Letters*, we can find mirth so becomingly and harmoniously blended with solemnity as in the *Short View*. In truth, all the modes of ridicule, from broad fun to polished and antithetical sarcasm, were at Collier's command. On the other hand, he was complete master of the rhetoric of honest indignation. We scarcely know any volume which contains so many bursts of that peculiar eloquence which comes from the heart and goes to the heart. Indeed, the spirit of the book is truly heroic. In order fairly to appreciate it, we must remember the situation in which the writer stood. He was under the frown of power. His name was already a mark for the invectives of one-half of the writers of the age, when, in the cause of good sense, good taste, and good morals, he gave battle to the other half. Strong as his political prejudices were, he seems on this occasion to have laid them entirely aside. He has forgotten that he is a Jacobite, and remembers only that he is a citizen and a Christian. Some of his sharpest censures are directed against poetry which had been hailed with delight by the Tory party, and had inflicted a deep wound on the Whigs. It is inspiriting to see how gallantly the solitary outlaw advances to attack enemies formidable separately, and, it might have been thought, irresistible when combined; distributes his swashing blows right and left among Wycherley, Congreve, and Vanbrugh; treads the wretched Tom D'Urfey down in the dirt beneath his feet, and strikes with all his strength full at the towering crest of Dryden. The effect produced by the *Short View* was immense. The nation was on the side of Collier. The general belief was, that Dryden would take the field against him; and all the wits anticipated a sharp contest between two well-paired combatants. But Dryden's conscience smote him; he stood abashed, like the fallen archangel at the rebuke of Zephon. At a later period he mentioned the *Short View* in the preface to his *Fables*. He complained with some asperity of the harshness with which he had been treated, and urged some matters in mitigation; but, on the whole, he frankly acknowledged that he had been justly reproved."

Collier

Collier afterwards executed a translation of Moreri's *Historical and Geographical Dictionary*, which appeared in 4 vols. fol., 1701, 1705, 1721. After this he published *An Ecclesiastical History of Great Britain, chiefly of England*, in 2 vols. fol., 1708 and 1714. His *Essays upon several Moral Subjects*, in 3 vols. 8vo, published between 1697 and 1709, display considerable learning, ability, and taste. In 1701 he published a translation of *Antoninus's Meditations*. His last work was a volume of *Practical Discourses*, published in 1725. Collier died of the stone, April 26, 1726.

COLLIERY.

Colliery. A COLLIERY is a place where coal is found in stratified masses, and excavated by manual labour, and commonly brought to the surface by mechanical power.

The exact date when coal began to be used as a fuel is very uncertain; the appearance, if not the use of the mineral, must have been known for a long time in districts where the deposit was naturally exposed; and, according to some authorities, it is mentioned as having been used in England in the ninth century, 852. In 1259 King Henry III. granted the privilege of digging coals to certain parties in Newcastle. Seven years afterwards coal had become an article of export, and was termed sea-coal; and in 1306, so extensive was the use of coals in London, that parliament complained to the king of the noxious vapours therefrom polluting the atmosphere. In consequence of which proclamation was made against their further use, lest the health of the knights of the shire should suffer during their residence in the metropolis.

Blythe, writing in 1649, states, "It was not many years since the famous city of London petitioned the parliament of England against two nuisances or offensive commodities, which were likely to come into great use and esteem; and that was, Newcastle coals, in regard of their stench, &c.; and hops, in regard they would spoyle the taste of drinck, and endanger the people."

In Belgium the earliest reference to coal was in 1198 or 1200 in the country of Liège, where, according to tradition, a blacksmith was the first to use it as fuel.

In France the precise period of its adoption as a substitute for wood is not ascertained. The commencement of its use in Paris was in 1520, the coal being drawn, not from the mines of France, but from the collieries of Newcastle.

In Scotland coal was known and used probably at a very early date. We are informed by Chalmers, the antiquarian, that coal was worked at Bo'ness by William de Verepont before the end of the twelfth century, and that a tenth of the coals was paid to the monks of Holyrood House.

It is more curious, however, than important here, to trace the date when mineral coal was first used as a fuel. The earliest employment of it in England in the manufacture of iron was in 1713 at Colebrookdale, in Scotland about the commencement of the eighteenth century, and in France in 1782.

Distribution. On examining a geological map of the world, it is interesting to compare the known mineral resources, and their distribution throughout the different countries, in strata of every variety of depth and area; and how remarkable that these productions (though extensively distributed) should be principally confined to those countries where the inhabitants, possessing the advantages of civilization, are enabled to make them contribute to the comfort of the great human family. See page 127.

Geological position. The stratified matter which composes part of the crust of the earth is deposited in beds or layers. Geologists have very satisfactorily shown the order in which the various layers have been deposited. "Had these lain in regular undisturbed succession, man would have made but little progress in deciphering their history, as the greatest perpendicular descent man has yet made into the crust of the earth does not extend to half a mile. But as these rocks are thrown up into slanting and irregular positions, so that the lowest are brought to the surface equally with the most recently formed, geologists have been able to collect a regular series of stratified rocks from those disposed as it were but yesterday, to the unstratified granite which forms their basis."

Colliery. The following figure (No. 1) will give an idea of the stratified rocks as they occur in Britain:—

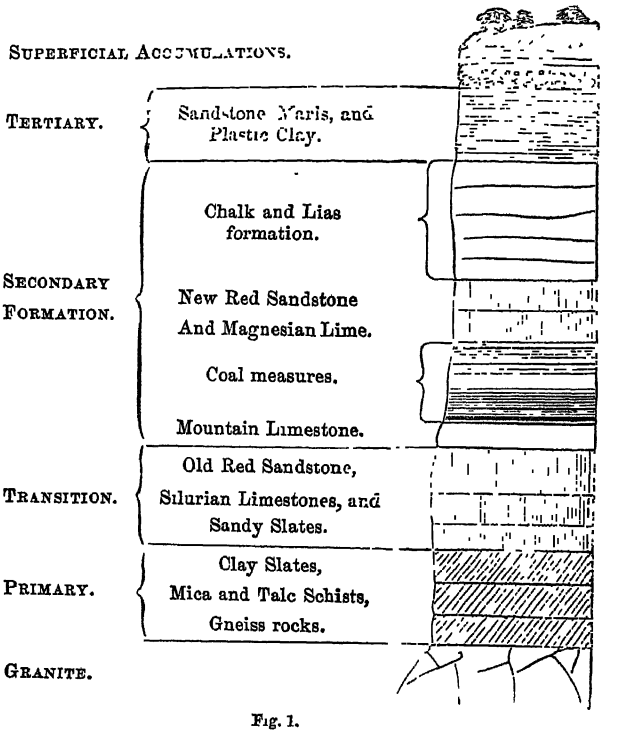


Fig. 1.

Coal is found in those strata designated the *secondary formation*, or *coal measures*, and in seams varying from an inch to forty feet; and though great sameness is observable in the continuous thickness and quality of each seam, still irregularities are of frequent occurrence, and of sufficient extent to baffle the profitable working of many well laid out collieries.

Irregularities. The irregularities common to all coal-fields are as follows —*nips* or *wants*, *shaken coal*, *saddle-backs*, *baulks*, *pot-bottoms*, *gaws*, *hitches*, and *dykes*.

Nips. *Nips* or *wants*. The coal is said to be "nipped" out when the roof and pavement approach each other, thereby reducing the thickness of the seam. It generally happens that this irregularity is more fully developed where the roof is hard—for example, where a considerable thickness of sandstone is in near or immediate contact with the coal. The general appearance of a seam of coal thus troubled is represented by figure 2.

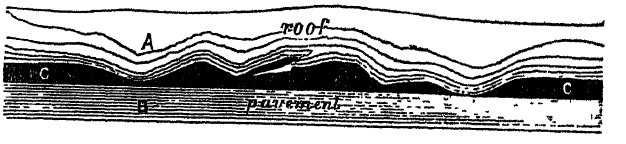


Fig. 2.

Referring to it, A is the roof; B the pavement; and CC the average thickness of the seam. Practical men are of opinion that this description of irregularity does not lessen the seam of coal; that is, when the thick and the thin parts are added together, they will nearly form an equivalent to the known average of the seam; and when this is not the case, the coal is found in a more compact state.

Colliery.

Shaken Coal.

Shaken coal is frequently found in the neighbourhood of "wants," in a regular and seemingly untroubled state; the seam is seldom changed in thickness, but the coal is no better than a heap of dross or small coal; and may be shovelled from the seam as off a coal-hill. The pavement is generally wet and soft. There is considerable diversity of opinion regarding the cause likely to have produced this change; and it is not unlikely to suppose that a stratum of mud or gravel may be in immediate connection, and not far distant from the pavement, which, when acted upon by pressure, would crush an inelastic substance like coal, and thus account for the change.

Saddle-backs, pot-bottoms, &c.

Saddle-backs, *pot-bottoms* or *baulks*, and *gaws*, are local terms given to irregularities in the roof or pavement of coal; when they occur on the pavement, it may be ascribed to the inequality of the surface on which the original deposition of vegetable matter (from which coal has been transmuted) was laid; but when found on the roof, may be supposed to have been occasioned by interruptions to these deposits or uneven pressure. The following is an illustration of these irregularities as they are met with in mining, figure 3:—

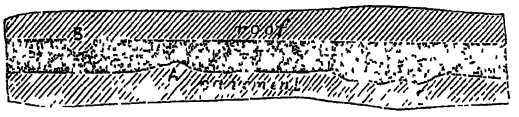


Fig. 3

A, a saddle-back; B, a baulk or pot-bottom; C, a gaw; and DD the seam of coal. Gaws are most frequent, and generally lie in a level-course direction; they are the reverse of saddle-backs, and as distinguished here they both represent changes of level in the pavement of the seam.

Hitches.

Hitches are dislocations, and show that the seams of coal and accompanying strata, though continuous at a former period, have been torn asunder by violent action, and their continuous regularity of level and inclination changed, the strata on the one side of the fracture being depressed, or on the other elevated. These subsidences or upheavals occur in almost every direction, from an inch to 1800 feet (as has been proved to the south of Glasgow); they follow one general law—that is, the fissure is always at a certain angle to or from the point of contact with the section of the strata, and rarely perpendicular. The accompanying section, fig. 4, represents a seam of coal *k*, being worked to-

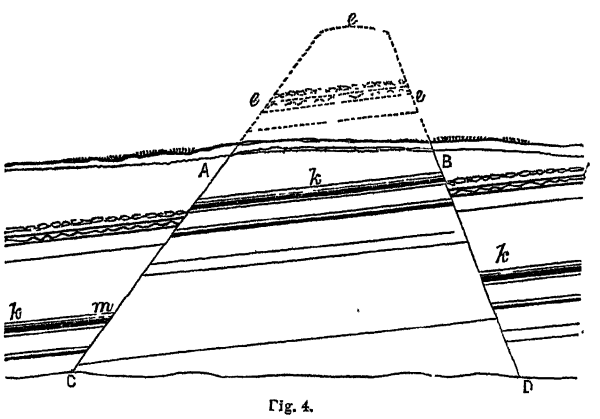


Fig. 4.

wards *m*, interrupted by hitches—A being an upthrow and B a downthrow.

When the strata are upheaved or elevated, the angle of the fissure is in the direction of AC; when depressed or thrown down, it lies in the direction of BD.

It has often been matter of surprise to those engaged in mining that so little is visible on the surface to indicate the place of these dislocations. It might have been expected that the displaced strata would have been found in the position of the dotted lines *eee* in a protuberance at the surface; but such is not the case; and in inquiring by what agency this elevated mass has been denuded and the present level produced, we are forced to take into account the slow operation of natural causes, extending over such a lengthened period of time, that we have no data by which to estimate it; and yet the time required for the abrasion of these elevations sinks into insignificance, when compared with that required for the degradation of previously indurated matter, of which the stratified rocks (upwards of eight miles in thickness) are composed.

Colliery.

Dykes.

Dykes form interruptions in the strata, but seldom cause any alteration of level or inclination. When composed of trap, they can generally be traced through a considerable extent of country. Their volcanic origin is undoubted, and the remains leave unmistakable proof of their ancient connection. Section fig. 5 will give a general idea of the manner in which coal-beds are sometimes deranged by this description of *trouble*.

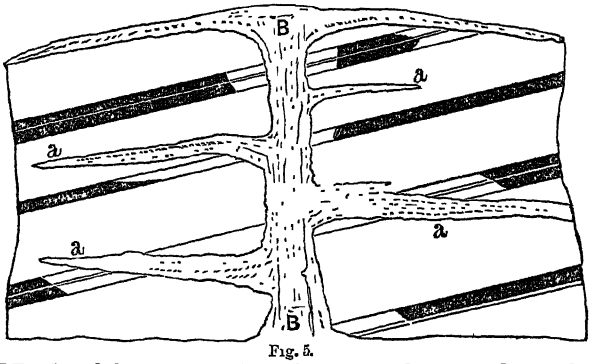


Fig. 5.

BB, the dyke; *aaaa*, branches, or beds injected into the surrounding strata, irregular, but sometimes parallel with the stratification for a considerable distance: and when one of these follows the course of a seam of coal, it (the coal) is either displaced or reduced to cinder.

Clay dykes are frequently encountered from ten to thirty fathoms from the surface. They form a complete barrier like dykes of trap, but do not alter the quality of the coal; and though not traceable for a great distance, they often extend to many yards in thickness.

Inclination.

Inclination scarcely comes under the head of irregularities; and though some seams are unworkable to profit on account of their rapid inclination, all coal-seams lie more or less at an angle to the horizon, and are *never found truly level*. Taylor, in his statistics of coal, when referring to the irregularity of inclination and out-crop, explains,—"During our investigations, we have remarked that the true positions of those veins which had their bassets on the slopes of the mountains were in most cases rendered obscure by the curvature of the crops almost at right angles to the true inclination of the veins. We ascribe this to the atmospheric agency operating to a given depth below the surface, and to the mechanical influence of surface waters, decomposition, the sliding down of the higher masses, &c. In every instance which has come under our observation, in relation to the outcropping of coal seams on these slopes, we have perceived the manifestation of the like influences which have deflected the 'wash,' or decomposed materials of the coal veins from their true courses, and thrown them over among the alluvial detritus, generally in a curve, as shown by the next figure, No. 6, which is merely the representative of numerous corresponding cases."

Varieties of coal.

Though it is universally admitted that all coal-seams are the result principally of accumulations of vegetable matter under different circumstances or degrees of pressure, it is evident that local or other causes have tended materially to

Colliery. change their quality. If we take the seams known to exist in one of our great coal-fields, and compare them, we find a marked difference in the quality of each; and the quality is not only different, but the structure, analysis, general appearance, and also the uses to which they are applied.

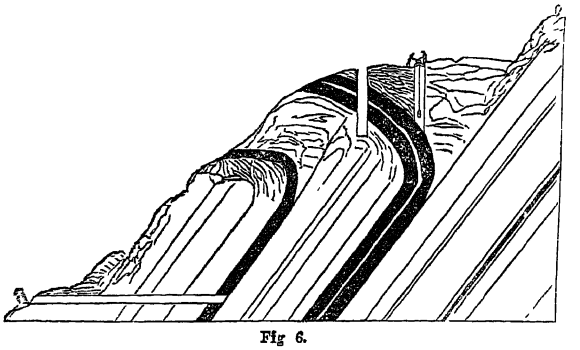


Fig 6.

The varieties of coal commonly known and generally in use throughout Great Britain, are *cubical coal, fat bituminous coal, anthracite, steam-coal,* and *cannel coal.*

Cubical coal. *Cubical or dry coal* is dark and shining; when worked, it admits of being put out in large masses; it has general properties in common with all seams of coal, viz., it is essentially composed of carbon, oxygen, hydrogen, and nitrogen. The quality of coal depends upon the relative proportion of these ingredients.

The term dry coal has sometimes also been applied to coal of this description in contradistinction to those which cake or cement. It burns freely, with much flame and heat. The "splint coal" of Scotland, famous for smelting ores in the blast-furnace, is of this class; and though other coals have become greater favourites in the parlour, none have yet been found equal to it for use in the blast-furnace; and it is a gratifying reflection for those engaged in the iron trade in Scotland, that vast fields of it still remain to be worked.

Fat bituminous coal. *Fat bituminous* or *caking coals* differ little in appearance from the *open burning cubical dry coal;* when exposed to a high temperature they swell considerably, and during combustion have a direct tendency to *cake* or *cement,* but though well adapted for household use, their cementing property has hitherto proved objectionable to their being used in the blast-furnace in a raw state.

Anthracite coal. *Anthracite coal* is black, brittle, and highly lustrous. When subjected to a high temperature it ignites, burns with considerable heat, produces no smoke, and leaves a small percentage of ash. It is extensively diffused throughout Wales; vast tracts of it exist in America. It also abounds in Ireland, known by the name of Kilkenny coal, and in Scotland as blind coal, where it is much prized by maltsters, brewers, and millers, on account of its being free of smoke during combustion, and possessed of strong heating powers. Of late years *anthracite* has been introduced successfully in the blast-furnace, partly in England, but extensively in America. The following table exhibits the amount of carbon contained in samples of this mineral from all the principal known deposits:

	S. Wales.	France.	Saxony.	Pennsylvania.	Russia.
Carbon,	88 to 95 p. cent.	80 to 83	81	85 to 92	94

Steam-coal. *Steam-coal* is a species of the above-described, and sometimes termed "smithy coal." It is neither bituminous nor anthracite; it possesses more hydrogen than the latter, and more carbon than the former. It has generally a clear glancing appearance, is somewhat tender, ignites easily, gives off comparatively little smoke during the process of combustion, and is now generally known as *steam-coal,* for which purpose it is highly prized.

At one time it was considered that coal of this description had been deprived of its volatile property, from contact with particular strata. It is now clearly established (particularly in Scotland), that wherever coal of this quality is found, it is close to, or in the immediate neighbourhood of *trap* (whin); and since the increased demand for steamboat coal, coal-fields have been taken for this description of coal, with no other direct knowledge of its existence, than that the trap lay at a given distance from the position of the coal-seams. It is proper to remark, that when freestone intervenes between the trap and the coal, it approaches nearer to the *anthracite* than when separated by fire-clay or shale. In some districts the coal is found excellent in quality from 15 to 30 fathoms beneath the trap. It is unnecessary here to remark, that where the trap does not exist, the coal is of the common open burning bituminous nature, and when in close contact it is either anthracite or cinder coal. Colliery

Cannel or gas coal. *Cannel* or *gas coal* is of a grayish-black, or dark brown colour, and may be termed non-lustrous. It is variable in quality, but uniform in stratification, and may be seen in a short distance blending into a great variety of shades; and not unfrequently its character is changed into blackband ironstone, or bituminous coal. It is extensively worked in the Lancashire coal-field, near Wigan; and there are various seams of it in the *upper* and *lower series* of the Scottish coal-field, the *Torbanehill* being the most valuable in the former, and the *Lesmahagow* in the latter. *Cannel* is of less specific gravity than common "cubical coal;" it is very compact, ignites with great facility, and burns with a brilliant flame. It has long been customary throughout Scotland for farmers to lay in a stock of it for the winter, on account of its light as a substitute for candles, hence the name *cannel coal.* It first received its name in Lancashire, where the word candle is commonly pronounced *cannel* by the peasantry.

It is now mostly used in producing gas, for which purpose it is admirably adapted.

Mode of letting coal-fields. Before proceeding to describe the searching for and working of coal-fields, it may be proper to advert shortly to the general mode of letting them. The arrangements are various in detail; the adventurer or tenant agrees to pay a certain value or royalty for the coal he proposes to work—in general, at either so much per ton or acre, or percentage upon the sales at the pit mouth. Coupled with the royalty there is a sum fixed as rent, which makes it imperative on the part of the tenant either to work the coal to a given extent, or pay for the occupation of the ground. The sum fixed is generally sufficient to induce the tenant to work the field, or otherwise show cause for abandoning it.

Searching for coal. Prior to the introduction of the science of geology, the definite character and extent of the strata which contain the coal measures seem to have been imperfectly understood. But it is to that science we are indebted for our information regarding those deposits, the importance of which is admitted, when it is considered that this formation is upwards of one and a half mile in thickness, composed of hundreds of layers, and often difficult to distinguish from the masses of stratified matter in immediate connection.

The geological arrangement marks with precision the upper and the lower link of connection, the *new red sandstone* on the one side, and the mountain limestone on the other. Without a knowledge of this general arrangement, it is obvious that the exploring miner in past times (however intelligent otherwise) must have frequently felt perplexed; and the course then pursued yet finds an occasional advocate, viz., that coal is to be got anywhere by only sinking deep enough. But we now know the limit of the *coal measures* and their general construction; and it is not assumption to say, that a successful search for coal is not altogether a matter of chance; and though we find sometimes in our researches that certain divisions of strata are absent, their stratigraphical order is never subverted, that is, the *new red sandstone* may repose upon the *mountain lime,* or

Colliery. *old red sandstone,* but never upon the *chalk* and *lias* formation.

It may not be out of place to advert to the variableness of the vegetable deposits throughout mining districts, and the advantage of being well informed regarding the leading features that serve to distinguish all coal-fields. The most marked and continuous of these are, seams of limestone, mussel-bands, and thick deposits of sandstone; seams of coal and ironstone vary much, and often cannot be recognised at another point of the same field; therefore as individual seams they are not to be trusted as guides, unless in close connection with those known groups to which they belong.

The search so long as it is confined to the coal measures, is comparatively easy; but in exploring fields that are distant from mining operations, and where no trace of the coal measures are found from the intervention of superior strata, it is then necessary to act with caution. Not that geologists have misnamed or misplaced the *chalk* or *lias formation,* nor that they do not exist often many hundred fathoms above the coal measures, but that frequently they are found overlying the outcrop of older formations (unconformably), and comparatively thin, as shown by figure 7.

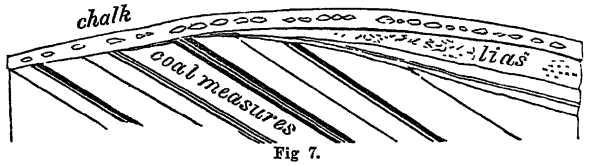


Fig 7.

When this irregularity of deposit comes to be generally understood, the explorations of the miner will take a wider range than they have hitherto done, and in some unpromising situations important discoveries may yet be made.

Boring. In searching for minerals, it seldom occurs that enough of the strata is exposed to warrant a shaft being put down; and it generally happens that the preliminary expedient of boring is had recourse to, as being the most expeditious and least expensive mode of ascertaining the character and contents of any mineral field.

The process of boring is well known, and has already been described under the head BLASTING. When the term is used in connection with mining, it is understood that a hole is to be drilled or bored into the earth. This is done by a chisel of an indefinite length, sometimes 20 feet and sometimes 1200 (according to the depth of the bore), the continuous length of which is formed by pieces of iron 9 feet long (or any other convenient length), with a screw on each end termed *male* and *female.*

The chisel at first, and for a number of fathoms, is lifted by the hands until the weight becomes inconvenient to lift directly, when a lever of the first power is introduced: the chisel or rod is suspended from the end of it, and the workmen exert their power at the other, while the person in charge turns the chisel by a cross piece of wood termed the *brace head,* attached to it. The process of cutting is thus performed by raising the chisel, turning it, and allowing it to fall by its own gravity; and the strata cut is procured by introducing for the lowest division of the chisel, a hollow tube with a valve in the bottom—when it is forced down into the bore the valve opens and receives the detritus produced by the action of the chisel, which, when brought to the surface is washed and preserved in samples, and delivered by the borer to his employer, in proof of the journal he renders.

To perform this description of work well, great care and attention is required; and though there are frequent failures, it may be remarked that a skilful workman renders a very correct description of the strata he bores through; and, generally, from a few well-selected bores, a good general idea can be formed of a field, and what it contains.

Plate CLXXV. fig. 3, will illustrate the principle of proving a mineral field by boring. Referring to it, the figure Colliery. represents a line direct from the dip to the rise of the field, and the inclination of the strata is one in eight. No. 1 bore is commenced at the dip, and reaches a seam of coal A, at 40 fathoms; at this depth it is considered proper to remove farther to the outcrop, so that inferior strata may be bored into at a less depth, and a second bore is commenced. To find the position of No. 2, so as to form a continuous section, it is necessary to reckon the inclination of the strata, which is 1 in 8; and as bore No. 1 was 40 fathoms in depth, we multiply the depth by the rate of inclination, $40 \times 8 = 320$ fathoms, which gives the point at which the coal seam A should reach the surface. But there is generally a certain depth of alluvial cover which requires to be deducted, and which we call 3 fathoms, then $40 - 3 = 37 \times 8 = 296$ fathoms; or say 286 fathoms is the distance that the second bore should be placed to the rise of the first, so as to have for certain the seam of coal A in clear connection with the seam of coal B. In boring, sometimes the miner gets bewildered; as will appear if we trace the course of bore No. 3, where the seam B, according to the same system of arrangement should have been found *at* or *near* the surface; instead of which another seam C is proved at a considerable depth, differing in character and thickness from either of the preceding. This derangement being carefully noted, another bore to the outcrop on the same principle is put down for the purpose of proving the seam C; the nature of the strata at first is found to agree with the latter part of that bored through in No. 3, but immediately on crossing the dislocation at A it is changed, and deeper the seam D is found.

A skilful borer in such a situation would be aware, that in both of these cases (3 and 4) there must be some material derangement; and by changing his position to the dip or outcrop, would rarely fail in proving to a certain extent the derangement and the cause, thus forming one of the most important operations connected with economical mining.

Having proved a field by boring, the next important step Winning. is to fix on an eligible situation for a "winning."

A coal-field is said to be "win" when access is made to the seams of coal. This may be done either by a vertical shaft or a crosscut mine. The accompanying figure, No. 8, will illustrate both; A B being a crosscut mine, by which the seams of coal 1 and 2 are *win,* and C D a vertical shaft by which the seams 1, 2, and 3 are *win.* When the field is

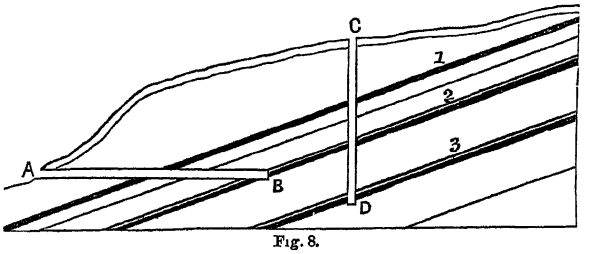


Fig. 8.

win by the former method, the coal is said to be level-free; if by the latter, not level-free. All coal situated above the level of the sea may be said to lie level-free, that is, if a level mine were continued from the surface of the sea throughout a district of country, all above the point of intersection would necessarily be drained. Sometimes from the contour of a country, rivers or valleys form natural mines, into which the drainage of coal seams may be economically taken. Ancient miners, for want of sufficient power to unwater their operations, were necessarily limited as to depth; to them a seam of coal level-free was of the utmost importance; to *this* their search was chiefly directed; and thus we find the sites selected for their operations were, generally speaking, level-free, or otherwise easy of access. Now that we have an unlimited power in the steam engine, seams of

Colliery. coal are got by shafts varying from 10 to 300 fathoms in depth; and though the latter is, perhaps, the greatest vertical depth to which the miner has yet pushed his operations in Great Britain, it by no means follows that that is the limit; for at no distant period future generations must, in some situations, draw their mineral supplies from shafts compared with which the latter will appear of insignificant depth.

Among the various forms of shafts, there are oval, circular, square, and oblong. The most common of these is the circular or oblong. When the surface is compact, the circular or oblong form may be adopted at pleasure; where the surface is deep and composed of mud, or sand charged with water, the circular form is generally adopted, as being the most nearly perfect form for resisting a uniform pressure. It is also the most suitable form for admitting of tubbing, a process of stopping back water much in use at deep collieries, and nowhere carried to such perfection as in the north of England. When first introduced it was effected by wood; at a later period iron cylinders were employed, cast in segments, made to rest upon each other; the joints, both upright and horizontal, being made tight with a layer of thin wood. A wedging crib was fixed at the bottom, and the segments were built up regularly to the height required. Where the layers in a shaft are so situated as to form a continuous drainage from rivers, or other regular sources, such a precaution for damming back water is of incalculable benefit, and should be taken advantage of at almost any cost. Tubbing, however, can only be effectively carried out under certain circumstances, and where the system of working does not interfere with the stability of the overlying strata.

To enter into the subject of sinking in detail, or to explain with any degree of minuteness the usual and necessary preparations and appliances, would swell this article far beyond the allotted space.

In general when a field has been proved to be free of insurmountable troubles or dislocations, and the whole of it can be drained by a dip-shaft, the most eligible situation for it is at the extreme dip of the field; by that arrangement any shafts sunk to the rise are dry: working upon the reverse system, that is, beginning with the first shaft near the outcrop, and in succession going to the dip, would lay the adventurer under the necessity of making erections for drawing water at the whole of them. However, there are many fields so situated by known dislocations, that to go to the dip of the field with the first shaft would be of very little advantage to after sinkings.

Sinking in many situations is difficult, and the laying out of a new colliery is a serious undertaking. The depth and nature of the alluvial cover to the rock strata, the weight of water to contend with, engine power, arrangements for future ventilation, besides many local difficulties for which no rule can be applied, are all points requiring the greatest deliberation and forethought. And when we consider that the deepest shaft in Great Britain was sunk and fitted up with engine power, &c., at an outlay of L.100,000, extending over a period of ten years, we will then be able to form an idea of the cost and time generally required for such operations, however simple.

Having fixed upon the form of shaft, and the sinking through the surface having been secured either by timber, masonry, or tubbing, the operation of sinking by blasting is commenced. This work is performed by a class of men called sinkers, who are rather better paid than miners. The work, though disagreeable and dangerous, is generally preferred to mining. The tools used are similar to those in use at quarries. Latterly the galvanic battery has been introduced in the process of blasting; and thus a number of charges can be fired at the same instant, and to better purpose than by the common method. See BLASTING.

In sinking where the alluvial cover is soft, temporary erections for lifting or pumping water are made until the rock strata be reached, and the shaft carefully secured. When the surface is of the usual compact nature, fittings may be put up at once. Colliery.

For want of sufficient data, there is often considerable difficulty in deciding upon the amount of engine power required to drain a new field; some approximate idea may be formed from bores, but even under the most favourable circumstances there is uncertainty. Pumps.

Plate CLXXVI. shows two illustrations of pumping machinery, generally in use throughout the mining districts. Fig. 1 is the Cornish method of pumping by force pumps, direct from the main beam of the engine; and fig. 2, the common lifting pump with bell cranks connected by gearing to the engine shaft.

The Cornish system is common where heavy permanent fittings are made, and is then supposed to possess advantages over all others. The rods are constructed so as slightly to exceed the weight of the water, the power of the engine being applied to lift the rods, which, in descending by their own gravity, cause the ascent of the water. This method admits of the steam being used expansively.

The advantages claimed for the lifting pumps with bell-cranks are, their simplicity, and the reduced speed which can be obtained by means of gearing; for while the engine may be driven 300 feet a minute, the bell-cranks may travel at one-third of that rate.

When force pumps are introduced, it is generally after the pit is sunk, the lifting ones being better adapted for sinking with. When a shaft exceeds 45 fathoms in depth, there is generally more than one lift of pumps, and it is always considered sound economy not to exceed 35 fathoms with each lift. When they exceed this depth the tear and wear of the machinery is greater; besides, there is often water in the strata, which can be arrested at the lodgments connected with these lifts.

Referring to the plan of forcing pumps, fig. 1, *a* is the main beam; *b* the main rod reaching to the lowest plunger *c*; *d* the working barrel fitted with stuffing box *e*; *f f* clack and door pieces; *s* suction; *p* pipes; *l* landing box by which the water is discharged into the lodgment *m*; *n* a dam formed of two divisions of plank let into the wall on each side, the space between the planking being filled with clay; s^2 the suction of the top set; d^2 the working barrel; c^2 the plunger glanded on the main rod *b* at *r*; *h h* clack and door pieces; p^2 pipes; l^2 the landing box which delivers the water at the surface.

In the plan of lifting pumps, fig. 2, *a a* the bell-cranks, *b b* the rods, *c c* the working barrels, *f f* clack pieces and doors, *h h* bucket doors, *k k* the suctions, *m m* the pipes, *n n* the landing boxes delivering the water at the surface, *p p p* rackings for keeping the pipes in a stationary position, and *r* the rod that connects the bell-cranks and engine.

During sinking a partial ventilation is required in the shaft, to carry off the gases and products of combustion. This is generally accomplished by temporary brattice or midwall. When the sinking has reached from 30 to 40 fathoms from the surface, the pumps, which hitherto may have been lowered as the sinking progressed, are fixed, and a lodgment is driven into the side of the shaft, for the purpose of collecting the water above it, and also to hold the discharge of the second lift of pipes which is now put on to follow the sinking of the shaft.

At a similar distance (should the sinking not have been completed) a second lift is fixed in the same manner, and a third column follows the sinkers, and so on.

It often happens that thin seams of coal are found conveniently situated in which these lodgments can be economically made.

The difficulties attending a dry sinking are few compared with one where there is much water to contend with; and in

Colliery.

such cases, unless the engine power, pumping materials, crabs, cranes, and other tackling, are all kept in good repair the work will not go on; but with all these precautions difficulties occur where least expected, often causing extra expense and loss of time.

Preparatory operations to working.

When the shaft is sunk and fitted up with guides for the cages, midwalls secured, and pumping operations complete, the next work is to lay out the pit-bottom arrangements. This generally embraces driving lodgment levels, erecting ventilating furnaces, and forming proper supports for the shaft.

Lodgment.

The term lodgment is applied to the openings to the dip of the dip-head levels. These are formed to contain the water anticipated from the drainage of the mine in a given time: they require to be frequently attended to, otherwise the advantages to be derived from them will be very much nullified by the sedimentary deposit constantly accumulating in such a situation.

Levels.

The term dip-head (sometimes pit-bottom) levels, means openings driven from the bottom of the shaft in a true level-course direction. Owing to the irregularity of the pavement, these openings seldom run in a straight line; their course is wholly guided by a flow of water to a given depth along the dip-side. It is of much importance to have them truly level: they form passages for the drainage to the lodgment, but when injudiciously made, curtail the limit of what would otherwise have been level-free coal.

Pit-bottom stoops.

Pit-bottom stoops are extensive pillars of coal designed to secure the shaft and machinery. To proportion these correctly, the depth and quality of the overlying strata require to be carefully considered; but as this coal may be worked out at any subsequent period, the propriety of making ample provision for the security of the shaft at the outset will be apparent.

Working the coal.

When the preliminary operations are completed, one or other of the numerous modes of working is adopted. At this stage of progress *real skill* and experience is invaluable, as frequently an injudicious arrangement of working has thwarted the success of an enterprise that otherwise might have been a profitable one.

It will appear obvious that, but for the inequality of cost in production, the best method of working a seam of coal is the one by which the greatest quantity of the mineral can be taken from a given area; but the difference of expenditure is frequently considerable, and hence a reason for varied modes of working. Still those different systems, however unlike they may at first appear, may very easily be shown to be represented by two distinct methods only, viz., those of *pillar working* and *longwall*.

To illustrate these varieties, see plan of the latter, and plans shewing modifications of the former.

Longwall method.

Plate CLXXV., fig. 1, shows the longwall method of working coal. In well regulated collieries where this system is practised, there are three winning-out walls, viz., the dip-head levels AA, and headway B. When these are kept going in a proper manner (a little in advance), the intervening workings may be compared to the excavation of a large intersected block of coal; the arrangement precludes the necessity of vertical cuttings ("shearing"), consequently saves labour, and produces a large proportion of round coal. The simplicity of this method, when compared with "*pillar working*" under any form, is very apparent. Colliers trained to it do their work with comparative ease; they arrange their operations so as to undermine or "hole" the coal (as at C, fig. 2) along their wall on the after part of the day, leaving it to be acted upon during the night by the overlying strata, which being only partially supported by the buildings, forces away the undermined portion of the coal before the workmen return. In the event of this failing, the coal is taken down with very little trouble by wedges, broken up, and sent away as sketched in fig. 2. Where the work is kept advancing regularly, the roof does not break readily along the face of the coal. The same figure (No. 2) shows the order of the subsidence of the roof along the drawing roads. Colliery.

When the "waste" is "stowed" in an average manner, the roof subsides from a half to two-thirds of the thickness of the seam; and the subsidence is *generally* complete (the roof at rest) at from 30 to 50 yards back from the face of the coal. When a "*falling*" intervenes between the coal and the roof, as shown at fig. 2, the colliers support it with wood for their own safety; another class of workmen (termed "brushers") take it down at night, and as much more of the roof as may be required for height of roadway; and with *this* they form the roadways, or make other requisite buildings along the wall-faces.

Stoop and room, &c.

Plate CLXXVII., fig. 1, represents one of the most ancient methods of coal-working, known in Scotland as "stoop and room." By this system all the coal is taken away, except what is left for the support of the roof, which in general ranges from a fourth to a fifth of the whole. Fig. 2 illustrates a system of working, combining *pillar* and *longwall*, differing from the latter in the manner in which the roads are arranged and maintained, and from the former in the peculiar way in which the coal is extracted, and the roof supported. It is practised in the Yorkshire coal-field, and sometimes in Scotland.

Newcastle *bord and pillar*.

Plate CLXXVIII. shows the mode of working coal by *bord and pillar*, or what is more generally understood by the Newcastle method. It was formerly the practice, under this system, to remove the pillars subsequently to the excavations in the solid. An improved method is now introduced, and, instead of going to the limit of the field, or other temporary barrier, the pillars are taken out as the workings in the solid progress, keeping a range of two or three pillars between, as may be found necessary. The principal advantages derived from this change are, the coal is worked out more expeditiously, the openings are reduced, and the exposure of the broken coal is of shorter continuance.

Lancashire method.

Fig. 9 shows the Lancashire method of coal working; and, to convey a general idea of the practical arrangements, the progress of the excavations are shown at different periods. (See sketch.) The width of the openings (or drifts) formed in the solid vary according to the nature of the roof, &c.; where favourably situated, they range from five to six yards in width. By this method the whole of the coal is intended to be worked away; and the order in which the pillars are taken out is shown.

Machine for cutting and excavating coal.

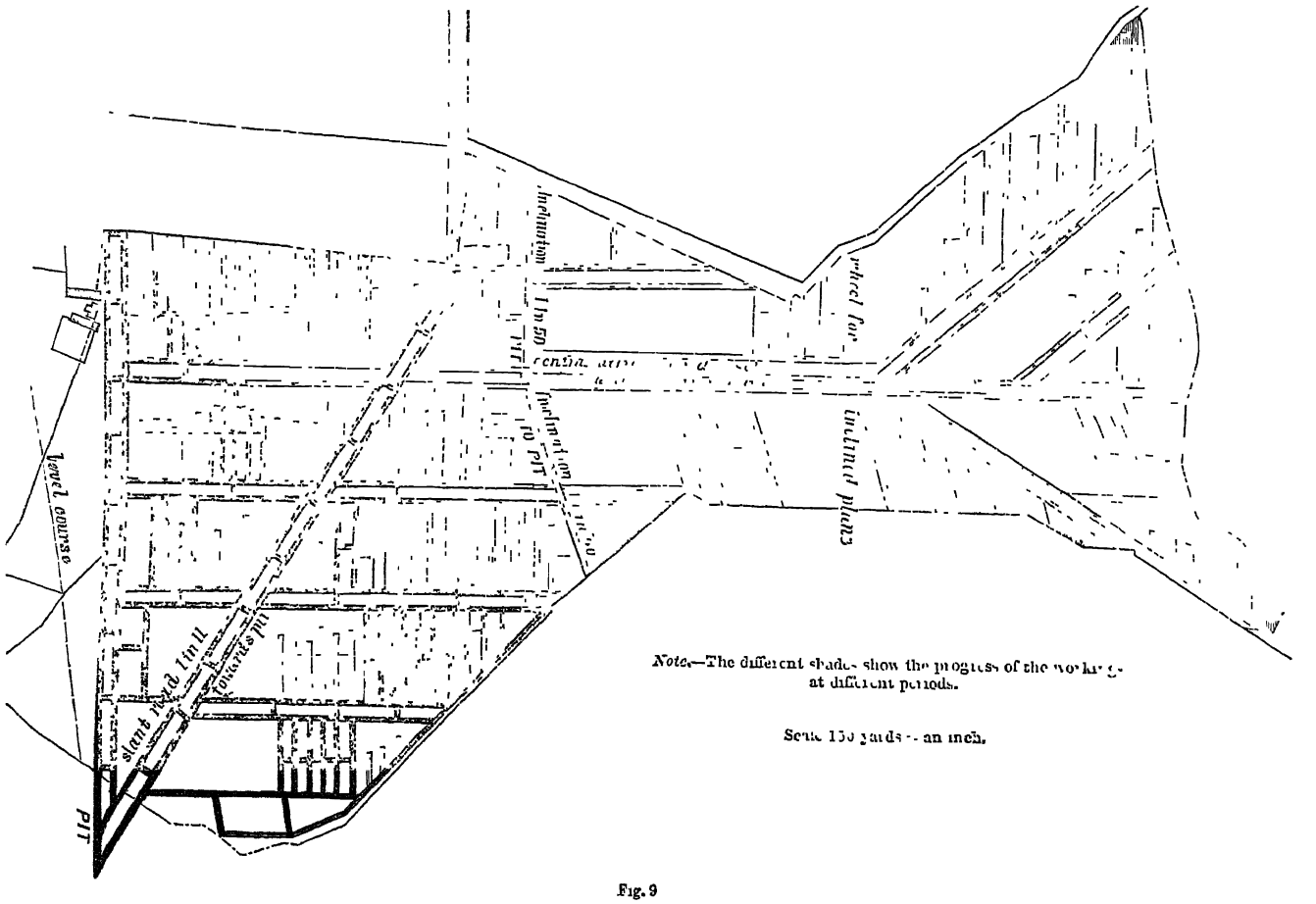
Several attempts have been made to introduce self-acting machines to assist the miner in extracting the coal from its native bed. Hitherto these have failed, or from other causes fallen into disuse. The late extraordinary demand for workmen, particularly in Lancashire, has induced the very intelligent engineer for the Earl of Balcarres, Mr William Peace, to invent a machine for performing the laborious operation of "holing" or undermining the coal. It is peculiarly adapted for longwall working, or any method by which the coal is worked in extensive ranges. The holing or undermining averages from four to six inches deep, and extends upwards of a yard under. This operation may be performed in the pavement, or parting, as freely as in the coal; and by this change it is not too much to anticipate from eight to nine-tenths of the coal in a round or marketable state.

Plate CLXXXI., figs. 1, 2, and 3, will illustrate the machine, and convey an idea of the manner in which it works. Referring to it, AAA the frame, upon which is fixed one or more cylinders BB, arranged so as to turn a crank shaft CC, fixed to the frame, as is also another shaft DD. This latter is capable of being turned by the former by means of metre or bevel wheels EEE; upon the lower end of the

Colliery

latter shaft (DD) is placed a wheel termed the driving wheel, having upon its periphery a groove with suitable projections for working into and propelling a chain or band. Beneath, or to the side, or both, of the frame, is fixed temporarily or otherwise a lever, the extremity of which is constructed to carry a wheel called the terminal wheel, marked

Colliery.



Note.—The different shades show the progress of the workings at different periods.

Scale 150 yards to an inch.

Fig. 9

HH; a chain or band is made to pass round the driving and terminal wheels, and by means of the driving wheel (FF) it is made to revolve. Into the chain are fixed cutters of different forms (see the parts marked 4, 5, 6, and 7), which, when the machine is in action, revolve with it, and upon being pressed or drawn against the coal, erode and excavate the same. The distance of the excavation from the face of the coal is governed by the dimensions of the machine, and by the length of the lever, and the distance between the driving and terminal wheels. The arrangements of the lever allow it to revolve, and to excavate any given range; see dotted lines fig. 1.

If found necessary, two or even three levers may be in operation at the same time, and arranged to cut in any direction. Other parts of the machine not particularly described are capable of elevating and depressing the front part of the machine, marked V, T, U, W; and those marked X, Y, Z, and K are capable of propelling the machine whilst at work, by acting against the prop.

The power employed to drive the machine (in the opinion of the inventor) may be steam, water, gas, or atmospheric air under pressure; and, in the latter case, the air may be used after having worked the machine for ventilating, or improving the ventilation of the mines.

The success of this invention is of considerable importance to the mining interest, and may ultimately prove a source of profit, as well as a convenience, to many extensive mining concerns.

The colliery tenant in carrying on his mining operations under the pillar system, has frequently to contend with difficulties arising from the peculiar nature of the roof or pavement of the coal. The most formidable of these are *creeps* and *sits*. A coal seam with a soft pavement and a hard roof is the most subject to a *creep*. The first indication is a dull hollow sound when treading on the pavement or floor, probably occasioned by some of the individual layers parting from each other as shown at *a*, fig. 10;

Accidents to which coal-workings are liable.

Creep

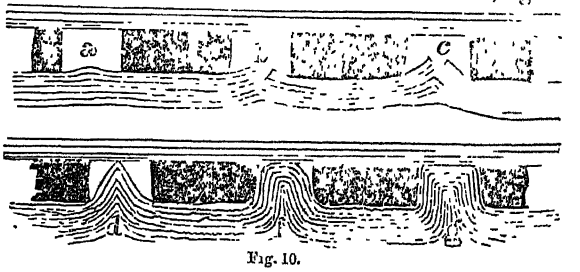


Fig. 10.

the succeeding stages of creep are shown at *b*, *c*, *d*, *f*, and *g*, in the same figure; the latter being the final stage, when the coal begins to sustain the pressure from the overlying strata, in common with the *hoved* pavement.

Sits are the reverse of *creeps;* in the one case the pavement is forced up, and in the other the roof is forced or falls down, for want of proper support or tenacity in itself.

Sits.

This accident generally arises from an improper size of pillars: some roofs, however, are so difficult to support that *sits* take place where the half of the coal is left in pillars.

Colliery

Fig. 11 will convey a general idea of the appearance of *sits, k, m, n,* showing different stages.

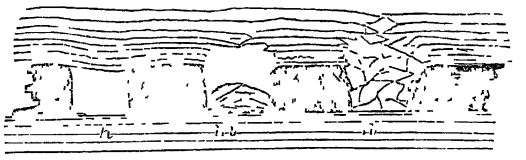


Fig 11

It is proper to remark that these obstacles are easily overcome under the longwall method of coal-working.

Ventilation.

Ventilation forms an indispensable prerequisite to mining. Its importance is becoming more generally understood, and of late years it has been the subject of much ingenious discussion; and when we consider that the efforts of the scientific and inventive have until lately been baffled in carrying out a salubrious ventilation by artificial means in the houses of parliament, the uninitiated in coal mining will readily conceive the greater difficulties the miner has to contend with in maintaining a healthy atmosphere, sometimes 1800 feet below the surface of the earth; where, immured in gloom, and surrounded by noxious gases, he has to lead in various forms, and subject to many interruptions, streams of air through the devious courses and windings of the mine, and often extending over many hundred acres. These gases (above alluded to), carbonic acid and carburetted hydrogen, may be termed the natural products of the mine; to expel them is impossible, to control their destructive effects is all that the most sanguine can anticipate; and the remedial means hitherto used has been forcing ample currents of atmospheric air through the farthest recesses of the mine. In principle, this does not admit of much variety; two separate communications with the surface being required, the one to act as an inlet to the mines, and the other as an outlet from them, in mining termed *downcast* and *upcast shafts.*

If the shafts A B, fig. 12, were of equal depth from the horizontal plane, and connected by the mine C, the air would fill the openings and remain quiescent. If the one were to the dip of the other, but communicating with the surface at a higher level, as by fig. 13, it would sometimes happen in summer, that D would be the downcast, and E the upcast; and in winter, E the downcast, and D the upcast. These conditions are induced by the temperature of the earth at a certain depth being nearly constant, while the atmosphere is changeable; the column of air in D *d* being at a lower temperature in summer than the column of air E *e*, and the reverse in winter.

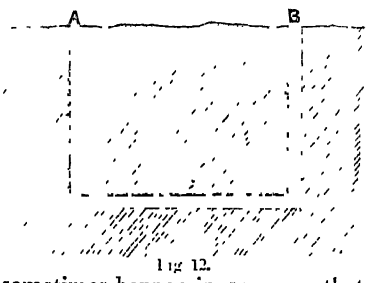


Fig 12.

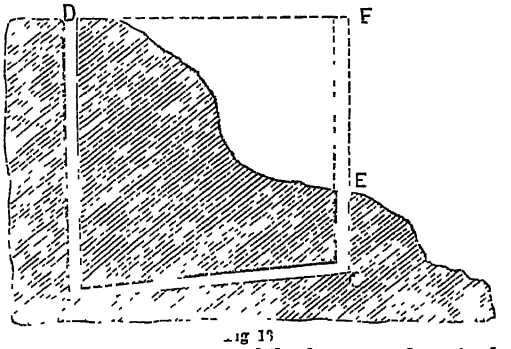


Fig 13

To overcome these natural difficulties, and produce a continuous movement or current, artificial means are resorted to, and the air in the upcast is dilated, by being passed over or brought in close contact with a fire or furnace; see Plate CLXXIX., fig. 3, where the air passes over the furnace B into the upcast shaft A. This method of producing artificial ventilation seems to have been described by Rodolphus Agricola in the sixteenth century. In his book *De re Metallica* he speaks of the method of drawing the foul air out of a mine by suspending a large fire in the middle of the shaft—a method which has been practised in mines ever since his time.

Colliery.

There have been various schemes for inducing a current of air below ground. Our space here will not allow us to enter into a description of them; but generally speaking, they have all given place to the furnace, which for simplicity and economy stands unrivalled. The only feasible objection yet offered against its universal use, is the probability that the *return air* in fiery collieries, after having traversed extensive wastes, might produce explosion when brought in contact with the flame of the furnace. In collieries so situated, a proper precaution is adopted for preventing explosions, and the return air is led into the upcast shaft by what is termed a *dumb drift*, as at C, Plate CLXXIX., fig. 3. Sometimes a chimney is situated near to the upcast shaft (on the surface), into which the return air can be taken, and when of sufficient capacity, it materially assists in ventilation. Plate CLXXIX., fig. 4, is an illustration of it, D the furnace, E the shaft, and S the chimney.

The size of the furnace is proportioned to the requirements of the mine, and its power is the increase of temperature it imparts to the column of air in the shaft in which it is situated.

"It is a law of expansion for atmospheric air and all gases, that they dilate almost equally and very nearly in proportion to the increase of temperature. According to Magnus and Regnault, 1000 cubic inches of air at the freezing temperature increase in bulk to 13,665 cubic inches at the temperature of boiling water, or 212°. This law of expansion applies equally to air in a state of motion as to air in a state of rest; and if we wish to know the force of the draught occasioned by an increase of temperature, according to Montgolfier, ascertain the difference in height between two equal columns of air, when one is heated to a certain temperature, the other being the temperature of the external air, and the force of the draught, or the rate of efflux is equal to the velocity that a heavy body would acquire by falling freely through this difference of height.

"Now the space through which a heavy body falls in perpendicular height in one second is rather more than sixteen feet; but by the law of accelerating forces, the velocity of a falling body at the end of any given time is such as would carry it in an equal time through twice the space through which it has fallen in that time; or the velocity in feet per second is equal to eight times the square root of the number of feet in the fall.

"When the force of the draught of a chimney is the difference in weight between two columns of air caused by the expansion of one of these columns by heat, the decimal ·002036, which represents the expansion of air by 1° of Fahrenheit, must be multiplied by the number of degrees the temperature is raised, and this product again by the height of the heated column. Thus, if the height of the column is 50 feet, and the increase of temperature 20°, we have $20 \times 002036 \times 50 = 2{\cdot}036$ feet; 52·036 feet of hot air will balance 50 feet of the cold air; and the velocity of efflux of the heated column when pressed by the greater weight of the colder column, will be equal to $8\sqrt{2{\cdot}036} = 11{\cdot}36$ feet per second.

"By the same means, the efflux of air under any given pressure can also be calculated. The pressure being known, we calculate the height of a column of air equal in weight

Colliery. to this pressure. Thus if the pressure be equal to one inch of mercury, water is 827 times the weight of air, and mercury 13·5 times the weight of water; therefore $827 \times 13{\cdot}5 = 11{,}164$ inches or 930·4 feet, and according to the rule $8\sqrt{930{\cdot}4} = 244$ feet per second for the velocity of efflux under the pressure of one inch of mercury.

"Allowance must be made for loss by friction, which will vary according to the nature and size of the opening, and also according to the velocity of the air.

"The retardation of the air by friction in passing through straight tubes (or air courses) will be directly as the length of the tube, and the square of the velocity, and inversely as the diameter."[1]

If the courses are of equal length but of different area, the quantities of air passed along them will not be in proportion to the area, but as the square root of the diameter of the opening multiplied by the sectional area or nearly. When the courses (for air in a mine) vary in length, the supply is governed by regulators, so that the short courses (which under similar circumstances with the long ones would pass greater quantities of air) have their areas contracted, consequently the velocity of the air increased; and as the resistance of air is as the length of the course and the square of the velocity, a uniform resistance is thus produced, and a proper distribution of air throughout the various openings maintained.

A current of air being induced, it is then taken in the most direct manner (avoiding a tortuous course) to the working parts, by what are termed *air-courses* or *air-ways*. These when formed require to be made substantial, adequate to any future emergency, and proportioned to the currents desirable in the different courses and openings of the mine. The air in the working parts of a mine cannot be properly conducted with due attention to the comfort of the workmen at a higher velocity than 3 or 3½ feet per second. In the main intake courses it may be increased to 4 or 5 feet per second; but as a high rate of velocity entails a considerable loss by friction, the air, instead of being taken in one undivided column, is led off ("split") near to the downcast by branches into the working parts, and from that into the main return, where the velocity may range from 8 to 20 feet per second.

The most intelligent and best informed in such matters aim at large air-courses, and a low rate of velocity in the interior of the mine, compared with that in the upcast; and though it was until lately advocated in theory, that the upcast should be of greater dimensions than the downcast, viz., equal to the expansion of the air, practical men had generally acted contrarily, on the well authenticated fact, in practice, that an upcast of less dimensions than the downcast was the more certain and constant in its action. The advantage gained by a comparative small upcast, is the high rate of velocity the air requires to travel in it, and which completely baffles the effects of surface currents so often detrimental to ventilation by large upcasts, and where counter-currents are frequently produced. Though there is no practical limit to splitting or dividing air, it is evident that it can only be profitably carried out when in certain proportion to the outlet, or upcast; and though the proportion has not been satisfactorily defined by experience, it has been acted upon in the following ratio: that when the sectional area of the air-courses is as three or four to one (the upcast), the effect will be a superior ventilation, other conditions being properly arranged.

It has also been laid down as a practical rule for regulating the ventilation of collieries, that under ordinary circumstances a certain amount of air should be provided for each workman; say from 100 to 200 cubic feet per minute; and in fiery collieries, from 400 to 600 cubic feet per minute; but no general rule can be perfectly applicable to the ever changing conditions of a colliery, and where "wastes" of dissimilar extent, and systems of working entirely opposite exist. Colliery.

Under the system of working coal by longwall, Plate CLXXV., fig. 1, where the openings never exceed a seventh of the excavations (sometimes not a fourteenth), the ventilation is simple and effective:—the air is divided at the bottom of the downcast, circulates in the direction of the arrows along the dip-head levels AA, round the faces into the mine leading to the ventilating furnace; over it, and into the upcast shaft, assuming nearly a direct course, and sweeping in its progress the gases liberated spontaneously and by combustion, and other noxious vapours of the mine.

The system of ventilation by pillar working is more intricate. There are various obstacles to contend with: the most insuperable of these are, the discharge of carburetted hydrogen gas, induced by the great section of coal exposed; the amount of openings requiring ventilation; the immense friction caused by the tortuous course of the air; and the defectiveness of stoppings, particularly in cases of explosion. Plate CLXXVIII. shows the most modern arrangements for carrying out a safe and wholesome ventilation by this mode of working. Referring to it, the air is "split" near the bottom of the downcast shaft, from which its onward course is indicated by the arrows into the various districts, and returned over the ventilating furnaces into the upcast shaft. The course for the air current is, in general, guided by doors and stoppings; which also act as regulators for the proper distribution of the air into the various working parts of the mine. Stoppings are sometimes composed of brick and lime, sometimes of wood, and not unfrequently of loose stones taken from the mine. Trap doors are moveable stoppings made of wood placed in roadways, along which the products of the mine require to be taken.

Sir Humphry Davy's invention (viz. the safety lamp), in connection with the ventilation of mines, is too well known to require description. For the principle upon which it is constructed, see the articles DAVY and SAFETY LAMP. When first introduced, it was used to test the state of the mines previous to the workmen going to their work; and this seems to have been the original intention of the inventor. However, its use in certain mining districts has been considerably extended, and some of the most extensive collieries in the world are now lighted wholly by it. Regarding the propriety of this, practical men are not agreed. Certainly, to those unaccustomed to the daily use of the safety lamp, it seems rather a fragile article, upon which hundreds of lives should be constantly dependent.

Under the most rigorous management, and improved system of ventilation, partial explosions from various causes frequently happen. These are seldom heard of beyond the immediate districts in which they occur; it is only when some dreadful havock has been made, by a sweeping explosion, that the public hear of those appalling scenes of death and misery which result therefrom.

A very correct description of such is to be found in Ure's Dictionary, at p. 990, from which the following is extracted:—

"The catastrophe of an explosion in an extensive coal-mine is horrible in the extreme. Let us imagine a mine upwards of 100 fathoms deep, with the workings extended to a great distance under the surrounding country, with machinery complete in all its parts, the mining operations under regular discipline, and railways conducted through all its ramifications, the stoppings, passing doors, brattices, and the entire economy of the mine, so arranged, that every thing moves like a well regulated machine.

"A mine of this magnitude at full work is a scene of cheering animation and happy industry; the sound of the

[1] *Warming and Ventilation*, by C. Tomlinson.

Colliery. hammer resounds in every quarter, and the numerous carriages, loaded or empty, passing swiftly to and fro from the wall-faces to the pit-bottom, enliven the gloomiest recesses. At each door a little boy, called a trapper, is stationed, to open and shut it. Every person is at his post, displaying an alacrity and happiness pleasingly contrasted with the surrounding gloom. While things are in this merry train, it has but too frequently happened, that from some unforeseen cause, the ventilation has partially stagnated, allowing a quantity of the fire-damp to accumulate in one space to the explosive pitch; or a blower has suddenly sprung forth, and the unsuspecting miner entering this fatal region with his candle, sets the whole in a blaze of burning air, which immediately suffocates and scorches to death every living creature within its sphere; while multitudes beyond the reach of the flame are dashed to pieces by the force of the explosion rolling like thunder along the winding galleries.

"Sometimes the explosive flame seems to linger in one district for a few moments, then, gathering strength for a giant effort, it rushes forth from its cell with the violence of a hurricane, and the speed of lightning, destroying every obstacle in its way to the upcast shaft. Its power seems to be irresistible. The stoppings are burst through, the doors are shivered into a thousand pieces; while the unfortunate miners, men and boys, are swept along with an inconceivable velocity in one body, with the horses, carriages, corves, and coals. Should a massive pillar obstruct the direct course of the aerial torrent, all these objects are dashed against it, and there prostrated, or heaped up in a mass of common ruin, mutilation, and death. Others are carried directly to the shaft, and are either buried there amid the wreck, or are blown up and ejected from the pit-mouth. Even at this distance from the explosive den, the blast is often so powerful that it frequently tears the brattice walls of the shaft to pieces, and blows the corves suspended in the shaft as high up into the open air as the ropes will permit. Not unfrequently, indeed, the ponderous pulley-wheels are blown from the pithead-frame, and carried to a considerable distance in the bosom of a thick cloud of coals and coal-dust brought up from the mine by the fire-damp, whose explosion shakes absolutely the superincumbent solid earth itself with a mimic earthquake. The dust of the ruins is sometimes thrown to such a height above the pit as to obscure the light of the sun. The silence which succeeds to this awful turmoil is no less formidable; for the atmospheric back-draught rushing down the shaft denotes the consumption of vital air in the mine, and the production of the deleterious choke-damp and azote.

"Though many of the miners may have escaped by their distance in the workings from the destructive blast and the fire, yet their fate may be more deplorable. They hear the explosion, and are well aware of its certain consequences. Every one anxious to secure his personal safety strains every faculty to reach the pit-bottom. As the lights are usually extinguished by the explosion, they have to grope their way in utter darkness. Some have made most miraculous escapes, after clambering over the rubbish of fallen roofs, under which their companions are entombed; but others wandering into uncertain alleys, tremble lest they should encounter the pestilential airs; at last they feel their power, and aware that their fate is sealed, they cease to struggle with their inevitable doom, they deliberately assume the posture of repose, and fall asleep in death."

Hitherto no human foresight has been able to prevent the recurrence of these dreadful calamities. Much has been done to prevent them, and much remains still to do. But though the prevention of explosions goes to the root of the evil, the far more fertile source of death is from the effects of the after-damp. It is, therefore, of sufficient importance for those interested in mining to devise means for the mitigation of the evil, or contrive that an arrangement of working be carried out, so that when explosions do happen, the effects of the after-damp (by which 75 per cent. are killed) may be rendered less fatal. Colliery

The writer of this has long felt the hopelessness of the miner's case in the event of an extensive explosion, whereby the arrangements for ventilation are entirely subverted (even though they escape the fire and the blast); and he submits a plan showing an arrangement of working and ventilation, by which he feels assured, that in case of an explosion, *few*, if *any*, will lose their lives from the effects of the after-damp. He does so with deference to that intelligent body whom it concerns as proprietors and managers of mines, and with a wish that it may prove beneficial to the miners, a most useful and hardy class of men, fearless from being all their lifetime inured to dangers; but from their habits, generally they and their families are ill-prepared to encounter those adversities of life, resulting from the accidents to which their employment constantly exposes them.

Plate CLXXX., fig. 1, will illustrate this arrangement of working and ventilation. Referring to it, the coal is worked on the longwall system, and divided into suitable districts, 1, 2, 3, 4. The ventilation is maintained by two pits, upcast and downcast.

The course of the air is indicated by the arrows; it is *split* at the bottom of the downcast, and taken into the several districts as may be required.

The advantages anticipated from this arrangement of working, in the event of an explosion, are—the air courses will be preserved; the districts will remain perfectly isolated; and from the peculiar situation of the upcast, the ventilating currents must of necessity make the circuit of the mine before they can get into it.

When workings are made a dipping of the pit-bottom, engines are often used underground for drawing the coal and water to the dip-head level. This is an irregular and objectionable mode of working, and where sinkings are readily made from the surface, it is generally found more economical to do so. Dip workings.

However, there are situations where limited portions lie to the dip of going works, which could not be taken out to advantage by any other arrangement.

It frequently happens that colliery operations are interrupted by dislocations, but seldom to such an extent as to cause new winnings to be made from the surface. The general mode of overcoming such difficulties, and continuing the workings of the colliery, is to form connections by stone drifts, or mines; and where practicable these are found the most convenient. Blind pits are sometimes used for the same purpose; and in deep pits, where two or more seams lie within a short distance of each other, they are frequently connected in this way, and the whole of the coals lowered to the lowest seam by a *drop*. The term *blind* pit is used in contradistinction to one sunk from the surface. Referring to Plate CLXXIX., fig. 1, where a drop is shown, *k* is the *blind* pit, made of such dimensions as to allow the cages *f f* to ascend and descend; *c* a wheel, the diameter of which is exactly the distance between the centres of the two cages less the thickness of the rope,—it is placed at the top of the pit, high enough to allow the bottom of the cage to rest level with the seam of coal *a a;* a flat rope *g*, attached to the cages, works on the wheel; a break *m* is applied to the underside of it, clear of the rope, and connected with the levers *n n*, which regulates the descent. The friction or grip of the rope on the wheel is sufficient to prevent its slipping when a full hutch is on the cage. In order to preserve the equilibrium, a rope is attached to the bottom of each cage g^2, and passes round the pulley c^2, placed below the bottom of the seam *b b*. Blind pit.

After the coal is taken down, it is put into boxes, baskets, or hutches, fitted with wheels for running upon rails, and is thus conveyed by manual labour or otherwise to the pit- Drawing or hauling.

Colliery.

bottom. When the seams lie steep, slope roads and self-acting inclines are made to lessen the labour of drawing; and where the roads are long, horses are used for the same purpose with advantage.

Pit-bottom arrangements.

Having brought the coals to the bottom of the shaft, and placed them upon the cage, it is necessary to signal to the engineman at the surface to wind them up; which is performed by means of a wire led down the shaft attached to a hammer at the surface. The order in which the signals are given vary in detail at different collieries, according to the nature of the under-ground arrangements; in general, however, when the hammer gives one stroke, the engineman knows that coals are to be drawn up; when three, that men are to be drawn up, and so on.

Above-ground arrangements.

The improvements in winding machinery, and general arrangements above ground, have advanced considerably within the last twenty years. The present system of winding with cages, guided in the shaft by wooden conductors, is almost universally adopted throughout the leading mining districts of the kingdom.

The conductors (commonly made of wood $3\frac{1}{2}$ inches square) reach from the pit-bottom to the pit-head pulley, and are stayed at proper intervals. *Cages* are simply platforms attached to the ropes for carrying the loaded hutches, and are furnished with guides for the conductors to work in; which renders the ascent safe and steady. The form of cages vary: sometimes they are made to hold one hutch and sometimes two, either alongside or one above the other; but when windings are deep, and a large output required, three or four hutches are taken up at once. The arrangement of conductors and cages has led to the introduction of safety apparatuses for disengaging the cage in case of overwinding or stopping its descent, in the event of the rope breaking. The following figures (14, 15, 16) show a very ingenious and effective apparatus of this description, invented and patented by Messrs White and Grant, engineers, Glasgow.

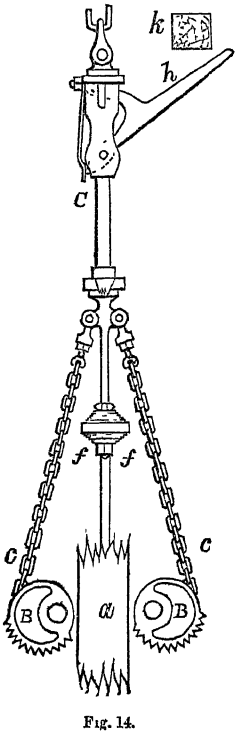


Fig. 14.

On referring to the figures 14, 15, and 16, the mode of action will be readily understood; fig. 15 shows the manner in which the pinions operate upon the conductors when the rope breaks, or when disengaged by the catch *h*; *aa* the wooden conductors; BB eccentric toothed pinions, connected with spiral springs *dd;* C the slide bar from which the cage is suspended, and to which are attached the springs *ff;* and *h* the catch, which disengages the rope in case of overwinding, or when it is brought in contact with the pit-head frame *k*. The use of the springs *ff* is to ensure the action of the pinions B B: they also prevent a sudden strain being put upon the rope when the load is lifted—an important precaution when wire-ropes are used.

In glancing at the history and improvements in mining machinery, the genius and far-sightedness of the late Mr John Curr stands out prominently. He was the inventor of cast-iron hutch-rails; and his designs, upwards of half a century ago, have not, up to this time, been improved upon. In 1798, he patented a system of winding with guides and conductors, differing very little in principle from that in use at present; by his design the hutch was suspended from a cross bar, guided by conductors; and at the present day it might be a question worth the consideration of owners of deep collieries, where heavy cages are in use, whether Curr's plan, or a modification of it, would not economize the present system of winding machinery. He also invented the flat hemp rope, which is unrivalled for the purpose to which it is applied. Thus, the truly inventive genius of Curr may be recognised in the improvements of the present day, as in all probability White and Grant's apparatus would never have existed had not the previous design of Curr (viz., the conductors) laid the ground-work of it.

Colliery.

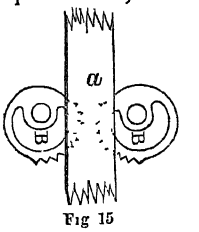


Fig 15

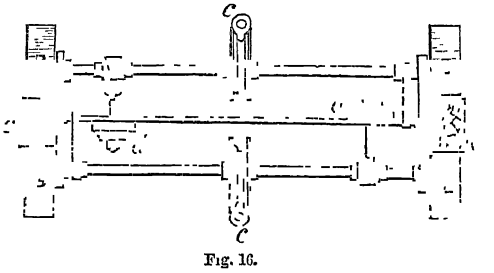


Fig. 16.

Plate CLXXXII. shows the general arrangements for winding, screening, and carrying away. Referring to it—*a a* the drums on which the ropes wind, *b* the pit-head pulleys—it will be observed the drums are on different shafts, the advantage of which is that the ropes bend always one way. Practice has proved that when both drums are on the same shaft, the one that overwinds lasts longest; and it is now considered economical, and in many cases convenient to use two shafts instead of one: *c* the engine-house, &c., *d d* the boilers, *e e* the engine and pit-head framing, *h* the cage, *n n* conductors, *l l* folding boards, placed so that the cage opens them in being brought up the pit, when they again shut for it to rest upon; this enables the banksman to draw the loaded hutch from the cage on to the platform *f*, and replace it by an empty one; they are again opened to allow the cage to pass through (by the engineman) by means of the rods *m m; t* the tumbler for emptying the hutches into the screen *g*, so constructed, that when the loaded hutch is run into it, the extra weight past the point of suspension produces the position of the hutch shown by dotted lines. A break or friction wheel controls this movement; and when the hutch is emptied, and the friction removed, the machine falls back into its first position; when the empty hutch is drawn out to make way for the next full one, to be disposed of in a similar way, and so on; *k z*, the waggons into which the coals and dross fall; *k* the dross, and *z* the coal waggon.

To exhibit clearly the relative annual production and value of the coal, anthracite and lignite or brown coal, in the six great coal-producing countries in our globe in the year 1845, the following illustrative statement has been prepared. It is hardly necessary to observe that, in the two preceding years a regular increase has been simultaneously going on in all the countries enumerated, and apparently about a corresponding ratio. The official estimated value of the coal at the places of production is given in the subjoined table:—

Great Britain	L.9,450,000
Belgium	1,660,000
United States	1,373,963
France	1,603,106
Prussian States	856,370
Austrian States	165,290

The subjoined diagrams represent the relative amounts

Colliery Collingwood.

of production of mineral combustibles in these states, likewise in the year 1845 :—

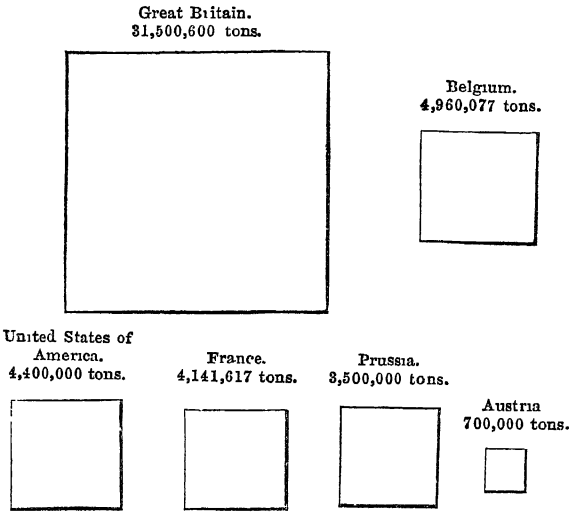


Fig. 17

From this diagram we find, that Great Britain (although considerably underrated) produces seven times more than the United States of America, from six to seven times more than Belgium ; from seven to eight times more than France, and nine times more than Prussia.

According to recent estimates, the annual produce of coal in Great Britain considerably exceeds 40,000,000 tons.[1] At the present rate of consumption, the coal deposits of *Great Britain* will still last more than 1500 *years ;* and by an improved method of working, viz., "longwall," this time might be extended at least 400 years. It may require some time to introduce this mode of working for economizing coal-fields ; but it is nevertheless a point deserving of careful consideration (seeing that our most valuable and easily obtained seams are at present being rapidly exhausted), and sufficiently important to enlist the interest of a great manufacturing country, whose commercial success is in a great measure dependent upon her collieries or coal mines.

Coal is plentifully distributed throughout that division of the earth's crust termed by geologists the *coal measures.* It is readily recognised from the strata in which it is found. It has a blackish appearance, is of less specific gravity (than the other strata), and is very inflammable when brought in contact with heat and flame.

Colliery || Collingwood

If we omit the earthy impurities, which, when burnt, are known as ashes, and which vary from 0·2 to upwards of 40 per cent. "coal is essentially composed of carbon, oxygen, hydrogen, and nitrogen ; and the quality of the coal depends upon the relative proportion of these ingredients."[2]

This important mineral is extensively used in navigation ; it is the indispensable aliment of industry ; and in cold or temperate climates is essential to the health and comfort of the inhabitants.

The following diagrams will convey an approximate idea of the respective areas of coal formation in the principal coal-producing countries of Europe and America. (See Taylor's *Statistics of Coal.*)

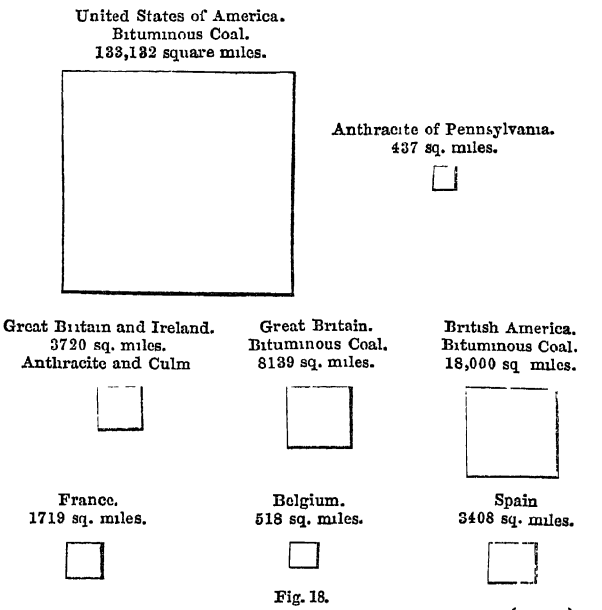


Fig. 18.

(W. A.)

COLLIMATION, Line of, the line of sight in astronomical and geodetical instruments, as mural circles, transit instruments, sextants, quadrants, theodolites, &c. Thus, in a telescope, the line of collimation is the straight line passing through the centre of the object-glass, at the point where the fine wires or spider-webs intersect each other in its focus. The term is derived from the Latin *collimo,* to aim at.

Collimation, *Error of,* the deviation of the actual line of sight, in a telescope, from the centre of the object glass, where it ought to be perpendicular to the horizontal axis. The amount of this deviation must be precisely ascertained and corrected, or allowed for, in order to insure accuracy in the result of the observations.

Among other contrivances for this purpose, the *collimator* of Captain Kater is used for determining the error of collimation in any principal instrument, by which the necessity of the reversal of the instrument itself is obviated.

COLLINGWOOD, Cuthbert, first Lord Collingwood, a celebrated naval commander, was born at Newcastle-upon-Tyne, on the 26th of September 1750. He was early sent to school ; and when only eleven years of age he was put on board the Shannon, then under the command of Captain (afterwards Admiral) Brathwaite, a relation of his own, to whose care and attention he was in a great measure indebted for that nautical knowledge which shone forth so conspicuously in his subsequent career. After serving under Captain Brathwaite for some years, and also under Admiral Roddam, he went in 1774 to Boston with Admiral Graves, who in the year following presented him with a lieutenancy. After occupying the same rank in two other vessels, he was in 1779 made commander of the Badger ; and shortly afterwards, post-captain of the Hinchinbroke, a small frigate. In the spring of 1780 that vessel, under the command of Nelson, was employed upon an expedition to the Spanish Main, where it was proposed to pass into the Pacific by a navigation of boats along the river San Juan and the lakes Nicaragua and Leon. The attempt failed, and most of those engaged in it became victims to the deadly influence of the climate. Nelson was promoted to a larger vessel, and Collingwood succeeded him in the command. It is a fact worthy of record, that the circumstance

[1] See note to Coal Trade, p. 44.

[2] Government Report by Sir H. de la Beche, and Dr Lyon Playfair, in 1846

Collingwood.

of the latter succeeding the former should so very frequently have occurred from the time when they first became acquainted, until the fatal day when the star of Nelson "dropp'd from its zenith," and set at Trafalgar—giving place to that of Collingwood, less brilliant certainly, but not less steady in its lustre.

After commanding in another small frigate, Collingwood was promoted to the Sampson, of sixty-four guns; and in 1783 he was appointed to the Mediator, destined for the West Indies, where with Nelson, who had a command on that station, he remained until the latter end of 1786. With Nelson he warmly co-operated in carrying into execution the provisions of the navigation laws, which had been infringed by the United States, whose ships, notwithstanding the separation of the countries, continued to trade to the West Indies, although that privilege was by law exclusively confined to British vessels. In 1786 Collingwood returned to England, where, with the exception of a voyage to the West Indies, he remained until 1793, in which year he was appointed captain of the Prince, the flag-ship of Rear-admiral Bowyer. About two years previous to this event he had entered into the matrimonial state. This alliance was a fortunate one, and continued to be a solace to him amidst all those privations to which the life of a seaman must ever be subject.

As captain of the Barfleur, Collingwood was present at the celebrated naval engagement which was fought on the 1st of June 1794; and on that occasion he displayed equal judgment and courage. On board the Excellent he shared in the victory of the 14th of February 1797, when Sir John Jarvis humbled the Spanish fleet off Cape St Vincent. His conduct in this engagement was the theme of universal admiration throughout the fleet, and greatly advanced his fame as a naval officer. After blockading Cadiz for some time, he returned for a few weeks to Portsmouth to repair. In the beginning of 1799 Collingwood was raised to the rank of vice-admiral, and hoisting his flag in the Triumph, he joined the Channel fleet, with which he proceeded to the Mediterranean, where the principal naval forces of France and Spain were assembled. Collingwood continued actively employed in watching the enemy, until the peace of Amiens restored him once more to the bosom of his family.

The domestic repose, however, which he so highly relished, was cut short by the recommencement of hostilities with France; and in the spring of 1803 he quitted the home to which he was never again to return. The duty upon which he was employed was that of watching the French fleet off Brest; and in the discharge of it he displayed the most unwearied vigilance. Nearly two years were spent in this employment: but Napoleon having at length matured his plans and equipped his armament, service of a more active description was immediately to be expected. The grand struggle, which the nations looked forward to with breathless suspense, and which was to decide the fate of Europe and the dominion of the sea, was close at hand. The enemy's fleet having sailed from Toulon, Admiral Collingwood was appointed to the command of a squadron, with orders to pursue the enemy. The combined fleets of France and Spain, after spreading terror throughout the West Indies, returned to Cadiz. On their way thither they bore down upon Admiral Collingwood, who had only three vessels with him: but he succeeded in eluding the pursuit, although chased by sixteen ships of the line. Ere one half of the enemy had entered the harbour he drew up before it and resumed the blockade, at the same time employing an ingenious artifice to conceal the inferiority of his force. But the combined fleet was at last compelled to quit Cadiz; and the battle of Trafalgar immediately followed. The brilliant conduct of Admiral Collingwood upon this occasion has been much and justly applauded. It is unnecessary here to enter into a full detail of the battle (for an account of which see the article BRITAIN); but a short outline is necessary, in order to show that no small portion of the glory of that day belongs to Collingwood. The French admiral drew up his fleet in the form of a crescent, and in a double line, every alternate ship being about a cable's length to windward of her second, both ahead and astern. The British fleet bore down upon this formidable and skilfully arranged armament in two separate lines, the one led by Nelson in the Victory, and the other by Collingwood in the Royal Sovereign. The latter vessel was the swiftest sailer, and having shot considerably ahead of the rest of the fleet, was the first engaged. "See," said Nelson, pointing to the Royal Sovereign, as she penetrated the centre of the enemy's line, "see how that noble fellow Collingwood carries his ship into action!" Probably it was at the same instant that Collingwood, his mind kindled up with the same generous and ennobling sentiments, and as if in response to the observation of his great commander, remarked to his captain, "What would Nelson give to be here!" The consummate valour and skill evinced by Collingwood had a powerful moral influence upon both fleets. It inspired with unbounded confidence in their commanders those who scarcely needed any incentive to do their duty in the bravest manner: and, on the other hand, the French admiral, struck with the noble daring displayed, was seized with a dark presentiment of the fate which a few short hours too fatally realized. It was with the Spanish admiral's ship that the Royal Sovereign closed; and with such rapidity and precision did she pour in her broadsides upon the Santa Anna, that the latter was on the eve of striking in the midst of thirty-three sail of the line, and almost before another British ship had fired a gun. Several other vessels, however, seeing the imminent peril of the Spanish flag-ship, came to her assistance, and hemmed in the Royal Sovereign on all sides; but the latter, after suffering severely, was relieved by the arrival of the rest of the British squadron; and not long afterwards the Santa Anna struck her colours. The result of the battle of Trafalgar, and the expense at which it was purchased, are well known. On the death of Nelson, Collingwood assumed the supreme command; and by his skill and judgment greatly contributed to the preservation of the British ships, as well as of those which were captured from the enemy. He was raised to the peerage, and received the thanks of both houses of parliament, with the grant of a pension of L.2000 per annum.

Collingwood

From this period until the death of Lord Collingwood no great naval action was fought; but he was much occupied in important political transactions, in which he displayed uncommon tact and judgment. Being appointed to the command of the Mediterranean fleet, he continued to cruise about, keeping a watchful eye upon the movements of the enemy. But his health, which had begun to decline previously to the action of Trafalgar in 1805, seemed entirely to give way; and he repeatedly requested government to be relieved of his command, that he might return home; but he was urgently requested to remain, on the ground that his country could not dispense with his services. This conduct has been regarded as harsh, and certainly it does not appear very amiable when we consider the age of Lord Collingwood, his long and active services, and the arduous nature of the enterprise in which he had embarked. But it cannot be denied that the remarkable good sense and political sagacity which he displayed in the various transactions with which he was connected at that critical and eventful period, in some measure affords a palliation of the conduct of the government which decreed that he should perish at his post. And it puts the estimation in which he was held in a very conspicuous point of view, that amongst the many able admirals, equal in rank and duration of service, none stood so prominently forward as to command the

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confidence of ministers and of the country to the same extent as he did. After many fruitless attempts to induce the enemy to put to sea, as well as to fall in with them when they had done so (which circumstance materially contributed to hasten his dissolution), he expired on the 7th of March 1810.

Lord Collingwood's merits as a naval officer were in every respect of the first order. In original genius and romantic daring he was inferior to Nelson, who indeed had no equal in an age fertile in great commanders. In seamanship, in general talent, and in reasoning upon the probability of events from a number of conflicting and ambiguous statements, Collingwood was equal to the hero of the Nile; indeed many who were familiar with both give him the palm of superiority. His political penetration was remarkable; and so high was the opinion generally entertained of his judgment, that he was consulted in all quarters, and on all occasions, upon questions of general policy, of regulation, and even of trade. In his moral character he was distinguished for benevolence and generosity. His acts of charity were frequent and bountiful, and the petition of real distress was never rejected by him. He was an enemy to impressment and to flogging; and so kind was he to his crew, that he obtained amongst them the honourable name of father. Between Nelson and Collingwood a close intimacy subsisted, from their first acquaintance in early life till the fall of the former at Trafalgar. In their lives they did not so much differ as in the manner of their deaths. The one expired in the arms of victory, while the other died piecemeal with harassing fatigue and care in the pursuit of an enemy whom he had sought with unexampled perseverance to encounter, but in vain. In death they are not divided; they lie side by side in the cathedral of St Paul's. The selections from the public and private correspondence of Lord Collingwood, published in 2 vols. 8vo in 1828, contain some of the best specimens of letter-writing that our language affords. (J. F. S.)

COLLINS, Anthony (1676–1729), a famous sceptical writer, was born of a wealthy family at Heston, near Hounslow, Middlesex. He received his preliminary education at Eton, and afterwards went to King's College, Cambridge, where his tutor was Francis Hare, subsequently Bishop of Chichester. On leaving college he became a student of the Temple, but devoted himself principally to literary pursuits. He carried on an intimate correspondence with Locke, who seems to have regarded him with peculiar affection, and at his death bequeathed to him a considerable sum of money. In 1707 Collins wrote his *Essay concerning the Use of Reason in Propositions, the Evidence whereof depends on Human Testimony*, and engaged in controversy with Clarke in support of Dodwell's book against the immortality of the soul. Two years later he began the controversy in regard to the 20th article of the Church of England, which led him afterwards to publish his *Historical and Critical Essay on the Thirty-nine Articles*. His *Vindication of the Divine Attributes* was written in reply to the Archbishop of Dublin, and advocated the necessitarian scheme which was more fully developed in his *Philosophical Inquiry concerning Liberty and Necessity*. In 1711 Collins went to Holland, where he matured his *Discourse on Free-thinking*, which was published on his return to England. In 1718 he was made treasurer of the county of Essex; and in the same year wrote his *Grounds and Reasons of the Christian Religion*, which called forth numerous replies, and was afterwards defended by the author in his *Scheme of Literal Prophecy*. His last work was written in 1727, and consisted of an answer to Dr Rogers' eight sermons on the necessity of revelation and truth of Christianity. His health began to decline some time before his death, which was caused by a violent attack of the stone. He was buried in Oxford Chapel, where a monument was erected to his memory. (For an account of his philosophical opinions, see the First Preliminary Dissertation of this work.)

Collins.

Collins, *William*, a celebrated English poet, was the son of a hatter at Chichester, and there he was born, December 25, 1720. He received his classical education at Winchester; after which he studied at New College, Oxford, was admitted a commoner of King's College in the same university, and at length elected a demy of Magdalene College. Whilst at Oxford he applied himself to the study of poetry, and published his Oriental Eclogues. He thence proceeded to London. He was naturally possessed of an ear for all the varieties of harmony and modulation; his heart was susceptible of the finest feelings of tenderness and humanity, and was particularly carried away by that high enthusiasm which gives to imagination its strongest colouring; and he was at once capable of soothing the ear with the melody of his numbers, of influencing the passions by the force of pathos, and of gratifying the fancy by the luxury of description. With these powers he attempted lyric poetry, and in 1746 published his Odes Descriptive and Allegorical; but the sale of this work being not at all commensurate with its merits, he, from a feeling of indignation, burnt the remaining copies. Being a man of a liberal spirit, and small fortune, his pecuniary resources were unhappily soon exhausted; and his life became a miserable example of necessity, indolence, and dissipation. He projected books which he was well able to execute, and became in idea an historian, a critic, and a dramatic poet; but he wanted the means and encouragement to carry these ideas into execution. Day succeeded day for the support of which he had made no provision; and he was obliged to subsist either by the repeated contributions of friends or the generosity of casual acquaintances. His spirits became oppressed, and he sunk into a sullen despondency. Whilst in this gloomy state of mind, his uncle Colonel Martin died, and left him a considerable fortune. But this came too late for enjoyment; for he had so long been harassed by anxiety and distress, that he fell into a nervous disorder, which at length reduced the finest understanding to the most deplorable imbecility. In the first stages of this disorder he endeavoured to find relief in travel, and passed into France; but his growing malady obliged him to return; and having, with short intervals, continued in this pitiable state till the year 1756, he died at a lunatic asylum in the arms of his sister.

The following character of the poetry of Collins is drawn by Mrs Barbauld, and is extracted from an essay prefixed to an edition of his works published in 1797:—"He will be acknowledged to possess imagination, sweetness, bold and figurative language. His numbers dwell on the ear, and easily fix themselves in the memory. His vein of sentiment is by turns tender and lofty, always tinged with a degree of melancholy, but not possessing any claim to originality. His originality consists in his manner, in the highly figurative garb in which he clothes abstract ideas, in the felicity of his expressions, and his skill in embodying ideal creations. He had much of the mysticism of poetry, and sometimes became obscure, by aiming at impressions stronger than he had clear and well-defined ideas to support. Had his life been prolonged, and had he with life enjoyed that ease which is necessary for the undisturbed exercise of the faculties, he would probably have risen far above most of his contemporaries." See Poetry.

Collins, *William* (1788-1847), an English landscape painter, born in London. Like most artists who have risen to eminence, his taste manifested itself in early boyhood. In 1807 he was admitted as a student of the Royal Academy; and two years after obtained the silver medal for a drawing from life. In 1813 he was elected an associate, and in 1820 a Royal Academician. At the persuasion of Wilkie, he visited Italy in 1830. During his tour he prosecuted his studies with the same assiduous perseverance as at

Collinson || Collision.

home. It is not believed that he increased his reputation much by the Italian figure-pieces which he now produced; but he learned from his sojourn in Italy a truer conception of nature and a higher idea of art. His health began to fail during the tour, and soon after his return to England he died of disease of the heart. Collins is principally known as a painter of coast and cottage scenes. His biography appeared in 1848, in 2 vols.

COLLINSON, PETER (1693-1768), an eminent naturalist and antiquary, descended of an ancient family, was born at Hugal Hall near Windermere, Westmoreland. In his youth he showed an ardent attachment to natural history, and began early to form a botanical collection. He soon made himself acquainted with the most eminent naturalists of his time; and Drs Derham, Woodward, Hale, Lloyd, and Sloane, were among his intimate friends. Through the friendship of Sir Hans Sloane, especially, he became familiar with that superb collection which is now in the British Museum. In the department of horticulture we are indebted to Collinson for the great variety of seeds and shrubs which are now the principal ornaments of every garden. His scientific correspondence embraced every nation in Europe, and extended in Asia as far as Pekin. To him Dr Franklin communicated his first essays on electricity; and Linnæus, who had become acquainted with him during his residence in England, continued to correspond with him till his death.

Besides his knowledge of natural history, Collinson was familiar with the antiquities of our own country, and read many interesting papers to the Society of Antiquaries, of which he had been elected a member. He left behind him valuable materials for the advancement of his favourite study; and from him a genus of labiate plants has been named *Collinsonia*.

COLLIQUAMENTUM, the transparent fluid in an egg, containing the first rudiments of the chick. It is included in one of its own proper membranes, distinct from the albumen. Harvey calls it the *oculus*.

COLLISION (Lat. *collisio*), in a general sense, is the act of any two or more bodies coming forcibly together. (See MECHANICS.)

COLLISION (Fr. *abordage*), in *Commercial Navigation*, signifies the shock of two ships coming into sudden and violent contact at sea, by which one or both may be more or less injured.

From the great increase of navigation, the risk of accidents by collision at sea has been proportionally augmented; and it is therefore of importance to be able satisfactorily to determine by whom the loss should, in such cases, be borne. This, however, is by no means an easy matter; and the laws of different countries, and the opinions of the ablest jurists, differ widely with respect to it.

Masters of ships are placed in a situation of great trust and responsibility; and they are bound to do everything in their power to insure the safety of the ships, crews, and passengers under their command. "If any injury or loss happen to the ship or cargo by reason of the negligence or misconduct of the master, he is personally responsible for it; and although the merchant may elect to sue the owners, they will have a remedy against him to make good the damages which they may be compelled to pay"—(Abbott—Lord Tenterden—on The Law of Shipping, cap. 4, § 1, Shee's ed.) As a branch of this general duty, masters are bound to keep a proper watch at sea, especially in channels much frequented by shipping, that they may avoid coming into collision with other vessels.

The obligation to provide against the risk of collision has not, however, been left to depend on general principles, but has been made in most maritime states the subject of regulation. In 1840 the Trinity-house issued a rule of navigation for the guidance and government of masters and others in charge of sailing and steam vessels passing each other on opposite courses—(see MacCulloch's *Commercial Dict.* Supp., art. COLLISION); and though not itself a law, masters not complying with the regulations therein laid down have been held to be guilty of unseamanlike conduct, and their owners or themselves have been made responsible for the consequences. But it is at the same time to be borne in mind, that no rule of this sort is to be regarded as inflexible; and that no master will be warranted in abiding by it when by doing so he must plainly incur danger. A may be in his proper course; but if by pursuing it he will run a great risk of coming into collision with B, who is upon a wrong course, he is bound to alter his course so as to avoid the collision. The fact of one master being ignorant, careless, or in fault, is no reason why another should not use every means in his power to provide for the safety of his ship, and consequently of the lives and property entrusted to his care.

Collision.

The act 14th and 15th Vict. cap. 79, regulating the navigation of steam-vessels, &c., has the following clauses in regard to the avoidance of collisions:—

Rules to be observed by vessels passing each other.—"Whenever any vessel proceeding in one direction meets a vessel proceeding in another direction, and the master or other person having charge of either such vessel perceives that if both vessels continue their respective courses they will pass so near as to involve any risk of a collision, he shall put the helm of his vessel to port, so as to pass on the port side of the other vessel, due regard being had to the tide, and to the position of each vessel, with respect to the dangers of the channel, and, as regards sailing vessels, to the keeping each vessel under command; and the master of any steam-vessel navigating any river or narrow channel shall keep as far as is practicable to that side of the fairway or mid-channel thereof which lies on the starboard side of such vessel; and if the master or other person having charge of any steam-vessel neglect to observe these regulations, or either of them, he shall, for every such offence, be liable to a penalty not exceeding L.50."—§ 27.

Owners not entitled to Compensation in certain cases of Collision, but Master to be liable to Penalty.—"If in any case of a collision between two or more vessels, it appear that such collision was occasioned by the non-observance either of the foregoing rules with respect to the passing of steamers or of the rules to be made by the lord high admiral,[1] or the commissioners for executing the office of lord high admiral, with respect to the exhibition of lights; the owner of the vessel by which any such rule has been infringed shall not be entitled to recover any recompense whatsoever for any damage sustained by such vessel in such collision, unless it appears to the court before which the case is tried, that the circumstances of the case were such as to justify a departure from the rule; and in case any damage to person or property be sustained in consequence of the non-observance of any of the said rules, the same shall in all courts of justice be deemed, in the absence of proof to the contrary, to have been occasioned by the wilful default of the master or other person having the charge of such vessel; and such master or other person shall, unless it appears to the court before which the case is tried, that the circumstances of the case were such as to justify a departure from the rule, be subject in all proceedings, whether civil or criminal, to the legal consequences of such default."—§ 28.

The conditions under which cases of collision take place may differ extremely. Thus, 1st, it may be merely accidental, or be occasioned by circumstances beyond the power of control, as by the violence of the wind or waves dashing or impelling the ships together, without blame being im-

[1] These Rules were issued on the 1st of May 1852. See *Com. Dictionary*.

Collision. putable to either party; or, 2d, it may be owing to the culpable negligence or misconduct of one party; or, 3d, both parties may be to blame. In adjudicating upon losses growing out of collisions that have taken place under such different circumstances, the conclusions must also be very different.

With respect to the first class of cases, there is little apparent difficulty: wherever a loss is occasioned by a storm, a fog, or other accidental circumstance, without any blame being ascribable to either party, it would appear to be equitable that it should be borne by the sufferer. And this principle having been embodied in the Roman law, was subsequently ingrafted into that of England. (Marshall *on Insurance*, cap. 12, § 2.) But other authorities, to whom the greatest deference is due, contend that the loss arising from accidental collisions, however it may affect the parties, should be equally divided between them; and this, in fact, is the rule followed in most maritime states.

Thus it is laid down in the famous French ordonnance of 1681 (lib. iii., tit. xii., art. 10), that "En cas d'abordage de vaisseaux, le dommage sera payé également par les navires qui l'auront fait et souffert, soit en route, en rade, ou au port." This also is the rule sanctioned by the law of England in cases of collision where both parties are to blame, but where the blame cannot be discriminated. Those cases in which the blame is clearly ascribable to either party present no difficulty.

The leading doctrines of the law of England with regard to collisions have been clearly and succinctly stated by Lord Stowell. "In the first place," says his lordship, "a collision may happen without blame being imputable to either party, as when the loss is occasioned by a storm or any other *vis major*. In that case the misfortune must be borne by the party on whom it happens to light; the other not being responsible to him in any degree. Secondly, a misfortune of this kind may arise where both parties are to blame, where there has been a want of due diligence or of skill on both sides; in such a case the rule of law is, that the loss must be apportioned between them, as having been occasioned by the fault of both of them. Thirdly, it may happen by the misconduct of the suffering party only; and then the rule is, that the sufferer must bear his own burden. Lastly, it may have been the fault of the ship which ran the other down, and in this case the innocent party would be entitled to an entire compensation from the other." —(2 Dodson's *Admiralty Reports*, 83.)

We may add, that the rule of the equal division of the damage where both vessels are to blame has been since Lord Stowell's time fully recognised, and finally established by a decision of the House of Lords on an appeal from Scotland.[1]

Various authorities have spoken disparagingly of the rule now referred to, and have called it a *judicium rusticorum*. And it would no doubt be very desirable in cases of collision where both parties are to blame, that the neglect or culpability of each should be accurately determined, and the damages assessed accordingly. But from the obscurity in which such cases are usually involved, and the conflicting testimony brought forward by the different parties, the difficulties in the way of this being done are usually quite insuperable. And it is better to adopt a rule which, though less equitable perhaps in principle, is fairer in its application than any other that could be adopted. It is followed, as the Dutch jurists say, *propter bonum publicum et culpæ probandæ difficultatem*. Of its expediency, indeed, there can be no reasonable doubt. The observations of Valin in this respect are quite conclusive—"C'étoit," says this great authority, "le moyen le plus propre à rendre les capitaines ou maitres des navires extrèmement attentifs à eviter tout abordage, surtout ceux des bâtimens foibles et plus susceptibles d'être incommodés par le moindre choc en leur rendant toujours présent la crainte de supporter la moitié du dommage qu'ils en pourroient recevoir. Et si l'on dit qu'il auroit été plus simple et plus court de laisser pour le compte particulier d'un chacun le dommage qu'il auroit reçu, comme provenant d'un cas fortuit; la réponse est qu'alors les capitaines de gros navires n'auroient plus craint de heurter les bâtimens d'une beaucoup moindre force que les leurs; rien donc de plus juste que la contribution par moitié."—(*Commentaire sur l'Ordonnance de* 1681, ii. 179. ed. 1776.) Collision.

In apportioning the damage in cases where both parties have been in fault, the question occurs, whether the damage done to the cargo shall be taken into account or left out in the estimate on which the apportionment is to be made. This knotty point has been differently decided in different countries. But the stat. 53 Geo. III., cap. 159, which limits the liability of owners to the value of the ship and freight, applies to cases of damage by collision. (For further observations on this curious and important subject in addition to Valin and the other authorities already referred to, the reader may consult the chapter on Collision in Maude and Pollock's Treatise on the Law of Merchant Shipping.)

Number of Collisions at Sea.—A statement has been prepared by Mr John A. Rucker, underwriter, giving a classification of the number of collisions at sea reported in Lloyd's lists during the five years from 1845 to 1849 inclusive. It thence appears that the annual numbers were 603, 564, 699, 633, and 565; so that there has been a decrease in 1849, notwithstanding the increased traffic of that year. The total collisions of the five years amount to 3064. Of these 279 were cases in which a vessel was sunk, run down, or abandoned; 189 were cases in which there was serious damage; 686 in which the damage, although less, was still considerable; and 1910 in which it was only slight. The average of steamers in contact with steamers during each year is about 11; of steamers in contact with sailing vessels about 37; of sailing vessels in contact with steamers 36; and of sailing vessels in contact with sailing vessels 533.

In 1852, 33 ships were totally lost by collisions, and 24 were so much injured as to be obliged to discharge their cargoes.

Liability of Insurers in cases of Collision.—Where the collision is purely fortuitous, without blame being ascribable to either party, it is obviously a loss by the perils of the sea, and must, as such, be made good by the underwriters.

The underwriters are also liable when the loss has been entirely occasioned by the misconduct of the master and crew of the defendant's ship; but when the damage has been occasioned by the misconduct or negligence of the master and crew of the pursuer's ship, such misconduct would perhaps be held to amount to barratry, and the loss would be recoverable under that head. There has, however, been no direct decision in our courts on this curious point. But if the misconduct or negligence in question were not held barratrous, it would be of so gross a character as to exempt the underwriters from their liability.

In cases where the damage is equally apportioned between the colliding ships, authorities differ as to whether the loss should be regarded as resulting from a peril of the sea. In this country the negative doctrine has been held, and, as we think, on entirely satisfactory grounds. The misconduct or incapacity of masters and crews can with no propriety be called a peril of the sea. It may occur on the sea, but is certainly not occasioned by it. (See for further details on this point, Arnould's learned Treatise on Marine Insurance, ii. 804, and the authorities there referred to.) (J. R. M.)

COLLODION. See CHEMISTRY.

[1] Hay *v.* Le Neve,—(2 Shaw's *Scotch Appeal Cases*, p. 395).

Collumpton ‖ Colman.

COLLUMPTON, or CULLOMPTON, a market-town, county of Devon, hundred of Hayridge, on the right bank of the Culm, a tributary of the Exe, 12 miles from Exeter, and 160 from London. Pop. (1851) 2765. The church, originally collegiate, is a handsome edifice of the fourteenth century. Attached to it is a chapel, built in 1528 by a clothier named Lane, and highly ornamented externally. The principal manufacture is that of woollens, particularly serges.

COLLUTHUS, a presbyter of Alexandria, who was indignant at the favour shown to Arius, and withdrew from the communion of the patriarch about the commencement of the fourth century. He afterwards promulgated heretical opinions, teaching that God did not create the wicked nor anything that is evil. He was condemned by a council held at Alexandria, A.D. 330. His followers were called Collythians.

COLLYRIDIANS, a name given by Epiphanius to a sect of Arab women in the fourth century, who, at the instigation of Thracian immigrants, instituted an annual festival, at which they offered cakes (κολλυρίδες) to the Virgin Mary.

COLLYRIUM (Latin and Greek), eye-salve; any wash for the eyes.

COLMAN, GEORGE, the elder, a dramatic and miscellaneous writer, was born at Florence about 1733. He was the son of Mr Colman the British resident at the court of Tuscany, and of a sister of the Countess of Bath. He received the early part of his education at Westminster School, where Lloyd, Churchill, and some others who afterwards attained distinction in literature, were among his intimate companions. While at school he appeared in the character of a poet, and addressed to his cousin, Lord Pulteney, a copy of verses which were afterwards published in the magazine of St James. At Christ Church College, Oxford, he gave many proofs of his lively genius, uniting with Thornton in producing a weekly periodical paper entitled the *Connoisseur*, which was continued from Jan. 1754 to Sept. 1756, and afterwards published in 4 vols. 12mo. Although this work did not enjoy a reputation equal to that of the *World*, the *Adventurer*, and the *Rambler*, which made their appearance about the same time, yet it may with justice be affirmed that, for a ludicrous delineation of the manners of the day, some papers in it are at least equal to any which these performances contain. Having taken the degree of A. M., he left college and went to London; entered at Lincoln's Inn; and was admitted to the bar. But literary pursuits were more consonant to the bent of his genius. He published in 1760 a dramatic piece entitled *Polly Honeycomb*, which was successfully acted at Drury Lane: and in the following year appeared his comedy of the *Jealous Wife*. By the demise of Lord Bath he came into the possession of a handsome fortune, which was further augmented by the death of General Pulteney in 1767. He still continued to write for the stage, and produced, along with Garrick, the *Clandestine Marriage*. He also translated the comedies of Terence into English.

Soon afterwards he purchased from Mr Samuel Foote the Haymarket theatre, which he supplied with pieces either original or translations, and engaged the ablest actors. He executed a translation of Horace's *Art of Poetry;* to which he prefixed an ingenious account of the author's intention, and added many critical notes. Besides *The Genius* and *The Gentleman*, he produced a great many short humorous pieces of considerable merit. His mind was much impaired by a stroke of the palsy in 1789; and in consequence, his son was intrusted with the management of the theatre. Colman died in the 62d year of his age, August 1794.

COLMAN, *George*, the younger, son of the preceding, was born Oct. 21, 1762. He began his education at a private academy in Marylebone, from whence he was removed to Westminster; and afterwards entered at Christ Church, Oxford. From Oxford he went to King's College, Aberdeen; and there he wrote some dramatical pieces, which were brought out in London at the Haymarket theatre, and immediately condemned. On his return to London he at first applied himself to law; but the bent of his genius and example of his father led him to devote his attention to literary pursuits. In 1785, during the illness of his father, he took the entire management of the Haymarket theatre, and became involved in a Chancery suit which ultimately reduced him to poverty. Having surrendered the management of the theatre, he was appointed licenser and examiner of plays, and received marks of distinguished favour from George IV. Of his dramatic works, the most popular are *John Bull, Inkle and Yarico, The Poor Gentleman, The Heir-at-Law, The Iron Chest*, &c. He wrote also the well-known comic tales *Broad Grins, Poetical Vagaries*, &c. In his *Random Records* he has given memoirs of his early life up to the time of his entering on the management of the Haymarket. Colman died Oct. 26, 1836. From the time that his earlier plays were condemned he invariably subscribed himself *the Younger*, lest his father's reputation should suffer from his ill success. Byron entertained a very high opinion of Colman's wit and conversational powers. "If I had," he said, "to choose, and could not get both at a time, I should say, 'Let me begin the evening with Sheridan, and finish it with Colman;'—Sheridan for dinner, and Colman for supper; Sheridan for claret and port, but Colman for everything. Sheridan was a grenadier company of life-guards, but Colman a whole regiment—of *light infantry* to be sure—but still a regiment."

Colmar ‖ Colocynth.

COLMAR, a city of France, capital of the department of Haut Rhin, and of a cognominal arrondissement; and the seat of a royal court for the departments of Haut and Bas Rhin, with tribunals of primary instance and commerce. It is for the most part well built, and is pleasantly situated on the Lauch and Fecht, tributaries of the Ill, 40 miles S.S.W. of Strasbourg, with which it is connected by railway. The most remarkable edifice is the cathedral, a Gothic structure, built in 1363. Among the other public buildings are the palace of justice, hôtel-de-ville, college (with a public library of 36,000 volumes), deaf-mute institution, civil and military hospitals, theatre, museum, and the churches of the Dominicans and the Trinity. It has extensive manufactures of cottons, hosiery, ribands, paper, and leather. In the thirteenth century Colmar was made a free imperial city; and was united to France in 1697 by the treaty of Ryswick. Pop. (1851) of city, 19,153; of arrondissement, 221,682.

COLNE, a market-town, county of Lancaster, 26 miles north of Manchester, on a small affluent of the Calder, near the Liverpool and Leeds canal. It is a place of great antiquity, and supposed by some to be the Colunio of the Romans. Many Roman coins have been found here. As early as the fourteenth century Colne was the seat of a woollen manufacture, but its principal manufactures now are printed calicoes and mousselines-de-laine. In the neighbourhood are several limestone and slate quarries. Market-day Wednesday. Pop. (1851) 6644.

COLOCYNTH (the bitter gourd), is the fruit of a cucurbitaceous plant, the *Cucumis Colocynthis*. The plant is extremely common in Palestine, Asia, Africa, &c., and its trailing stems often cover the desert spots for miles. The fruit is about the size and shape of a large orange; with a thin, leathery, yellowish rind; and a dry, cellular interior, containing many seeds, from which a coarse oil is expressed. The dry pith is the part used in medicine: it is intensely bitter, and is one of the most powerful purgatives we possess. This fruit, however, is chiefly interesting to the general reader, as being supposed to be the *pakyoth* or wild gourds mentioned in the Second Book of Kings, which the prophet's servant shred into the pot of pottage, mistaking them for one of the eatable gourds or cucumbers. The original word is used to denote an oval fruit; and hence it is not quite

Cologna || Cologne.

certain whether the wild gourds were the fruit of the colocynth or of the squirting cucumber (*Momordica Elaterium*), both of which are equally bitter and poisonous. The colocynth could only be shred in its young state, when it is oval in form and full of juice. Under these circumstances, both the colocynth and the fruit of the squirting cucumber might easily be mistaken for young gherkins. See BOTANY, vol. v., p. 192.

COLOGNA, a town of Venetian Lombardy, delegation of Verona, and 20 miles from that city. It is a place of some trade, and has considerable manufactures of silk. Pop. 6000.

COLOGNE (German, *Coln*), a fortified city of Rhenish Prussia, capital of a cognominal government, on the left bank of the Rhine, 45 miles N.N.W. of Coblenz. N. Lat. 50. 56. 29., E. Long. 6. 57. 52. A bridge of boats, nearly 1400 feet long, connects it with the town of Deutz on the opposite side of the Rhine. Cologne occupies the site of the *Oppidum* or *Civitas Ubiorum*, the chief town of the Ubii, who were settled here by the Romans about 37 B.C. In A.D. 51 a Roman colony was planted in the town by the Emperor Claudius, at the instigation of his wife Agrippina, who was born there. From her it took the name of *Colonia Agrippina* or *Agrippinensis*. It soon became a large and flourishing city, and was the capital of Lower Germany. In the middle ages it was much more populous and wealthy than at present, and was long one of the most important cities of the Hanseatic League. The intolerance of its magistrates in expelling the Jews, Protestants, and others, at different times—and the closing of the Rhine for navigation by the Dutch in the sixteenth century—contributed to its decline. This last restriction was removed in 1837, and since that time the trade of Cologne has much improved. It has a considerable trade in corn and Rhenish wine with Holland, Belgium, and other countries. This proverbially ill-built and filthy town has lately been much improved; many of the old streets have been widened and improved, new streets have been laid out, and the general appearance of the town considerably ameliorated, although much still remains to be done. Among the numerous objects of interest in Cologne is the cathedral, begun in 1248 by Archbishop Conrad of Hochsteden, but still unfinished. It is considered one of the finest and purest Gothic monuments in Europe. According to the original designs, the two principal towers were to have been 500 feet in height, but the most complete is not more than one-third of that elevation. By the munificence of the Prussian government, and by private subscriptions, the works have been prosecuted with vigour, particularly since 1842. The entire length of the body of the church will be 511 feet, and the breadth 231 feet. The choir is 161 feet high; and internally, from the disposition of its pillars, arches, chapels, and beautifully-coloured windows, it resembles a splendid vision. Under a slab in the pavement the heart of Mary de Medici is buried; and in the adjoining side chapels are monuments of the founder and other archbishops of Cologne; and the shrine of the three kings, which is richly adorned with gold and precious stones. Several of the other churches are also interesting, as those of St Ursula, St Mary, St Gereon, and St Peter. This latter church contains the famous altar-piece by Rubens, representing the crucifixion of St Peter. The other public buildings are the town-hall, court-house, exchange, theatre, museum, &c. Cologne is the seat of an archbishopric founded in the eighth century, of the provincial authorities, and of the courts of appeal for the province. The university, founded in 1388, was suppressed during the occupation of the country by the French. There are two gymnasia—one for Catholics, to which is attached a very valuable library and one for Protestants; an archiepiscopal seminary, for the education of clergymen; normal and commercial schools with public libraries; and numerous literary and scientific institutions. The principal manufactures are cotton yarn and stuffs, hosiery, woollens, silks, velvets, tobacco, soap, &c. Of the well-known Eau-de-Cologne, upwards of a million bottles are annually exported. The walls which surround the town are about seven miles in circuit. The Roman walls may still be traced in parts of the city, and numerous statues, sarcophagi, and other ancient remains, have been found. Pop. (1849) 94,789; of whom 49,457 were males, and 45,332 females; 81,706 Roman Catholics, 11,788 Protestants, and 1286 Jews. The government, of the same name, contains 13 cities, 13 market-towns, and 674 villages; and has an area of 1533 square miles. Pop. (1849) 497,330.

Colombia.

COLOMBIA. The republic of Colombia, so named in honour of Columbus, comprised the ancient vice-royalty of New Granada and Quito, and the *capitania general* of Venezuela. It was bounded E. by the Atlantic Ocean, and extended from Cape Nassau at the mouth of the Essequibo (N. Lat. 7. 39., W. Long. 53. 47.) to Cape Gracias-a-Dios, in the province of Honduras (N. Lat. 15. 1., W. Long. 82. 46.), including the islands of Margarita, St Andrews, and others. On the Pacific, the western boundary commenced at Golfo Dulce (N. Lat. 8. 20., W. Long. 83.), and extended along the Pacific, comprehending the adjacent islands, as far as the river Tumbes (S. Lat. 3. 34., W. Long. 86. 30.) On the south it was separated by the Tumbes and a lofty mountain ridge from Peru, Brazil, and the British possessions on the Essequibo. The boundary line between Colombia and Guatemala on the north, although highly important to both countries on account of the proposed water communication between the Atlantic and the Pacific at lake Nicaragua, was not accurately defined. The extent of territory comprised within these limits has been estimated at 92,000 square leagues, of which 58,000 belonged to New Granada and Quito, and 33,700 to Venezuela. Colombia is traversed from north to south by the Cordillera of the Andes, which, at an average distance of about 150 miles, runs parallel with the coast of the Pacific, and contains, besides other lofty mountains, Chimborazo, the height of which is estimated at 21,424 feet. In the centre of New Granada, the Andes separate into three parallel ridges which extend from 3. 30., to 5. 15. of N. Lat., and again unite to form one chain in the rugged province of Pasto. To the south they are divided into two parallel ranges, which cross the equator, and are reunited at Asuay. A lateral range proceeding eastward from the Andes gives origin to the Guaviare and the Meta, forms the watershed between the Orinoco and the Marañon, and, before its termination, separates Colombia from the British possessions of Essequibo, Berbice, and Demerara. At the lofty *paramo* of Almorsadero, the Cordillera divides into two branches, the eastern proceeding along the maritime provinces of Merida, Coro, Caraccas, and Cumana, reaching in some parts the limits of perpetual snow, and comprehending the Nevada of Merida, 15,000 feet in height. The western branch proceeds northward by Ocaña, to form the Sierra Peripa, west of the lake of Maracaybo, and terminates near Santa Martha in the Sierra Nevada.

The *llanos* of Colombia are extensive plains, about 200 or 300 feet above the level of the sea; which are watered by the Caqueta, Meta, Guaviare, Casanare, Apure, and other tributaries of the Orinoco. Their area is estimated at 17,000 square leagues; and their climate is hotter and less healthy than that of the mountains. Towards the south they are covered with immense forests; their vegetation throughout is extremely luxuriant; and they teem with an endless variety of animals, birds, reptiles, and insects. The river Meta, in connection with the Orinoco, affords water communication from the Atlantic to within a few leagues of Bogota, a distance of 1500 miles. By means of the Cassiquiari, a branch of the Orinoco, this river is connected with the Rio Negro, a tributary of the Marañon, and thus a water communication is established between two of the

Colombo ‖ Colony.

largest rivers of the world. In addition to these, the Magdalena which is navigable to within a short distance of Bogota; the Guayaquil, important as furnishing an outlet to the commerce of Quito; and the extensive lake of Maracaybo with its large tributaries, afford great facilities for internal communication.

Colombia, embracing in climate all the gradations of temperature from extreme heat to extreme cold, would long before this have become one of the most prosperous countries of the world, had not its political condition under Spanish rule greatly retarded the development of its natural resources. The cultivation of the vine and olive, the breeding of the silkworm, and the working of the iron mines were prohibited by the Spaniards in South America under severe penalties, lest they should interfere with the industry of Spain. Foreign commerce also was fettered by monopoly, and all commercial intercourse with the neighbouring countries subject to numerous restrictions. The natural productions of Colombia are cacao, coffee, cotton, sugar, tobacco, rice, maize, wheat, barley, dyewoods, cinchona bark, gums, balsams, timber adapted for ship-building, and a variety of medicinal and other useful substances. Cattle exist in great numbers on the extensive plains of Venezuela and Casanare, and horses and mules are also abundant. The riches of the mountainous districts consist principally of the valuable mines and washings of gold, silver, platina, and other metals. The population of the country, which consists of whites, free coloured persons, and negro slaves, was calculated to exceed three millions in 1834: the uncivilized indigenous Indian population was estimated at 200,000. As Colombia, however, has now for a considerable period been divided into the three distinct and independent states of New Granada, Venezuela, and Ecuador, reference must be made to these heads for particular information relative to the population, laws, constitution, religion, education, and commerce of these countries. For the History of Colombia, see article Bolivar.

COLOMBO, the capital and principal seaport town of Ceylon, is situated on the W. coast of the island, in Lat. 6. 56. N., Long. 79. 49. E. The fortified part of the town is about a mile and a half in circuit, standing on a rocky promontory, and surrounded on three sides by the sea. On the land side it is protected by a lake, moat, and draw-bridges. Colombo contains the government offices and courts, and is the residence of the civil and military authorities, and the majority of the European inhabitants. The principal buildings are the government house, court house, hospital, masonic hall, barracks, lighthouse, and several churches and chapels. Besides these, Colombo has a college, government academy, several schools, museums, libraries, and various religious and benevolent institutions. Pop. about 40,000. See Ceylon.

Colon ‖ Colony.

COLON, the largest division of the intestinal canal. See Anatomy, vol. iii. p. 61.

COLONEL (pronounced *curnel*), the chief commander of a regiment, whether of infantry or of cavalry. Skinner derives the word from colony, on the ground that the chiefs of colonies, called *colonales*, might give name to leaders or commanders of forces. See Commission.

Colonel-Lieutenant, the commander of a regiment of guards, of which the king, prince, or other person of eminence, is colonel. Colonel-lieutenants have always a colonel's commission, and are usually general officers.

Lieutenant-Colonel, the second officer in a regiment, who commands in the absence of the colonel.

COLONNA, the name of one of the noblest families of modern Italy, which has produced princes, popes, cardinals, warriors, and authors, who have figured in the history of their country. One of the most eminent of these was,

Vittoria Colonna, daughter of the high constable of Naples, and wife of the celebrated warrior Davalos Marquese de Pescara, the faithful general of the Emperor Charles V. Her talents, her beauty, and her virtues, have been extolled by Michel Angelo, Ariosto, and other celebrated poets. When Pescara died in 1548, his accomplished widow retired to a convent, and there indulged her melancholy and her religious sentiments in beautiful poetic effusions to the memory of her husband, and on spiritual subjects. These appeared at Venice in 1548, under the title of *Rime Spirituali di Victoria Colonna*. She was born in 1490, and died at Rome in 1549. Tiraboschi remarks, that she was called "a model for Italian matrons."

Colonna, *Giovanni Paolo*, chapel-master of St Petronio at Bologna, and president of the Philharmonic Academy there, was born at Brescia about the middle of the seventeenth century. The music-school which he established at Bologna produced many good musicians; among them Clari. Most of Colonna's works are for the church, and are among the most remarkable compositions of the seventeenth century. Doctor Boyce considered Colonna as Handel's model for choruses accompanied with many instrumental parts different from the vocal. (G. F. G.)

Colonna, Cape. See Attica.

COLONNADE, in *Architecture*, a series or range of columns placed at certain intervals from each other; varying according to the rules of art, and the order employed.

COLONY.

It will scarcely be necessary to inform the reader that the following paper is from the pen of the late James Mill. It has obtained indeed a wide celebrity in connection with his name. The readers of the Encyclopædia would not readily have pardoned the suppression or material alteration of an essay forming an important chapter in the literature of political economy, and therefore it remains unchanged in its broad reasonings on colonial systems; that portion only which professed to give, in an abbreviated and almost tabular shape, the colonial statistics of the day, being removed to make way for more recent information. There is a peculiar appropriateness in preserving, in this instance, an essay which does not precisely represent the policy still pursued, as it is believed to have exercised a great influence in producing the changes made in our colonial system subsequent to the publication of the preceding edition of the Encyclopædia. To afford the immediate means of estimating the influence of Mr Mill's views, and to bring down the whole matter to the state of existing knowledge, a short supplemental view has been given of the late changes in our colonial policy.

The term "colony" has not been used with much precision. Dr Johnson defines it "a body of people drawn from the mother country to inhabit some distant place;" and it would not be easy to find a short expression better calculated to embrace all the particulars to which the name is ever applied. Yet this will be found to include some very heterogeneous objects; nay, more, to embrace particulars to which the term "colony" really does not extend. When the French Protestants, for example, settled in great numbers in England, and in the United Provinces, they were "a body of people drawn from the mother country to inhabit a distant place;" but did not for that reason become a colony of France. Let the first part of the definition be supposed to be correct, and that a colony must of necessity be "a body of people drawn from the mother country;" something more is necessary to complete the definition than the idea of inhabiting a distant place; for not every sort of inhabiting constitutes them a colony. It seems necessary that, inhabiting a distant place, they should not come under the authority of any foreign government, but either remain under the government of the

 mother country, or exist under a government of their own. Of colonies remaining under the government of the mother country, the West India islands of the different European states afford an example. Of those existing under a government of their own, the most celebrated example is found in the colonies of the ancient states of Greece. The United States of America, as they constituted an example of colonies of the first sort before the revolution which disjoined them from the mother country, so they may be regarded as constituting an example of colonies of the Grecian sort, now that they exist under a government of their own. Our resentment at their preferring to live under a government of their own has indeed often prevented us from regarding them in the endearing light of a colony or daughter country. It has made us much rather apply to them the name of enemies, and in our feelings towards them has mixed up a greater proportion of the hostile than the friendly ingredients.

Again, the term " colony" is sometimes employed in a sense in which the idea of a body of people drawn from the mother country hardly seems to be included. Thus we talk of the British colonies in the East, meaning, by that mode of expression, the East Indies. Yet it can hardly be said that any body of people is drawn from the mother country to inhabit the East Indies. There is nobody drawn to *inhabit*, in the proper sense of the word. A small number of persons, such as are sent to hold possession of a conquered country, go; and in this sense all the conquered provinces of the ancient Roman empire might be called what they never have been called, colonies of Rome.

In the meaning of the term " colony," the predominant idea among the ancient Greeks and Romans appears to have been that of the *people*, the egress of a body of people to a new and permanent abode. Among the moderns, the predominant idea appears to be that of the *territory*, the possession of an outlying territory, and, in a loose way of speaking, almost any outlying possession, if the idea of permanency is united, would receive the name of a " colony." If we use the term with so much latitude as to embrace the predominating idea, both of ancients and moderns, we shall say that a colony means an outlying part of the population of the mother country, or an outlying territory belonging to it, either both in conjunction, or any one of the two by itself.

Sect. I.—*Of that Class of Colonies in the Conception of which the Idea of the People is the predominating Idea.*

Of this sort were the Roman and the Grecian colonies, and of this sort are some of the British colonies.

1. The Roman colonies arose out of a peculiarity in the situation of the Roman people. In Rome, as in other countries, the lands were originally regarded as belonging to the state, and as belonging to the people when the people took the powers of government to themselves. A sense of convenience there, as everywhere else, rendered the land private property by degrees; and, under a form of government so very defective as the Roman, the influence of the leading men enabled them in a short time to engross it. The people, when reduced to misery, did not altogether forget that the land had once been regarded as theirs, and every now and then asserted their claims in so formidable a manner that, when aided by circumstances, they compelled the ruling few to make something of a sacrifice. They did not indeed compel them to give up the lands which they had appropriated; but it always happened that, in the countries conquered by the Romans, a portion of the lands was public property, and continued to be cultivated for the benefit of the Roman state. When the importunity of the people for a division of lands began to be troublesome or formidable, a portion of these lands was generally resorted to, enough to take off the most fiery of the spirits, and, contenting the leaders, to quiet the populace for a time. The portion of land set apart for the purpose was divided at the rate of so much for every man; and a sufficient number of persons to occupy it, and to form a community, were sent out, more or less provided with the various supplies which were necessary for commencing the settlement.

In the nature of an establishment of this description there is no mystery, and hardly any thing which requires explanation. The colonists lived in a Roman province, under Roman laws, and differed not materially from the people of any other local jurisdiction. Being once got rid of, no further advantage was expected from them than from the other inhabitants of the country, in paying taxes, for example, and furnishing men for the army. In a few instances, in the planting of colonies, some benefit was looked to in the way of defence, when they were established in newly-conquered countries, the people of which were not yet patient under the yoke, or when they were placed in the way of invading enemies. But not much advantage of this sort can be derived from a colony which in general has more need to receive than ability to yield protection.

These colonies were planted wholly for the benefit of the Roman aristocracy. They were expedients for preserving to them the extraordinary advantages and powers they had been enabled to assume, by allaying that impatience of the people, under which the retention of their usurpations became difficult and doubtful. The wonder is that the people were so easily contented, and that, having the means of intimidating the aristocracy to so great a degree, they did not insist upon greater advantages: And the pity is that they understood so little what was for their advantage. If, instead of demanding a portion of land, the benefit of which, at best, was only temporary, they had demanded good laws, and had obtained efficient securities for good government, securities against that prevalence of the interests of the few over the interests of the many, which existed to so great an extent in the Roman government, as it has existed, and still does exist, in almost all other governments; they would have rendered to themselves, and would have rendered to the human race, the greatest of all possible services. But the human mind had not then made sufficient progress to see distinctly what was the real object of good government, or what the means which would be effectual in attaining it.

2. We next come to the class of colonies which are exemplified in the case of those sent out by the Greeks; and we take them in order subsequently to the Roman, because there is something in them for which rather more of explanation is required. Of those early migrations which carried a Greek population into Asia Minor, and at a later period into Italy and Sicily, we have not a sufficient number of historical facts to know very accurately the cause. It may be, that internal commotions, and as frequently a superabounding population, were the source from which they were derived. When, of two contending parties, one acquired the ascendency, they frequently made the situation of their opponents so painful to them, and sometimes also the shame of defeat was so great, that the vanquished party chose rather to live anywhere than be subject to the power and contempt of those over whom they had hoped to domineer. The leaders proposed emigration; and a great part of those who contended under their banners, were ready to depart along with them. In this way they might remove in large bodies, and, carrying

Colony. with them all their moveable effects, would be in circumstances, when they established themselves on a fertile soil, to attain, in a little time, a great degree of prosperity. All this seems necessary to account for the flourishing state of the Greeks in Asia Minor, among whom arts and sciences flourished sooner, and civilization made still more rapid strides, till checked by Persian domination, than in the mother country itself, where a more dense population and a less fertile soil opposed obstructions to the happiness of the people and the progress of the human mind.

There is nothing in modern times which so much resembles the colonization of Asia Minor by the Greeks, as the colonization of North America by the English. Of the first English planters of North America, a large proportion went out to escape the oppression of a predominating religion, as the Greeks did to escape the oppression of a predominating political party. One difference there was—that the English did not go off at once in any considerable bodies, under distinguished leaders, or with any great accompaniment of capital, the means of future prosperity. Accordingly, the prosperity of the British colonies in North America was much less rapid and much less brilliant than that of the Grecian colonies in Asia Minor. Another great difference there was, in that the English colonies, though they made a sort of subordinate government for themselves, were still held to be subject to the government of the mother country. The Grecian colonies became states, in all respects independent, owning no government but that which they established for themselves; though they still looked to the mother country for protection and assistance, and held themselves under a very strong obligation to befriend and assist her in all her difficulties.

In regard to those detachments of the population of the Grecian states, which resulted either from political disgust or political oppression, there is nothing which stands in need of explanation. The motive which gave rise to them is familiar and obvious; and the sort of relation in which they and the mother country stood to one another, importing mutual benevolence, but no right in the one to command, or obligation on the other to obey, every body can immediately understand.

There were other occasions, however, on which the Greeks sent out colonies; and these are the colonies which are commonly meant, when the Grecian principle of colonization is spoken of by way of distinction. These were resorted to when the population of the mother country became superabundant, and relief was demanded by a diminution of numbers. This is a ground of colonization, which, since the principle of population has been shown to exert so great an influence upon the condition of human beings, deserves profound regard. We shall not, therefore, pass it by without a few observations.

A population is said to be redundant: when is it so? Not when it is numerically either great or small, but solely and exclusively when it is too great for the quantity of food. Any one country produces or procures a certain quantity of food in the year. If it has a population greater than such a quantity of food is sufficient to maintain, all that number which is over and above what it is capable of maintaining, is a redundancy of population.

A curious phenomenon here presents itself. A redundancy of population in the states of ancient Greece made itself visible even to vulgar eyes. A redundancy of population in modern Europe never makes itself visible to any but the most enlightened eyes. Ask an ordinary man, ask almost any man, if the population of his country is too great; if the population of any country in Europe is, or ever was, too great. So far, he will tell you, is it from being too great, that good policy would consist in making it, if possible, still greater; and he might quote, in his own support, the authority of almost all governments, which are commonly at pains to prevent the emigration of their people, and to give encouragement to marriage. Colony.

The explanation of the phenomena is easy; but it is also of the highest importance. When the supply of food is too small for the population, the deficiency operates, in modern Europe, in a manner different from that in which it operated in ancient Greece. In modern Europe the greatest portion of the food is bought by the great body of the people. What the great body of the people have to give for it, is nothing but labour. When the quantity of food is not sufficient for all, and when some are in danger of not getting any, each man is induced, in order to secure a portion to himself, to give better terms for it than any other men, that is, more labour. In other words, that part of the population who have nothing to give for food but labour, take less wages. This is the primary effect, clear, immediate, certain. It is only requisite farther to trace the secondary or derivative effects.

When we say, that in the case in which the supply of food has become too small for the population, the great body of the people take less wages, that is, less food, for their labour, we mean that they take less than is necessary for comfortable subsistence; because they would only have what is necessary for comfortable subsistence in the case in which the supply of food is not too small for the whole.

The effect, then, of a disproportion between the food and the population, is not to feed to the full measure that portion of the population which it is sufficient to feed, and to leave the redundant portion destitute; is to take, according to a certain rate, a portion of his due quantity from each individual of that great class who have nothing to give for it but ordinary labour.

What this state of things imports is most easily seen. The great class who have nothing to give for food but ordinary labour, are the great body of the people. When every individual in the great body of the people has less than the due quantity of food, less than would fall to his share if the quantity of food were not too small for the population, the state of the great body of the people is the state of sordid, painful, and degrading poverty. They are wretchedly fed, wretchedly clothed, have wretched houses, and neither time nor means to keep either their houses or their persons free from disgusting impurity. Those of them who, either from bodily infirmities, have less than the ordinary quantity of labour to bestow, or, from the state of their families, need a greater than the ordinary quantity of food, are condemned to starve; either wholly, if they have not enough to keep them alive, or partially, if they have enough to yield them a lingering, diseased, and, after all, a shortened existence.

What the ignorant and vulgar spectator sees in all this is not a redundant population, it is only a poor population. He sees nobody without food who has enough to give for it. To his eye, therefore, it is not food which is wanting, but that which is to be given for it. When events succeed in this train, and are viewed with these eyes, there never can appear to be a redundancy of population.

Events succeeded in a different train in the states of ancient Greece, and rendered a redundancy of population somewhat more visible, even to vulgar and ignorant eyes.

In ancient Greece, the greatest portion of the food was not bought by the great body of the people; the state of whom, wretched or comfortable, legislation has never yet been wise enough much to regard. All manual labour, or, at least, the far greatest portion of it, was performed, not by free labourers serving for wages, but by slaves, who were the property of the great men. The deficiency

Colony. of food, therefore, was not distributed in the shape of general poverty and wretchedness over the great body of the population, by reduction of wages; a case which affects, with very slight sensations, those who regard themselves as in no degree liable to fall into that miserable situation. It was felt, first of all, by the great men, in the greater cost of maintaining their slaves. And what is felt as disagreeable by the great men, is sure never to continue long without an effort, either wise or foolish, for the removal of it. This law of human nature was not less faithfully observed in the states of ancient Greece, for their being called republics. Called republics, they in reality were aristocracies; and aristocracies of a very bad description. They were aristocracies in which the people were cheated with an idea of power, merely because they were able, at certain distant intervals, when violently excited, to overpower the aristocracy in some one particular point; but they were aristocracies in which there was not one efficient security to prevent the interests of the many from being sacrificed to the interests of the few; they were aristocracies, accordingly, in which the interests of the many were habitually sacrificed to the interests of the few; meaning by the many, not the slaves merely, but the great body of the free citizens. This was the case in all the states of Greece, and not least in Athens. This is not seen in reading the French and English histories of Greece. It is not seen in reading Mitford, who has written a *History of Greece* for no other purpose but that of showing that the interests of the many always *ought* to be sacrificed to the interests of the few; and of abusing the people of Greece, because every now and then the many in those countries showed that they were by no means patient under the habitual sacrifice of their interests to those of the few. But it is very distinctly seen, among other occasions, in reading the Greek orators, in reading Demosthenes for example, in reading the oration against Midias, the oration on Leptines, and others, in which the license of the rich and powerful, and their means of oppressing the body of the people, are shown to have been excessive, and to have been exercised with a shameless atrocity, which the gentleness and modesty of the manners of modern Europe, even in the most aristocratically despotic countries, wholly preclude.

In Greece, then, any thing which so intimately affected the great men, as the growing cost of maintaining their slaves, would not long remain without serious attempts to find a remedy.

It was not, however, in this way alone that a redundant population showed itself in Greece. As not many of the free citizens maintained themselves by manual labour, they had but two resources more, the land, and profits of stock. Those who lived on profits of stock, did so commonly by employing slaves in some of the known arts and manufactures, and of course were affected by the growing cost of maintaining their slaves. Those who lived on the produce of a certain portion of the land, could not but exhibit very distinctly the redundancy of their numbers, when, by the multiplication of families, portions came to be so far subdivided, that what belonged to each individual was insufficient for his maintenance.

In this manner, then, it is very distinctly seen, why, to vulgar eyes, there never appears, in modern Europe, to be any redundancy of population, any demand for relieving the country by carrying away a portion of the people; and why, in ancient Greece, that redundancy made itself be very sensibly perceived; and created, at various times, a perfectly efficient demand for removing to distant places a considerable portion of the people.

But what if that redundancy of population which shows itself in modern Europe, in the effects of reduced wages, and a poor and starving people, should suggest to rulers the policy of ancient Greece, and some time or other recommend colonization? A few reflections may be well bestowed upon a supposition of this kind. Colony.

In the first place, it should be very distinctly understood what it is we mean when we say, in regard to such a country as Great Britain, for example, that the supply of food is too small for the population; because it may be said immediately, that the quantity of food may be increased in Great Britain, a proposition which no man will think of denying.

Let us suppose that, in any given year, this year for example, the food in Great Britain is too small for the people, by 10,000 individuals. It is no doubt true, that additional food sufficient to supply 10,000 individuals might be raised next year; but where would be the amelioration, if 10,000 individuals were at the same time added to the numbers to be fed? Now, the tendency of population is such as to make, in almost all cases, the real state of the facts correspond with this supposition. Population not only rises to the level of the present supply of food; but, if you go on every year increasing the quantity of food, population goes on increasing at the same time, and so fast, that the food is commonly still too small for the people. This is the grand proposition of Mr Malthus's book; it is not only quite original, but it is that point of the subject from which all the more important consequences flow; consequences which, till that point was made known, could not be understood.

When we say that the quantity of food in any country is too small for the quantity of the people, and that, though we may increase the quantity of food, the population will at the same time increase so fast that the food will still be too small for the people; we may be encountered with another proposition. It may be said, that we may increase food still faster than it is possible to increase population. And there are situations in which we must allow that the proposition is true.

In countries newly inhabited, or in which there is a small number of people, there is commonly a quantity of land, yielding a large produce for a given portion of labour. So long as the land continues to yield in this liberal manner, how fast soever population increases, food may increase with equal rapidity, and plenty remain. When population, however, has increased to a certain extent, all the best land is occupied; if it increases any farther, land of a worse quality must be taken in hand; when land of the next best quality is all exhausted, land of a still inferior quality must be employed, till at last you come to that which is exceedingly barren. In this progress it is very evident that it is always gradually becoming more and more difficult to make food increase with any given degree of rapidity, and that you must come at last to a point where it is altogether impossible.

It may, however, be said, and has been said in substance, though not very clearly, by some of Mr Malthus's opponents, that it is improper to speak of food as too small for the population, so long as food can be made to increase at an equal rate with population; and though it is no doubt true that, in the states of modern Europe, food does not actually increase so fast as the population, and hence the poverty and wretchedness of the people; yet it would be very possible to make food increase as fast as population, and hence to make the people happy without diminishing their numbers by colonization; and it is owing to unfavourable, or to ill-contrived institutions, that such is not the effect universally experienced.

As this observation has in it a remarkable combination of truth and error, it is worthy of a little pains to make the separation.

Colony. There can be no doubt that, by employing next year a greater proportion of the people upon the land than this year, we should raise a greater quantity of food; by employing a still greater proportion the year following, we should produce a still greater quantity of food, and, in this way, it would be possible to go on for some time, increasing food as fast as it would be possible for the population to increase. But observe at what cost this effect would be attained. As the land yields gradually less and less to every new portion of labour, it would be necessary to employ, gradually, not only a greater and greater *number*, but a greater and greater *proportion* of the people in raising food. But the greater the proportion of the people which is employed in raising food, the smaller is the proportion which can be employed in producing any thing else. You can only, therefore, increase the quantity of food, to meet the demand of an increasing population, by diminishing the supply of those other things which minister to human desires.

There can be no doubt that, by increasing every year the proportion of the population which you employ in raising food, and diminishing every year the proportion employed in every thing else, you may go on increasing food as fast as population increases, till the labour of a man upon the land is just sufficient to add as much to the produce as will maintain himself and raise a family. Suppose, where the principle of population is free from all restriction, the average number of children reared in a family is five; in that case, so long as the man's labour, added to the labour already employed upon the land, can produce food sufficient for himself and the rearing of five children, food may be made to keep pace with population. But if things were made to go on in such an order till they arrived at that pass, men would have food, but they would have nothing else. They would have neither clothes, nor houses, nor furniture. There would be nothing for elegance, nothing for ease, nothing for pleasure. There would be no class exempt from the necessity of perpetual labour, by whom knowledge might be cultivated, and discoveries useful to mankind might be made. There would be no physicians, no legislators. The human race would become a mere multitude of animals, of a very low description, having just two functions, that of raising food, and that of consuming it.

To shorten this analysis, let us then assume what will hardly be disputed, that it is by no means desirable for human nature to be brought into a situation in which it would be necessary for every human being to be employed, and fully employed, in the raising of food; that it never can be desirable that more than a certain proportion should be employed in the raising of food; that it must for ever be desirable that a certain proportion should be employed in producing other things which minister to human desires; and that there should be a class possessed of leisure, among whom the desire of knowledge may be fostered, and those individuals reared who are qualified to advance the boundaries of knowledge, and add to the powers and enjoyments of man.

It is useless, then, to tell us that we have the physical power of increasing food as fast as population. As soon as we have arrived at that point at which the due distribution of the population is made between those who raise food and those who are in other ways employed in contributing to the well-being of the members of the community, any increase of the food faster than is consistent with that distribution can only be made at the expense of those other things, by the enjoyment of which the life of man is preferable to that of the brutes. At this point the progress of population ought undoubtedly to be restrained. Population may still increase, because the quantity of food may still be capable of being increased, though not beyond a certain slowness of rate, without requiring to the production of it a greater than the due proportion of the population. Colony

Suppose, then, when the due proportion of the population is allotted to the raising of food, and the due proportion to other desirable occupations, that the institutions of society were such as to prevent a greater proportion from being withdrawn from those occupations to the raising of food. It would, surely, be very desirable that the institutions of society should secure this important object. If population, in that case, should go on at its full rate of increase, or, in other words, faster than with such a distribution of the population it would be possible for food to be increased, what would be the consequences? The answer is abundantly plain. All those effects would take place which have already been described as following upon the existence of a redundant population in modern Europe, and in all countries in which the great body of those who have nothing to give for food but labour, are free labourers. Wages would fall; poverty would overspread the population; and all those horrid phenomena would exhibit themselves which are the never-failing attendants on a poor population.

It is of no great importance though the institutions of society may be such as to make the proportion of the population kept back from the providing of food rather greater than it might be. All that happens is, that the redundancy of population begins a little earlier. The unrestrained progress of population would soon have added the deficient number to the proportion employed in the raising of food; and, at whatever point the redundancy begins, the effects are always the same.

What are the best means of checking the progress of population, when it cannot go on unrestrained, without producing one or other of two most undesirable effects, either drawing an undue proportion of the population to the mere raising of food, or producing poverty and wretchedness, it is not now the time to inquire. It is, indeed, the most important practical problem to which the wisdom of the politician and moralist can be applied. It has, till this time, been miserably evaded by all those who have meddled with the subject, as well as by all those who were called upon by their situation to find a remedy for the evils to which it relates. And yet, if the superstitions of the nursery were discarded, and the principle of utility kept steadily in view, a solution might not be very difficult to be found; and the means of drying up one of the most copious sources of human evil, a source which, if all other sources of evil were taken away, would alone suffice to retain the great mass of human beings in misery, might be seen to be neither doubtful nor difficult to be applied.

The only question to which we are here required to find an answer, is that of colonization. When the population of a country is full, and its increase cannot go on at its most rapid pace, without producing one of the two evils of redundancy, a portion of the people, sent off to another country, may create a void; and till this is filled up, population may advance as rapidly as before, and so on for any number of times.

In certain circumstances, this is a better resource than any scheme for diminishing the rate of population. So long as the earth is not peopled to that state of fulness which is most conducive to human happiness, it contributes to that important effect. It is highly desirable, on many accounts, that every portion of the earth, the physical circumstances of which are not inconsistent with human well-being, should be inhabited, as fully as the conditions of human happiness admit. It is only in certain

Colony

circumstances, however, that a body of people can be advantageously removed from one country for the purpose of colonizing another. In the first place, it is necessary that the land which they are about to occupy should be capable of yielding a greater return to their labour than the land which they leave; otherwise, though relief is given to the population they leave behind, their own circumstances are not better than they would have been had they remained.

Another condition is, that the expense of removal from the mother country to the colonized country should not be too great; and that expense is usually created by distance.

If the expense is too great, the population which remains behind in the mother country may suffer more by the loss of capital than it gains by the diminution of numbers.

It has been often enough, and clearly enough, explained, that it is only capital which gives employment to labour; we may, therefore, take it as a postulate. A certain quantity of capital, then, is necessary to give employment to the population which any removal for the sake of colonization may leave behind. But if, to afford the expense of that removal, so much is taken from the capital of the country that the remainder is not sufficient for the employment of the remaining population, there is, in that case, a redundancy of population, and all the evils which it brings. For the well-being of the remaining population, a certain quantity of food is required, and a certain quantity of all those other things which minister to human happiness. But to raise this quantity of food, and this quantity of other things, a certain quantity of capital is indispensably necessary. If that quantity of capital is not supplied, the food and other things cannot be obtained.

On the subject of that class of colonies, in the conception of which the idea of the people is the predominating idea, we have now explained the principle which is exemplified in the Roman, and that which is exemplified in the Grecian cases; belonging to the same class there are British colonies, in which another and a very remarkable principle is exemplified. The Greeks planted colonies for the sake of getting rid of a redundant population; the British, for the sake of getting rid of a delinquent population.

3. The brilliant idea of a colony for the sake of getting rid of a delinquent population, if not peculiar to English policy, is, at any rate, a much more remarkable part of the policy of England than of that of any other country. We have not time here to trace the history of this singular portion of English policy; nor is it of much importance. Every body knows, that this mode of disposing of delinquents was carried to a considerable height before this country lost her dominion over the North American colonies, to which she annually transported a considerable number of convicts. It will suffice, for the present occasion, to offer a few observations on the nature of such an establishment as that of New South Wales.

Considered in the light of its utility as a territory, the colony of New South Wales will be included in the investigation of that class of colonies, in the conception of which the idea of territory is the predominating idea. At present it is to be considered in its capacity of a place for receiving the delinquent part of the British population.

In dealing with a delinquent population, the end to be aimed at, the security of the non-delinquent, embraces two particulars; security from the crimes of this or that individual delinquent himself, and security from those of other men who may be tempted to follow his example.

The first object is comparatively easy. It is not difficult to prevent an individual from doing any mischief. What is chiefly desirable is, that the individual who is proved to be a delinquent, should be so dealt with, that the mode of dealing with him may be as effectual as possible in deterring others from the commission of similar offences. Colony.

In pursuit of the first object, securing society from the crimes of the convicted individual, there is a good mode and a bad mode. The best of all modes, unquestionably, is the reformation of the offender. Wherever this can be accomplished, every other mode, it is evident, is a bad one. Now, in regard to the reformation of the offender, there is but one testimony, that New South Wales, of all places on the face of the earth, except, perhaps, a British prison, is the place where there is the least chance for the reformation of an offender, the greatest chance of his being improved and perfected in every species of wickedness.

If it be said, that taking a man to New South Wales at any rate affords to the British community security against the crimes of that man, we may answer, that putting him to death would do so. And we further pronounce, that saving a man from death, with the mind of a delinquent, and sending him to New South Wales, to all the effects of his vicious propensities, is seldom doing even him any good.

It is, however, not true that sending a delinquent to New South Wales secures the British community from his future offences. A very great proportion of those who are sent to New South Wales find the means of returning; and those who do so are in general, and may always be expected to be, the very worst.

We have a high authority for this affirmation. The committee of the House of Commons, who were appointed in the session of 1812 " to inquire into the manner in which sentences of transportation are executed, and the effects which have been produced by that mode of punishment," stated solemnly in their report, that " no difficulty appears to exist among the major part of the men who do not wish to remain in the colony, of finding means to return to this country. All but the aged and infirm easily find employment on board the ships visiting New South Wales, and are allowed to work their passage home. But such facility is not afforded to the women. They have no possible method of leaving the colony, but by prostituting themselves on board the ships whose masters may choose to receive them. They who are sent to New South Wales, that their former habits may be relinquished, cannot obtain a return to this country, but by relapsing into that mode of life which, with many, has been the cause of all their crimes and misfortunes. To those who shrink from these means, or are unable, even thus, to obtain a passage for themselves, transportation for seven years is converted into a banishment for life; and the just and humane provisions of the law, by which different periods of transportation are apportioned to different degrees of crime, are rendered entirely null."

So much, then, with regard to the reformation of the individual, and security from his crimes, neither of which is attained, But, even on the supposition that both were ever so completely attained, there would still be a question of great importance, namely, whether the same effects could not be attained at a smaller expense? It never ought to be forgotten that society is injured by every particle of unnecessary expense; that one of the most remarkable of all the points of bad government is that of rendering the services of government at a greater than the smallest possible expense; and that one of the most remarkable of all the points of good government is that of rendering every service which it is called upon to render, at the smallest possible expense.

In this respect, also, the policy of the New South Wales establishment is faulty beyond all endurance. The cost

Colony. of disposing in this way of a delinquent population is prodigious. We have no room for details, and there is no occasion for proof, the fact is notorious; whereas, on the contrary, it is now well known that, in houses of industry and reformation upon the best possible plan, that, for example of Mr Bentham's *Panopticon*, which has no parallel, there is little or no expense, there is perfect security against the future crimes of the delinquent, and that to a great degree, by the best of all possible modes, his reformation.

If the mode of dealing with a delinquent according to such an institution as that of New South Wales is thus wretched, as far as regards the securing of the community from the future crimes of the convicted delinquent, it is not less so in what regards the deterring of all other men from following similar courses to those of the delinquent.

It is very evident that this last is by far the most important of the two objects. It is now agreed that this is the end, the only good end, of all punishment properly so called; for mere safe custody and satisfaction to the injured party are not, in the proper sense of the word, punishments; they are for other ends than punishment, in any point of view in which it is ever contemplated.

The great importance of this above the previous case consists in this, that when you take security against the crimes of the convicted delinquent, you take security against the crimes of only one man, and that a man in your hands, with whom you can deal as you please. When, by means of the mode of dealing with him, you deter all other men from following similar courses, you provide security, not against one man alone, but many men, any number of men, of men undetected, and not in your power, each of whom may be guilty of many crimes before he can be stopped.

On this point it is only necessary, for form's sake, to write down what is the fact; for every human being of common reflection must anticipate the observation before it is made. If an assembly of ingenious men, in the character of legislators, had taken pains to devise a method of dealing with delinquents, which, while it had some appearance of securing society from the crimes of the detected individual, should be, to the greatest possible degree, devoid both of the reality and even the appearance of any efficacy of deterring other men from the pursuit of similar courses, they could not have devised any thing better calculated for that preposterous end than the colony of New South Wales. Nothing can operate where it is not. The men to be operated upon are in England; the example which should operate is in New South Wales. Much more might be said, but it is unnecessary. In the great majority of cases a voyage to New South Wales has not even the appearance of a punishment. Men of that description have neither friends nor affections. They leave behind nobody whom they like, and nobody who likes them. What is it to such men that they are for a while or for ever taken away from England, along very frequently with the only sort of persons with whom they have any connection, the companions of their debaucheries and of their crimes?

Sect. II.—*Of Colonies, in the conception of which the idea of Territory is the predominating idea.*

Of this sort are most of the colonies of the states of modern Europe; the British possessions, for example, in the East and West Indies.

The question is, in what way or ways, abstracting from the questions of population, an outlying territory, considered merely as territory, is calculated to become advantageous; or, in other words, what reasons can any country have for desiring to possess the government of such territories? Colony.

There are two ways which will easily present themselves to every mind, as ways in which advantage may accrue to the governing country. First, these outlying dominions may yield a tribute to the mother country, secondly, they may yield an advantageous trade.

1. *Where Tribute to the Mother Country is the benefit she proposes.*

This will not require many words, as few persons are much in error on the subject. In regard to the West Indies, no such idea as that of a tribute has ever been entertained. Even in regard to those taxes which a vain and unprofitable attempt was made to impose upon the formerly existing colonies in North America, they were never dreamt of as a tribute, and never spoken of but in a sense contrary to the very idea of a tribute, that of reimbursing to the mother country a part, and no more than a part, of that which they cost her in governing and defending them.

With regard to the East Indies, we believe, there exists more or less of prejudice. Under the ignorance in which Englishmen have remained of East India affairs, it floats in the minds of a great many persons, that, somehow or other, a tribute, or what is equivalent to a tribute, does come from the East Indies. Never did an opinion exist more completely without evidence, contrary to evidence, evidence notorious, and well known to the persons themselves by whom the belief is entertained. India, instead of yielding a tribute to England, has never yielded enough for the expense of its own government. What is the proof? That its government has always been in debt, and has been under the necessity of continually augmenting its debt, till it has arrived at a magnitude which it has often itself described as alarming.

So far is India from yielding a tribute to Great Britain, that, in loans and aids, and the expense of fleets and armies, it has cost this country enormous sums. It is no doubt true, that some acts of parliament have assumed the existence of a tribute from India, or what has been called a surplus revenue, for the use of the nation. But parliament, we have pretty good experience, cannot make things by affirming them. *Things* are a little more stubborn than the credulity of Englishmen. That, in general, is obedient enough to the affirmations of those who lead the parliament, and who have sometimes an interest in leading it wrong. *Facts* take their own course, without regard to the affirmations of parliament, or the plastic faith of those who follow them.

A general proposition on this subject may be safely advanced. We may affirm it, as a deduction from the experienced laws of human society, that there is, if not an absolute, at least a moral impossibility, that a colony should ever benefit the mother country by yielding it a permanent tribute.

Let any body but consider what is included in the word government; and when he has done that, let him then tell himself that the colonies must be governed. If he has the sufficient degree of knowledge and reflection, no further proof will be necessary.

No proposition in regard to government is more universal, more free from all exception, than this, that a government always spends as much as it finds it possible or safe to extract from the people. It would not suit the limits of the present design, to run over the different governments of the world for the experimental proof of this proposition. We must invite every reader to do it for himself. Of one thing we are perfectly sure, that the

Colony. more profoundly he is read in history, the more thoroughly will he be convinced of the universality of the fact.

Now, then, consider whether this universal fact be not inconsistent with the idea of a tribute from a colony. The government of the mother country itself cannot keep its expenses within bounds. It takes from the people all it can possibly take, and is still going beyond its resources. But if such is the course of government at home, things must be worse in the colonies. The farther servants are removed from the eye of the master, the worse, generally speaking, their conduct will be. The government of the colonies, managed by delegates from home, is sure to be worse, in all respects, than the government at home; and, as expense is one of the shapes in which the badness of government is most prone to manifest itself, it is sure, above all things, to be in proportion to its resources more expensive. Whatever springs operate at home to restrain the badness of government, cannot fail to operate with diminished force at the distance of a colony. The conclusion is irresistible. If the government of the mother country is sure to spend up to the resources of the country, and if a still stronger necessity operates upon the government of the colony to produce this effect, how can it possibly afford any tribute?

If it be objected to this conclusion, that this propensity of governments to spend may be corrected, we answer, that this is not the present question. Take governments as, with hardly any exception, they have always been [this is a pretty wide experience], and the effect is certain. There is one way, to be sure, of preventing the great evil, and preventing it thoroughly; but there is only one. In the constitution of the government, make the interest of the many to have the ascendency over the interest of the few, and the expense of government will not be large. The services expected from government may, generally speaking, be all rendered in the best possible manner, at very little expense. Whenever the interests of the many are made, in the framing of governments, to have the ascendency over the interests of the few, the services of government will always be rendered at the smallest possible expense. So long as the interests of the few are made to have the ascendency over the interests of the many, the services of government are all sure to be rendered at the greatest possible expense. In almost all governments that have ever yet existed, the interest of the few has had an ascendency over the interests of the many. In all, the expense of government has, accordingly, been always as great as, in existing circumstances, the people could be made, or could be made with safety, to give the means of making it.

One other supposition may be urged in favour of the tribute. The expense, it may be said, of governing the colony by a deputation from the mother country may be escaped by allowing the colony to govern itself. In that case the colony will not choose to pay a tribute. If the tribute rests upon the ground of friendship, it will not be lasting. If the mother country extorts it by force, the colony is, in fact, governed by the mother country; and all the expense of that mode of government is insured. If it be urged that the colony may continue to pay a tribute to the mother country, and that voluntarily, because the mother country may be of use to it; that, we may answer, is a bargain, not a tribute. The mother country, for example, may yield a certain portion of defence. But the colony is saved from the expense of providing for itself that defence which it receives from the mother country, and makes a good bargain if it gets it from the mother country cheaper than it could be provided by itself. In this case, too, the expense incurred by the mother country is apt to be a very full equivalent for the tribute received. It is evident that this sort of bargain may subsist between any two states whose circumstances it may suit, and is not confined to a mother and daughter country. It is, therefore, no part of the question relating to colonies. Colony.

2. *Where Profits of Trade are the advantage sought by the Mother Country.*

We have now investigated the first of the modes in which a colony, considered as territory merely, may be expected to benefit the mother country; and we have seen the chances of good which it affords. The second of these modes, namely, the trade, by means of which it is supposed that colonies may benefit the mother country, is a topic of some importance; for it is on account of the trade that colonies have remained an object of affection to Englishmen. It is on account of trade solely that the colonies in the West Indies are valued; and though an idea of something like a tribute from the East Indies has till this time maintained a place in the minds of the unthinking part of the community, still it is the trade which has been supposed to be the principal source of the advantage which has been ascribed to what we call "the British empire in the East."

In the idea of deriving a peculiar advantage from the trade of the colonies, is necessarily included the idea of monopoly. If the trade of the colony were free, other nations would derive as much advantage from it as the mother country; and the mother country would derive as much advantage from it if the colony were not a colony.

Dr Smith affirms that this monopoly can never be of any advantage—must always, on the contrary, be a source of great disadvantage to the mother country.

If the trade of the colony is left open to all the merchants of the mother country, it will no doubt happen that the competition of these merchants, one with another, will make them sell as cheap in the colony as they can afford to sell, that is, buy as dear as they can afford to buy. The produce of the colony will, in that case, go as cheap to the foreign as to the home consumer.

There is another case, namely, that in which the trade of the colony is placed in the hands of an exclusive company. In that case it is true that the mother country may obtain a great quantity of the goods of the colony for a less quantity of her own than otherwise she would do. The goods of the mother country are in that case placed, with regard to the goods of the colony, in the situation in which those commodities which can only be produced in a limited quantity, particular wines, for example, which can only be produced on one particular spot, are placed with regard to all the rest of the goods in the world. It is evident that any quantity of the rest of the goods in the world may be given for those wines, if people are sufficiently desirous to possess them; that there is no limit, in short, to that quantity, but the unwillingness of people to part with more of the things which they possess, to obtain the commodities which are thus in request. The same would be the case with a colony, the trade of which was entirely in the hands of an exclusive company. The exclusive company, by limiting the quantity of the goods of the mother country which they chose to send to the colony, might compel the colonists to give for that limited quantity any quantity of the produce of their own land and labour which their desire to obtain the goods of the mother country would admit. If the goods of the mother country were goods which excited a very strong desire, if they were goods of the first necessity, the necessary materials of food or the instruments of their industry, there would be no limit but one to the greatness of the quantity of their own produce, which they might

Colony. be compelled to pay for a given quantity of the produce of the mother country. When nothing was left to the colony of the whole produce of its labour, but just enough to keep the labourers alive, it could not go any farther. Up to that point, if dependent for articles of the first necessity, it might, by an exclusive company, undoubtedly be stript.

Even where the monopoly is not confined to an exclusive company, but extended to all the merchants of the mother country, she might still, in one supposable case, draw an ordinary advantage from the trade of the colony.

The facts would be these. Whatever foreign goods the colony bought, she would still be obliged to purchase from the mother country. No doubt, the competition of the merchants of the mother country would, in this case, compel them to sell as cheap to the colony as to any other country. Wherein, then, would consist the advantage? In this, that England might thus sell in the colony, with the usual profits of stock, certain kinds of goods, which not being able to manufacture so cheaply as some other countries, she would cease to manufacture, except for the monopoly. But still a very natural question arises: What advantage does she derive from forcing this manufacture, since she makes by it no more than the ordinary profits of stock, and might make the ordinary profits of stock by the same capital in some other employment? The answer is, that she might, by this means, obtain a greater quantity of the goods of the colony by a given quantity of the produce of her own labour, or, what comes to the same thing, an equal quantity of the goods of the colony by a less quantity of the produce of her own labour, than she could in a case of freedom.

It may be seen to be so in this manner. England desires to purchase, say 10,000 hogsheads of sugar. This is her consumption. For this she will give, of the produce of her own labour, whatever quantity it is necessary to give. She wishes, however, to give as little as possible; and the question is, in what way she may give the least. The sugar is worth, say L.500,000. England sends goods to the colony which sell for L.500,000. Now, apply the supposition introduced above. Suppose that, if trade were free, these goods from England, which the manufacturers and merchants of England cannot afford to sell for less than L.500,000, could be had for L.400,000 from some other country. In that case it is evident, that the same quantity of these same goods with which England, under the monopoly, purchased 10,000 hogsheads of sugar, would now purchase only 8000; for that is the ratio of the L.400,000 to the L.500,000. What then would happen, supposing England still to resolve upon having 10,000 hogsheads of sugar? One of two things must of necessity happen. Either she will purchase the sugar with the same goods, or she will not. If she purchase it with the same goods, it is evident that she must give a greater quantity of goods; she must give one fifth more of the produce of her labour; one fifth more of her industrious people must be withdrawn from administering to other productions, and employed in enabling her to obtain the same quantity of sugar. This quantity of produce, in that case, the mother country saves by means of the monopolized trade of the colony; this quantity she loses by losing such a colony. But undoubtedly the mother country would, in such a case, endeavour to purchase the sugar, not with such goods as she purchased it with before, but with other goods. She would endeavour to purchase it with goods which she could manufacture as cheaply as any other country; but supposing the colony had no demand for any goods which the mother country could afford as cheap as any other country, even in that case the mother country would still have a resource. If there was any country in which she could sell such goods for money, she could purchase the same quantity of sugar for the same quantity of the produce of her own labour as before. Colony.

It is not then true, according to Dr Smith, that in no case can the mother country derive any peculiar advantage in the way of trade, from the possession of colonies. We see that there are two cases in which she may derive an advantage in that way. It remains to inquire what that advantage is ultimately worth; not only what it is in itself independently, but what it is, after compensation is made for all the disadvantages with which the attainment of it is naturally attended.

We are first to inquire what is the value of that advantage, all deductions made, which the mother country may derive, through an exclusive company, from the trade of a colony?

It is very evident, in the first place, that whatever the mother country gains the colony loses. Now, if the colony were part of the dominions of a foreign state, there is a certain way of viewing such questions, in which that result would appear to be perfectly desirable; but, suppose that the colony, which is the fact, is not part of the dominions of a foreign state, but of the same state; that it is, in truth, not part of a different country, but of the same country; its subjects not part of a different community, but of the same community; its poverty or riches not the poverty or riches of another country, but of the same country. How is the result to be viewed in that case? Is it not exactly the same sort of policy as if Yorkshire were to be drained and oppressed for the benefit of Middlesex? What difference does it make, that one of the portions of the same empire is somewhat farther off than another? Would it, for that reason, be more rational to pillage Caithness than to pillage Yorkshire for the sake of Middlesex? Does the wealth of a state consist in the wealth of one part, effected by the misery of another? What opinion must we form of such a rule for guiding the policy of state? Assuredly this would be a contrivance not for increasing her wealth and happiness upon the whole: it would be a contrivance for diminishing it. In the first place, when, from one or two parties, equally provided with the means of enjoyment, you take a portion to give it to the other, the fact is,—a fact too well established, and too consonant with the experience of every man, to need illustration here,—that you do not add to the happiness of the one so much as you take from the happiness of the other, and that you diminish the sum of the happiness of the two taken together. This in truth is the foundation upon which the laws for the protection of property rest. As the happiness of one man is, or ought to be, of no more value to the state than the happiness of another man, if the man who takes from another man a part of his property, added to his own happiness as much as he took from the happiness of the other, there would be no loss of happiness upon the whole, and the state would have no ground in utility on which to interfere.

But this is not all. Not only is the quantity of happiness diminished upon the whole, but by that operation which gives the mother country an advantage by the trade of the colony, the quantity of produce of the community is diminished upon the whole. The subjects of the state, taken as a whole, not only enjoy less than they would otherwise enjoy, but they produce less than they would otherwise produce. The state is not a richer state; it is, on the contrary, a poorer state, by means of such a colonial policy.

By means of such a policy, a portion of the capital of the state is employed in a channel in which it is less productive than it would have been in the channel into which it would have gone of its own accord. It is a point esta-

Colony. blished in the science of political economy, that it is not good policy to confine consumption to any sort of home manufacture, when it can be purchased more cheaply abroad. It is upon this ground that we have laughed at the late and present outcries of the Germans, because the English sell their goods cheaper than they can make them. The reason is, because when a country continues to consume an article made at home, which it could get cheaper from another country, it does neither more nor less than insist that it shall employ a certain number of men's labour in providing it with that article, more than it would be necessary to employ if it imported the article; and, of course, it loses completely the benefit of these men's labour, who would otherwise be employed in producing for it something else. The country is, therefore, the poorer by the whole value of these men's labour. The case is exactly the same where the colonies are confined to the manufactures of the mother country. When the colony is obliged to employ, for the purpose of obtaining a certain quantity of goods from the mother country, the labour of a greater number of men than she would be obliged to employ to get the same quantity of goods from another country, she loses the labour of all that additional number of men. At the same time the mother country does not gain it; for if the mother country did not manufacture for the colony, her capital would be liberated to another employment, and would yield the same profits in that as it did in the former employment.

We have still, however, to examine that extraordinary case which we before supposed, in which the mother country cannot produce any sort of commodity whatsoever as cheap as other countries, and, if trade were free, of course would sell nothing in a foreign market. The case here is somewhat altered. In liberating the colony from the monopoly of the mother country, there would be no change of capital from a less to a more productive employment; because, by the supposition, the mother country has not a more productive employment to which her liberated capital can be sent. Events would succeed in the following order: The colony would obtain the goods which it demanded, with a smaller portion of its own labour, and would hence be more amply supplied with goods. But it is not supposed that this event would give to its industry a more beneficial direction. In the case of a sugar colony, at any rate, its industry would remain in the same channels as before. Such would be the effects in regard to the colony. What would they be in regard to the mother country? If her capital is no longer employed in manufacturing for the colony, she can always, indeed, employ it with the same profit as before. But she still desires the same quantity of sugar, and her goods will not go so far as before in the purchase of it. Whatever fall would be necessary in the price of her goods to bring them upon a level with the goods of other countries, is equivalent, as far as she is concerned, to a rise of the same amount in the price of sugar. In this case the mother country would lose exactly as much as the colony would gain. The community, taken as a whole, would be neither the richer nor the poorer for driving the things out of the free into the compulsory channel. The people of the mother country would be so much the richer, the people of the colony would be so much the poorer.

This, however, still remains to be said. There is only one case in which this sort of monopoly would not diminish the produce of the community, and render it positively poorer upon the whole. There is only that one case, supposed above, in which the mother country has not one commodity which she can sell as cheap as other countries. Now this may fairly be regarded as a case, if not altogether, at any rate very nearly, impossible. It is not easy to conceive a country so situated, as not to have advantages in Colony. regard to the production of some sorts of commodities, which set her on a level with other countries. As long as this is the case, she can obtain money on as good terms as any other country; and if she can obtain money on as good terms, she can obtain sugar, and every thing else.

The question, then, as to the benefit capable of being derived from a colony through the medium of an exclusive trade, is now brought to a short issue. There is no benefit except through the medium of a monopoly. There is only one case in which the monopoly does not make the whole community poorer than it would otherwise be. In that case, it does not make the community richer than it would otherwise be; and that case is one which can either never be realized, or so rarely, as to be one of the rarest of all exceptions to one of the most constant of all general rules. The policy of holding a colony for the benefit of its trade, is, therefore, a bad policy.

To these conclusions one or two of the doctrines of Dr Smith will be seen to be opposed, and, therefore, require a few words of elucidation.

If an advantage, in the two cases just explained, would arise from colonies, it would be counterbalanced, he says, by the disadvantage attending the rise in the profits of stock.

Both parts of this doctrine may be disputed. In the first place, it may be disputed whether the monopoly of the colony trade has any tendency to raise the profits of stock in the mother country. In the next place, it may be disputed whether a high rate of profits in any country has any tendency to lay it under any disadvantage in its traffic with other nations.

First, it may be disputed whether the monopoly of the colony trade would increase the profits. The expulsion of foreign capital would create a vacuum, whence, according to Smith, a rise of profit, and an absorption of capital from the mother country. The question is, whether capital would not flow into the colonies from the mother country, till it reduced the profits in the colony to the level of the profits in the mother country, instead of raising those in the mother country in any degree toward a level with those of the colony. That it would do so, appears to be capable of demonstration. Mr Ricardo's argument would be very short. Nothing, he would say, can raise the profits of stock, but that which lowers the wages of labour. Nothing can lower the wages of labour, but that which lowers the necessaries of the labourer. But nobody will pretend to say that there is any thing in the monopoly of the colony trade which has any tendency to lower the price of the necessaries of the labourer. It is, therefore, impossible that the monopoly of the colony trade can raise the profits of stock. By those who are acquainted with the profound reasonings of Mr Ricardo, in proof of the two premises, this argument will be seen to be complete. There is not a demonstration in Euclid, in which the links are more indissoluble. To those who are not acquainted with those reasonings, we are aware that the propositions will appear mysterious; and yet we are afraid that, in the few words to which we are confined, it will not be possible to give them much satisfaction.

With regard to the last of the two propositions, that nothing can lower the wages of labour but that which lowers the necessaries of the labourer, we may confine ourselves to that combination of circumstances which marks the habitual state, without adverting to the modifications exemplified in those states of circumstances which are to be regarded as exceptions. The habitual state of population is such, that wages are at the lowest terms; and cannot be reduced lower without checking population, that is, reducing the number of labourers. In this case, it is self-evi-

Colony. dent that nothing can lower the wages of labour but lowering the necessaries of the labourer. In all, then, except the extraordinary cases, which it would require too many words here to explain, in which a country is but partially peopled, and in which part of the best land is still unemployed, the proposition of Mr Ricardo is indisputable, that nothing can lower the wages of labour except a fall in the necessaries of the labourer.

Let us next consider the proposition, that nothing can raise the profits of stock but that which lowers the wages of labour.

One thing is perfectly clear, that if the whole of what is produced by the joint operations of capital and labour were, whatever it is, divided, without deduction, between the owner of the stock and the labourers whom it employs, in that case, whatever raised the wages of labour would lower profits of stock, and profits of stock could never rise, except in proportion as wages of labour fell. The whole being divided between the two parties, in whatever proportion the one received more, it is certain that the other would receive less.

But what is here put in the way of supposition, namely, that the whole of what is produced by the joint operations of capital and labour, is divided between the capitalists and the labourers, is literally and rigidly the fact. It is, then, undeniable, that nothing can raise the profits of stock but that which lowers the wages of labour.

The whole produce, without any exception, of every country, is divided into three portions, rent, wages, and profits. If there were no rent, and the whole were divided into profits and wages, the case would be clear; because nothing could be added to the one without being detracted from the other.

Rent, however, does, in reality, make no difference. Rent is no part of the joint produce of labour and capital. It is the produce, exclusively, of a particular degree of fertility in particular lands; and is yielded over and above a return to the whole of the labour and capital employed upon that land, over and above a return equal to the joint produce of an equal portion of labour and capital in any other employment.

So much, then, for Dr Smith's opinion, that the monopoly of the colonial trade raises the profits of stock. Let us next inquire if it be true, that a rise in the profits of stock, if it were produced by the monopoly, would occasion, as he supposes, any discouragement to the foreign trade of the mother country.

It would occasion this discouragement, he says, by raising prices. If, then, it can be shown that it would certainly not raise prices, every reason for supposing that it would afford any discouragement to foreign trade is taken away. But that a high rate of profits does not and cannot raise prices, is evident from what has been deduced above. The whole produce of the joint operations of labour and capital being divided between profits and wages, in whatever degree profits rise, wages fall; the cost of production remains the same as before.

Not only does a variation in the state of wages and profits give no obstruction to foreign trade,—a variation even in the cost of production gives no obstruction. A nation exports to another country, not because it can make cheaper than another country; for it may continue to export, though it can make nothing cheaper. It exports, because it can, by that means, get something cheaper from another country than it can make it at home. But how can it, in that case, get it cheaper than it can make it at home? By exchanging for it something which costs it less labour than making it at home would cost it. No matter how much of that commodity it is necessary to give in exchange. So long as what it does give is produced by less labour than the commodity which it gets for it could be produced by at home, it is the interest of the country to export. Suppose that the same quantity of corn which is produced in England by the labour of one hundred men, England can purchase in Poland with a quantity of cotton goods which she has produced with the labour of ninety men; it is evident that England is benefited by importing the corn and exporting the cotton goods, whatever may be the price of the cotton goods in Poland, or the cost of producing them. Suppose that the cotton goods could be produced in Poland with the labour of eighty-five men, that is, less than they are supposed to be produced with in England. Even that would not hinder the trade between them. Suppose that the same quantity of corn which is raised in England with the labour of one hundred men, is raised in Poland with the labour of eighty; in that case, it is plain that Poland can get with eighty men's labour, through the medium of her corn, the same quantity of cotton goods, which would cost her the labour of eighty-five men, if she was to make them at home. Both nations, therefore, profit by this transaction,—England to the extent of ten men's labour, Poland to the extent of five men's labour; and the transaction, in a state of freedom, will be sure to take place between them, though England is less favourably situated than Poland with regard to both articles of production. Colony.

In what manner this class of transactions is affected by the intervention of the precious metals—in what manner the precious metals distribute themselves, so as to leave the motives to this barter exactly the same as they would be if no precious metal intervened—it would require too many words here to explain. The reader who recurs for that explanation to Mr Ricardo, the first author of it, will not lose his time or his pains.

One other disadvantage of the colony trade is adduced by Dr Smith. It turns the capital of the country out of a more into a less profitable employment, by turning it from the home to a foreign trade; from a foreign of quick to a foreign of slow returns; and from a foreign to a carrying trade. This doctrine, too, requires some explanation, and more, to be sufficiently clear, than can here be bestowed upon it. The home trade is not necessarily more advantageous than the foreign; nor the foreign of quick, than the foreign of slow returns; nor any of them all, than the carrying trade. These trades, it may be allowed, increase the gross produce of a country, in the order in which Dr Smith has arranged them. But a country is happy and powerful, not in proportion to its gross, but in proportion to its net revenue; not in proportion to what it consumes for the sake of production, but to what it has over and above the cost of production. This is an important fact, which, in almost all his reasonings, Dr Smith has overlooked. It will hardly, however, be denied, that in various circumstances, any one of these trades, the carrying trade itself, may be more conducive to a net revenue than any of the rest, and in a state of freedom will be sure to be so, as often as the interest of individuals draws into that channel any portion of the national stock.

We have now, therefore, considered all those cases which, in the study of colonial policy, can be regarded in the light of *species* or classes. There are one or two singular cases, which are of sufficient importance to require a separate mention.

3. *Where Maritime Strength is the object sought by the Mother Country.*

That English law which established the monopoly of the colonies, at least of the transatlantic ones, professes to have in view, not trade so much as defence. The reason of that round-about policy is in this manner deduced. The

Colony. defence of England stands very much upon her navy; her navy depends altogether upon her sailors; the colony trade and its monopoly breed sailors; therefore colonies ought to be cultivated, and their trade monopolized.

Upon the strength of this reasoning, in which, for a long time, it would have appeared to be little less than impiety to have discovered a flaw, the navigation laws, as they are called, were embraced with a passionate fondness by Englishmen.

Nothing is worthy of more attention, in tracing the causes of political evil, than the facility with which mankind are governed by their fears, and the degree of constancy with which, under the influence of that passion, they are governed wrong. The fear of Englishmen to see an enemy in their country has made them do an infinite number of things which had much greater tendency to bring enemies into their country than to keep them away.

In nothing, perhaps, have the fears of communities done them so much mischief, as in the taking of securities against enemies. When sufficiently frightened, bad governments found little difficulty in persuading them, that they never could have securities enough. Hence come large standing armies, enormous military establishments, and all the evils which follow in their train. Such are the effects of taking too much security against enemies.

A small share of reflection might teach mankind, that in nothing is the rigid exercise of a sound temperance more indispensable to the well-being of the community than in this. It is clear to reason, were reason allowed to be the guide in these matters, that the provision for defence should always be kept down to the lowest possible, rather than always raised to the highest possible terms. At the highest possible terms, the provision for defence really does all the mischief to a community which a foreign enemy *could* do; often does a great deal more than he *would*. A moderate provision against evils of frequent and sudden occurrence, a provision strictly proportioned to the occasion, and not allowed to go beyond it, will save more evil than it produces. All beyond this infallibly produces more evil than it prevents. It enfeebles by impoverishing the nation, and by degrading with poverty and slavery the minds of those from whom its defence must ultimately proceed. It makes the country, in this manner, a much easier prey to a powerful enemy than if it had been allowed to gather strength by the accumulation of its wealth, and by that energy in the defence of their country which the people of a well-governed country alone can evince.

A navy is useful for the defence of Great Britain. But a navy of what extent? One would not, for example, wish the whole people of Great Britain engaged in the navy. The reason, we suppose, would be, because this would not contribute to strength, but weakness. This is an important admission. There is, then, a line to be drawn; a line between that extent of navy which contributes to strength, and that extent which, instead of contributing to strength, produces weakness. Surely it is a matter of first-rate importance to draw that line correctly. What attempt has ever been made to draw that line correctly? What attempt has ever been made to draw it at all? Can any body point out any land-marks which have been set up by the proper authority? Or, has the matter been always managed without measure or rule? And has it not thus always been an easy task to keep the navy in a state of excess always beyond the line which separates the degree that would contribute to strength from the degree that infallibly contributes to weakness?

As the passion of England has always been to have too great a navy—a navy which, by its undue expense, contributes to weakness; so it has been its passion to have too many sailors for the supply of that navy. The sailors of a navy are drawn from the sailors of the maritime trade. Colony. But a navy of a certain extent requires for its supply a maritime trade of only a certain extent. If it goes beyond that extent, all the excess is useless with regard to the supply of the navy. Now, what reason has ever been assigned to prove that the maritime traffic of Great Britain would not, without the monopoly of the colonies, afford a sufficient supply of sailors to a sufficient navy? None whatsoever; none that will bear to be looked at. But till a reason of that sort, and a reason of indubitable strength, is adduced, the policy of the navigation laws remains totally without a foundation. In that case it deserves nothing but rejection, as all the world must allow. It is a violent interference with the free and natural course of things, the course into which the interests of the community would otherwise lead them, without any case being made to appear which requires that violent disturbance.

The discussion of this supposed benefit of colonies we shall not pursue any farther; for it is a signal proof of the diffusion of liberal ideas, that the policy of the navigation laws has become an object of ridicule in the British parliament, and finds even there but a small number of defenders.

4. *Where Profit from Mines of the Precious Metals is the object of the Mother Country.*

There is another singular case, created by mines of the precious metals. A colony may be formed and retained for the sake of the gold and silver it may produce. Of this species of colony we have something of a specimen in the Spanish colonies of Mexico and Peru. The question is, whether any advantage can ever be derived from a colony of this description? The answer to this question is not doubtful; but it is not very easy, within the limits to which we are confined, to make the evidence of it perfectly clear to every body. In one case, and in one case alone, an advantage may be derived. That is the case in which the colony contains the richest mines in the world. The richest mines in the world always, in the case of the precious metals, supply the whole world; because from those mines the metals can be afforded cheaper than the expense of working will allow them to be afforded from any other mines; and the principle of competition soon excludes the produce of all other mines from the market.

Now, the country which contains the richest mines may so order matters as to gain from foreign countries, on all the precious metals which she sells to them, nearly the whole of that difference which exists between what the metal in working costs to her, and what in working it costs at the mines, which, next to hers, are the most fertile in the world.

She must always sell the metal so cheap as to exclude the metal of those other mines from the market; that is, a trifle cheaper than they can afford to sell it. But if her mines are sufficiently fertile, the metal may cost her much less in working than the price at which she may thus dispose of it. All the difference she may put in her exchequer. In three ways this might be done. The government might work the mines wholly itself; it might let them to an exclusive company; it might impose a tax upon the produce of the mine. In any one of these ways it might derive a sort of tribute from the rest of the world, on account of the gold and silver with which it supplied them. This could not be done if the mines, without being taxed, were allowed to be worked by the people at large; because, in that case, the competition of the different adventurers would make them undersell one another, till they reduced the price as low as the cost of working would allow

Colony. Could the tax at the mine be duly regulated, that would be the most profitable mode; because the private adventurers would work the mines far more economically than either the government or an exclusive company.

It is evident that this is a mode of deriving advantage from the possession of the richest mines of the precious metals, very different from that which was pursued by the Spanish government, and which has been so beautifully exposed by Dr Smith. That government endeavoured to derive advantage from its mines by preventing other countries from getting any part of their produce, and by accumulating the whole at home. By accumulating at home the whole of the produce of its mines, it believed (such was the state of its mind) that Spain would become exceedingly rich. By preventing other countries from receiving any part of that produce, it believed that it would compel them to continue poor; and if all countries continued poor, and Spain became exceedingly rich, Spain would be the master of all countries.

In this specimen of political logic, which it would not be difficult to match nearer home, there are two assumptions, and both of them false. In the first place, that a country can accumulate, to any considerable extent, the precious metals; that is, in any other way than by locking them up, and guarding them in strongholds. In the next place, that, if it could accumulate them, it would be richer by that means.

The first of these assumptions, that a country can keep in circulation a greater proportion than other countries of the precious metals, "by hedging in the cuckoo," as it is humorously described by Dr Smith, has been finely exposed by that illustrious philosopher, and requires no explanation here.

On the second assumption, that a country, if it could hedge in the precious metals, would become richer by that process, a few reflections appear to be required.

It is now sufficiently understood, that money, in any country, supposing other things to remain the same, is valuable just in proportion to its quantity. Take Mr Hume's supposition, that England were walled round by a wall of brass, and that the quantity of her money were in one night, by a miracle, either raised to double or reduced to one half. In the first case, every piece would be reduced to one half of its former value; in the second case, it would be raised to double its former value, and the value of the whole would remain exactly the same. The country would, therefore, be neither the richer nor the poorer; she would neither produce more nor enjoy more on that account.

It is never, then, by *keeping* the precious metals, that a country can derive any advantage from them; it is by the very opposite, by *parting with* them. If it has been foolish enough to hoard up a quantity of the produce of its capital and labour in the shape of gold and silver, it may, when it pleases, make a better use of it. It may exchange it with other countries for something that is useful. Gold and silver, so long as they are hoarded up, are of no use whatsoever. They contribute neither to enjoyment nor production. You may, however, purchase with them something that is useful. You may exchange them either for some article of luxury, and then they contribute to enjoyment; or you may exchange them for the materials of some manufacture, or the necessaries of the labourer, and then they contribute to production; then the effect of them is to augment the riches, augment the active capital, augment the annual produce of the country. So long as any country hoards up gold and silver, so long as it abstains from parting with them to other countries for other things, so long it deprives itself of a great advantage.

Conclusion.—Tendency of Colonial Possessions to produce or prolong bad Government. Colony.

If colonies are so little calculated to yield any advantage to the countries that hold them, a very important question suggests itself. What is the reason that nations, the nations of modern Europe at least, discover so great an affection for them? Is this affection to be *wholly* ascribed to mistaken views of their utility, or partly to other causes?

It never ought to be forgotten that, in every country, there is "a few," and there is "a many;" that in all countries in which the government is not very good, the interest of "the few" prevails over the interest of "the many," and is promoted at their expense. "The few" is the part that governs, "the many" the part that is governed. It is according to the interest of "the few" that colonies should be cultivated. This, if it is true, accounts for the attachment to colonies, which most of the countries, that is, of the governments of modern Europe, have displayed. In what way it is true a short explanation will sufficiently disclose.

Sancho Panza had a scheme for deriving advantage from the government of an island. He would sell the people for slaves, and put the money in his pocket. "The few," in some countries, find in colonies a thing which is very dear to them: they find, the one part of them, the precious matter with which to influence—the other, the precious matter with which *to be* influenced; the one, the precious matter with which to make political dependents—the other, the precious matter with which they are made political dependents; the one, the precious matter by which they augment their power—the other, the precious matter by which they augment their riches. Both portions of the "ruling few," therefore, find their account in the possession of colonies. There is not one of the colonies that does not augment the number of places. There are governorships and judgeships, and a long train of *et ceteras;* and above all, there is not one of them but what requires an additional number of troops, and an additional portion of navy. In every additional portion of army and navy, beside the glory of the thing, there are generalships, and colonelships, and captainships, and lieutenantships; and in the equipping and supplying of additional portions of army and navy there are always gains which may be thrown in the way of a friend. All this is enough to account for a very considerable quantity of affection maintained towards colonies.

But beside all this, there is another thing of still greater importance; a thing, indeed, to which, in whatever point of view we regard it, hardly any thing else can be esteemed of equal importance. The colonies are a grand source of wars. Now wars, even in countries completely arbitrary and despotical, have so many things agreeable to the ruling few, that the ruling few hardly ever seem to be happy except when engaged in them. There is nothing to which history bears so invariable a testimony as this. Nothing is more remarkable than the frivolous causes which almost always suffice for going to war, even when there is little or no prospect of gaining, often when there is the greatest prospect of losing by it, and that, even in their own sense of losing. But if the motives for being as much as possible in war are so very strong, even to governments which are already perfectly despotic, they are much stronger in the case of governments which are not yet perfectly despotic, of governments of which the power is still, in any considerable degree, limited and restrained.

There is nothing in the world, where a government is in any degree limited and restrained, so useful for getting rid of all limit and restraint as wars. The power of almost

Colony. all governments is greater during war than during peace. But in the case of limited governments, it is so in a very remarkable degree.

In the first place, there is the physical force of the army, and the terror and awe which it impresses upon the minds of men. In the next place, there is the splendour and parade, which captivate and subdue the imagination, and make men contented, one would almost say happy, to be slaves. All this surely is not of small importance. Then there is an additional power with which the government is intrusted during war. And, far above all, when the government is limited by the will of only a certain portion of the people, as it is under the British government by the will of those who supply with members the two houses of parliament, war affords the greatest portion of the precious matter with which that will may be guided and secured. Nothing augments so much the quantity of that portion of the national wealth which is placed at the command of the government as war. Of course, nothing puts it in the power of government to create so great a number of dependents, so great a number of persons bound by their hopes and fears to do and say whatever it wishes them to do and say.

Of the proposition, that colonies are a grand source of wars, and of additional expense in wars, that expense by which the ruling few always profit at the cost of the subject many, it is not probable that much of proof will be required.

With regard to additional expense, it can hardly appear to be less than self-evident. Whenever a war breaks out, additional troops, and an additional portion of navy, are always required for the protection of the colonies. Even during peace, the colonies afford the pretext for a large portion of the peace establishment, as it is called; that is, a mass of warlike apparatus and expense, which would be burdensome even in a season of war. How much the cost amounts to, of a small additional portion, not to speak of a large additional portion of army and navy, Englishmen have had experience to instruct them; and how great the mischief which is done by every particle of unnecessary expense, they are daily becoming more and more capable of seeing and understanding.

That the colonies multiply exceedingly the causes and pretexts of war, is matter of history, and might have been foreseen before reaping the fruits of a bitter experience. Whatever brings you in contact with a greater number of states, increases, in the same proportion, those clashings of interest and pride, out of which the pretexts for war are frequently created. It would exhibit a result which probably would surprise a good many readers, if any body would examine all the wars which have afflicted this country, from the time when she first began to have colonies, and would show how very great a proportion of them have grown out of colony disputes.

Sect. III.—*Sketch of Existing Colonies.*

The history and theory of colonial policy having been pretty fully surveyed, little remains to complete the design of this article. A statistical view of the present state of colonial possession will suffice, because the several colonies are described in detail under their respective heads.

1. *British Colonies.*

North America.—1. Canada; 2. Nova Scotia and Cape Breton; 3. New Brunswick; 4. Prince Edward Island; 5. Vancouver; 6. Newfoundland. Aggregate population 2,503,666; area 455,493 square miles.

West Indies.—1. Jamaica; 2. Windward Islands, including Barbados, St Vincent, Grenada, Tobago, St Lucia, and Trinidad; 3. Leeward Islands, including Antigua, St Kitt's, Anguilla, Montserrat, Nevis, Dominica, and Virgin Islands; 4. Bahamas; 5. Bermudas; 6. British Guiana; 7. Honduras; 8. Falkland Islands. Aggregate pop. 980,535; Area, 167,384 square miles.

Asia.—1. Ceylon; 2. Hong Kong; 3. Labuan. Aggregate pop. 1,454,614. Area 24,727 square miles.

Africa.—1. Cape of Good Hope; 2. Mauritius; 3. Sierra Leone; 4. Gambia; 5. Gold Coast; 6. St Helena. Aggregate pop. 920,960. Area 127,330 square miles.

Australasia.—1. New South Wales; 2. Western Australia; 3. South Australia; 4. Van Diemen's Land; 5. Victoria; 6. New Zealand. Aggregate pop. 676,952. Area 649,000 square miles.

Europe.—1. Gibraltar; 2. Malta and Gozo; 3. Heligoland. Aggregate pop. 150,409. Area 145 square miles. To these may be added the Ionian Islands. Pop. 226,698. Area 1041 square miles.

Total population of the above colonies, 6,687,136. Total area, 1,424,079 square miles.

Recent parliamentary documents acquaint us with the heavy expense to which the British government is still exposed for the care and control of the colonies. In the year 1843 this expenditure had risen to L.540,842 for civil government, L.74,005 for naval expenditure, and L.2,556,919 for military expenditure, making a total of L.3,171,646.

In 1847 this expenditure had increased to L.3,804,038, but had declined to L.2,914,354 in 1850–51.

In 1851–52 the net military expenditure again rose to L.3,003,282, the net civil expenditure to L.499,350, and the naval expenditure to L.55,717, making a total of L.3,558,350, or, with certain deductions arising from the excess of post-office revenue over expenditure, L.3,555,573.

The prominent item of expenditure in 1843 was the military government of Gibraltar. This amounted to very nearly a quarter of a million sterling. The military expenditure for Canada was considerably above half a million sterling, and for the North-Eastern Provinces L.173,030. Of the British colonies eleven, including Gibraltar, Cape of Good Hope, Hong Kong, &c., are military and maritime stations, maintained to facilitate commerce, or for the general strength and security of the British empire.

It will be observed, that from the above enumeration is excluded all that part of the foreign dominions of the British state which is under the management of the East India Company; a part which, in point of importance, exceeds all the rest, and of which the circumstances are peculiar and anomalous.

In this dominion, the whole continent of India, from the frontier of the Burman empire to the Suliman mountains, may be said to be included, since the military power of the whole is exclusively in our hands; and those parts of which the civil government remains with the native princes are under our absolute control.

The outlying territories under the government of the Company are Prince of Wales Island and the island of Singapore in the straits of Malacca, with some parts on the coast of the adjoining continent, of comparatively small importance; and the island of St Helena, which alone has now a separate government, by a governor, and orders from the court of directors.

The whole of India is under the governor-general in council, with whom rests the sole power of legislation; that authority also exercising a general control over the subordinate governments, to whom the local administration is committed. These latter include the governor in council of Madras, the governor in council of Bombay, the lieutenant-governor of the North-West Provinces, and the lieutenant-governor of Bengal. The affairs of the Punjaub (a more recent acquisition) are administered by an officer called a chief commissioner, acting under the immediate superin-

Colony. tendence of the governor-general in council. All the local authorities, the chief as well as the subordinate, are accountable to the Court of Directors of the East India Company, whose lawful orders and instructions they are bound to obey.

Of the territories in India of which the military power is in our hands, but the civil government still confided to the native princes, the principal are, the territory of the king of Oude, Rajpootana, the territories of a few Mahratta princes, those of the Nizam, those of Travancore, and those bestowed by the British upon the Rajah of Mysore and the Rajah of Sattarah.

According to the best computation, the population in India subject to the government, both military and civil, of the East India Company, amounts to 107,172,433, spread over a territory of 695,905 square miles.

The extent, by computation, of the country still in part administered by its native chiefs, under the names of allied or protected princes, is 691,474 square miles, supporting a population of 52,414,576, making the whole population in India dependent upon the British government, and substantially its subjects, about 159,587,009.

This represents India as a colony of a very peculiar description; and perhaps the name of colony would not with propriety be given to it, if we had any other general title under which we could arrange it. When the foreign territory which a state conquers contains a large population of its own, and so much of the population of the conquering state as is necessary to its government, or at least so much, and but little more, is sent to it, or goes there, such territory is commonly retained, for the sake of a tribute demanded from it, and is denominated a tributary country. But that is not the case with India, from which no tribute has ever been obtained; nor has tribute been ever looked to as the object of our policy in retaining it. Our object in originally forming our connection with it was commerce; and our first territorial acquisitions were made for the sake of commerce, for the protection of commerce, or for extending the sphere of its operations. Afterwards other acquisitions were made for the sake of the first, which could not, it seemed, be held in security without addition to the last; and there has been a progress in this way, from one acquisition to another, the sum total of which is the enormous territory now placed under British rule.

If it be asked, for what advantage is all this territory governed by Great Britain, it is much more easy to answer the question on the side of India than on that of England. It is of immense importance for a people so greatly behind Europeans in all the advantages of civilized life, and whose institutions and habits had acquired a fixity which seemed to preclude improvement among themselves, to be relieved from the paralyzing operation of their own rude government, and placed under the rule of a more enlightened and active people, provided that rule be not carried to the extreme of oppression. And no one can reasonably doubt, that the prospects opened to the vast population of India, by the continuance of the British rule, as it is, and as it will be under successive improvements, are of the most gratifying kind. The Indian people will be gradually elevated to the level of European intelligence, all the blessings of which will then flow in upon them.

With regard to the people of Great Britain, it cannot easily be disputed that their great advantage from this dominion consists in the consciousness of being the instruments in so good a work; and that is a distinction of which undoubtedly they may be proud. There is no other instance in the history of mankind of a foreign territory held by another state for the good of the people of that territory: there is no other instance of one people held in subjection by another, and the power exercised not only with so much real advantage to the subject people, but with such a constant, and vigilant, and minute care of their interests. Colony.

In other respects, our gains may be easily computed. We have the advantage, it may be said, of the commerce with India. There is an inveterate habit in England of estimating, not commerce in general, but commerce with this or that country, in addition to others, far beyond its value. They who are under the dominion of this blind persuader do not reflect that commerce is exchange, and that England, or any other country, can exchange only to the extent of what she has got to exchange. But can anybody doubt that England could exchange all that she has got to exchange, which is but a limited amount, if India "were in the deep sea sunk?" To make out their argument, then, they must say, that we exchange on better terms with India than we could with any other country; but if they do say so, it will puzzle them to make good their position.

There is one other source of advantage to Great Britain, which, though it may easily be overrated, and probably is by most people, is worth something; and that is, the outlet which India furnishes to the sons of a number of families in the higher grades of the middle rank in England, who are sent to administer the government as civil and military officers. In an over-peopled country, this, to its extent, is a relief. It has a tendency to keep at rather a higher level than it would otherwise fall to, the reward of the labour of educated men. And the fortunes which Indian gentlemen bring home, if greater than the fortunes they would have made at home, are an addition to the capital of the country. Such fortunes, however, are much smaller than in former times, and would have been regarded as contemptible by Anglo-Indians of the days of Clive.

It is often said that we limit our advantages by our own senseless policy, by restraining the most of Englishmen to India. This is another case in which men dream of riches, and believe their dreams when awake. There are two ways in which Englishmen may go out to India with honest views, as labourers or as capitalists. If we ask in which of these ways it is supposed they will go out, we may be told, in both. Let us see.

In respect to labourers, India is an overstocked country, and wages are so low that Englishmen would not live upon them. Out of doors work, moreover, which is nearly all the work of the country, cannot be performed by Englishmen under such a climate. And another obstruction is, that English labourers cannot pay the expense of the voyage. In fact, it is not alleged by persons who have every knowledge of the circumstances, that English labourers, to any amount worth regarding, can ever find their way to India.

Then comes the question of capitalists. To what extent is it reasonable to suppose that they, under a system of free admission, would establish themselves in India? Employment of European capital would be either on the land or in manufactures; for, as to the mere commercial part, buying, selling, and carrying, it is both a minor part, and is actually supplied.

When people look at a large object, not with the eyes of the understanding, but those of the imagination, glaring through the medium of all the avaricious passions, they easily give to it gigantic dimensions, and cherish a delusion.

First, as to the land; nobody imagines that the ordinary products of the land, the food of the people, can be raised by Englishmen more cheaply than by the natives; or that Englishmen will find a motive to establish themselves as farmers and agriculturists in India. The case is different in regard to products intended for the European market. English capital is employed in the growth of the indigo plant; and some other articles may be looked to, of which sugar and cotton are the chief. But altogether, these products imply a very limited demand for capital. Indigo has already been supplied in excess; and knowing how cheaply sugar and cotton can be furnished from the other side of

Colony. the Atlantic, we must regard a successful competition from India as hopeless.

Then, what are the manufactures in which there is to be a demand for capital? None can be named but cotton and silk. Of raw silk, there is some probability that after a time a considerable supply may be drawn from India. The cotton manufacture we are now supplanting by actual importations from this country.

The truth then appears to be, that for the employment of labour and capital, by Europeans, there is little scope in India. If Englishmen were allowed to go for the purpose of seizing lands, and collecting plunder from the natives, there would be a harvest, doubtless, of a few years, and no more. But this, we may hope, will not be granted. If so, and if permission to them extends only to the honest employment of their labour and capital, it will not, how free soever, carry many of them to India, or much increase the advantages we derive from it.

The revenue of the British government in India, and the value of the exports and imports, are given under INDIA.

2. *Foreign Colonies.*

Spanish Colonies.—Cuba, Puerto Rico, and some smaller islands in America; the Philippine and Marianne islands in the Pacific, the Canary islands in the Atlantic, Fernando Po and the island of Annabon in the Gulf of Guinea, and Ceuta, Gomera, and Melilla in Barbary.

Dutch Colonies.—Java, Sumatra, Borneo, Celebes, Moluccas, Amboyna, and other islands; Surinam, Curaçao and dependencies, and Guinea coast.

French Colonies.—The islands Martinique, Guadaloupe, Marie-Galante, Desirade, Saintes, and part of St Martin; French Guiana and Cayenne, St Pierre and Miquelon; Algeria, Senegal, and Goree; the islands Bourbon and St Marie, part of Madagascar, Mayotta and Mossi-Bé; Pondicherry, Karakal, Mahé, Yanaon, and Chandernagore; the Marquesas and Tahiti islands.

Danish Colonies—In the West Indies, the islands of St Croix, St Thomas, and St John.

Swedish Colonies.—The Swedes have only the small island of St Bartholomew in the West Indies.

Portuguese Colonies.—Goa, Damaun, and Macao, in Asia; besides small possessions in the islands Solor, Timor, and Midoro; Angola, Congo, Mozambique, and part of Senegambia; the islands Madeira, Cape Verd, Princes Island, and St Thomas. (J. M—L.)

In applying the views promulgated in the preceding pages to our present colonial policy, it will be observed that the system of differential duties, the great practical testimony to the economic fallacies of the colonial system, has been nearly obliterated by the late free-trade measures, and any remnant of them now existing represents, not a lingering belief in their value, but the incidental impediments which have resisted their entire abolition. The belief that it is a sound policy in a nation to pay for the support of colonies, and afford them exclusive privileges, for the sake of the advantage of trading with them, has now disappeared.

At the same time our colonies not only remain on as great a scale as when Mr Mill's paper was written, but they have materially enlarged both in extent and vitality. The reasons of this deserve attention, and are intimately connected with the views which he has set forth. In fact the increase of our colonial system has proceeded on new, and, it is believed, sound views, developed by that principle of free trade which is the key-note of the preceding remarks. According to the undoubted laws of political economy, so long as we have a free trade at home, no other nation can produce and trade without our reaping the advantage of it. No nation that trades refuses to sell to another, though it may refuse to buy from that other. The selling, however, is just the same as buying to the same amount. If Britain obtains goods from Lombardy, though Lombardy should prohibit the importation of British goods, yet Britain must export an equivalent into some circle of trade by which the value will come to Lombardy, otherwise Lombardy will not be paid. Hence, wherever a nation produces and sells, Britain, as a free-trade country, profits. Colony.

But suppose a great tract of rich country inhabited by a scattered population who neither produce nor sell. In this case it is the interest of Britain that the country should be inhabited, if it honestly can be so, by a people industrious and enterprising. To understand the importance of this, let us suppose the territory of the United States, where people purchase from us sixteen millions worth of goods, inhabited by the original Indian tribes, who probably would not have purchased L.100,000 worth from us, or from any other country.

This illustration points at once to the conclusion, that it is of no consequence whether the trading nation is dependent on us—nay, it is of secondary consequence whether it directly trades with us, *provided it trade at all.* But there is no doubt that increasing and multiplying the British stock increases the producing and trading populations over the earth. Hence, if we can conveniently spare a portion of our people to inhabit distant regions, it may be politic to aid them by a government staff and other provisions in making a settlement. It happens that in general this country has not only been able to spare a portion of her citizens, but has found a relief in seeing them depart from her shores. To those indeed who have fallen into an unproductive and unhappy position in the mother country, the fresh emigration field has had the same effect as a supply of capital; for the occupation and use of a piece of productive land which has not previously been productively applied is to those who take it equivalent to the obtaining of so much capital. It is for the purpose of protecting if not creating emigration fields, that our colonial system has thus extended itself, and hence the more important considerations connected with it came under the head of Emigration. Wherever we can plant a numerous and prosperous body of the British people, we create a trading population which will increase our own commerce; and if it be said that they take capital out of the country to employ it elsewhere, after the secondary answer that colonists do not generally remove much capital, the main answer is, that for a nation like the British, in the full enjoyment of free trade, the best part of the world for their capital to be placed in, is that where it is most productive. Hence, the removal of a portion of our people, and with them of a portion of our capital, may tend to increase the trade and wealth of Britain. This phenomenon is at present very distinctly exemplified in our Australian colonies, and it is the principle on which, along with those of New Zealand and the additions to the North African colonies, they have been created and supported.

It is needless to say that a body of men settling in a distant desert require the protection of the mother country. They not only require it against foreign enemies, but against internal injustice and oppression. When in its earlier stages there comes from a colony a strong outcry against the domination and interference of the mother country, it generally proceeds from some body of men who, having acquired a preponderance of local power, desire to oppress their weaker fellow colonists. The tendency of the strong to exact services from the weak, to establish slavery or something as closely resembling it as may be, is a leading colonial vice. The disgust always felt by the Dutch colonists of the Cape towards Britain has proceeded from the abolition of slavery there. Even in our Australian colonies the great squatting aristocracy have shown this propensity. They desired the continuance of transportation, which supplied them with convict bondsmen, and wished to have the class

Colony. of assisted emigrants prohibited from leaving the district to which they were assisted; complaining, when defeated, of arbitrary interference with their own management of their own affairs. The appropriation of land is another source of local injustice and oppression, and the ravenous class, who sometimes purchased provinces for a musket or a red handkerchief, have bitterly complained of that rule which vests the newly acquired territory of every colony in the British crown, for the purpose of justly regulating its appropriation.

The grand scheme formed by some able and adventurous young men for the colonization of New Zealand subjected the colonial peculiarities to much impassioned discussion. Their leader had formed a theory of colonization so very plausible, that it was unfortunately in some measure adopted by the legislature. It was said that society should be transplanted to the new territory with all its social elements complete, so that each person—the lawyer, the physician, the clergyman, the merchant, and the mechanic—should find himself in his right place. As a means of accomplishing this, a high price was set on land; in order, as it was said, that capital might be compelled to emigrate in a due proportion to labour. This was the part of the scheme which was adopted by the government, and it proved a pernicious interference in the places where it was applied.

The New Zealand projectors, however, proposed to conduct their scheme in their own way as an independent project. They, in fact, conceived the ambitious design of founding an independent empire in those noble islands, which they saw in the distant future arising up in rivalry with Britain. And when their vast transactions with the native chiefs were superseded, and the crown stepped in to arrange the rights and liabilities of parties, they loudly complained that the British government would not itself occupy the islands, yet immediately interfered when others proposed to do so. It is clear, however, that if the adventurers were to receive the protection accorded to British subjects, they could not exempt themselves from liability to the national policy. The young colony could not have protected itself from appropriation by some other power; and it has always been part of the policy of the British empire never to allow its lieges to incur, by want of protection, the risk of being subject to another state. This principle was, perhaps, less reasonably acted on towards the Dutch colonists of the Cape. In their hatred of British domination, a large body of them emigrated to a distant territory acquired by treaty from the king of the Zoolus. In the year 1843 this district was declared to be a British possession, and a dependence of the Cape. It was the cause of continual contention for ten years; and at last the step, previously unexampled, was taken of contracting the boundary of the British territory there.

It deserves to be incidentally mentioned that the founders of the New Zealand Company, before abandoning their projects for transplanting society, in full growth and proportion, endeavoured to employ the zeal of religious parties in their cause, and to form ecclesiastical settlements. They found two bodies ready to respond to the invitation. The English high-churchmen founded the colony of Canterbury, while the members of the Free Church of Scotland created that of Otago. These were attempts to plant religious intolerance; but as the emigrants of the present day are not generally of the class who will sacrifice material interests to carry out ecclesiastical schemes, they have failed at least in accomplishing to any extent their distinctive features. They did not, it is true, entirely exclude nonconformists; but by applying a portion of the heavy purchase money exacted to the peculiar ecclesiastical purposes of the colony, all who would not contribute to such an object were virtually excluded.

With these explanations it may be generally stated that our revised colonial system mainly exists for the provision of emigration fields. It is true that we still preserve the other colonies, such as those of the West Indies, which were supported by the force of trading privileges and inequalities. Colony. It is a hard trial of national pride to abandon that which rival nations are anxious to possess, however reasonable the abandonment may be shown to be. There is scarcely a European tongue not spoken among the inhabitants of the colonies belonging to Britain; there is no instance where any other nation possesses, as a token of successful war, a colony where the people speak English. But as our old colonies become less valuable to their inhabitants, they will become less an object of desire to our rivals, and will perhaps be permitted to drop, by mutual consent, out of existence.

The hardest battle for colonial monopoly was fought on the staple produce of the West Indies—sugar. The national horror of slavery was appealed to, and it was maintained that Britain should give a premium to the free-labour produce of her own colonies. But her own hands being clean, it did not appear that she could effectually distribute pecuniary rewards and punishments over the globe; and it was successfully maintained, that her duty in matters of trade was to put all the world on a par;—she might then pursue the extinction of slavery as a separate object in her own way. The differential duties on sugar were gradually reduced, and came to a termination on the 5th of July 1854. The duties on spirits are still in some measure differential, the general duty on foreign produce being 15s. per gallon, while that on colonial produce has been reduced, but is different in amount according as the importation is to England, Scotland, or Ireland, and varies in the three kingdoms on an adjustment to the scale of inland spirit duties in the three kingdoms. This peculiarity arose with the scarcity of the year 1847, from a reduction of the duties on imported spirits avowedly for the purpose of bringing them into competition with home produce, and reducing the distillation from grain; but it is believed that the change has had very little effect in substituting colonial for British spirits.

The differential wine duty still continues, but it operates almost entirely as a tax on the foreign produce, not as an exemption or privilege to the colonial, since it has been incapable of overcoming the substantial objections to the Cape and other colonial wines. On the other hand, though there is still a differential duty on timber, both classes have been materially reduced with the view of rendering even the higher duty light. Thus while, by a gradual reduction, 7s. 6d. per ton on squared wood was in 1851 substituted for the old duty of 55s., there is a mere nominal tax of 1s. (with 5 per cent.) on the colonial produce. The North American colonies, in whose favour the differential duties existed, have been placed, in legislative and executive matters, in a position which they feel to be peculiarly satisfactory. The existence in the principal colony of two rival races makes the supremacy of Britain important as a counteracting power to the ascendency of either; and the colonies are much in the position of constitutional monarchies, whose monarch is at a distance.

The applicability of existing conditions to a portion of Mr Mill's article may be better reserved for the head of Transportation. In the meantime, it may be mentioned that, in the later administration under the act of 1824, establishing the hulks and penitentiary system, other methods of punishment have been gradually substituted for transportation. Finally, by an act of 1853 (16th and 17th Vict., cap. 99), the practice has been very nearly abolished. For crimes which would have been punished with transportation for a less period than four years, penal servitude—generally for a period rather more than half the transportation period—is substituted; and where the punishment was by the old law transportation for fourteen years or upwards, it may now be transportation or penal servitude at the discretion of the court. (J. H. B.)

Colophon || Colossians.

COLOPHON, an Ionian city of Asia Minor, on the small river Hales or Halesus, about 8 miles from Ephesus, and a short distance from the sea-coast. It is said to have been founded by the mythical Andræmon at the same time with Notium, which became its harbour. The first event of importance in the history of Colophon was the seizure by some of its inhabitants of the city of Smyrna, which they were allowed to retain unopposed. Colophon was in its turn taken by Gyges, king of Lydia; and at the opening of the Peloponnesian war by the Persians, for whom the factions of the townsmen prepared an easy victory. The Persians themselves were at length driven out by the Colophonians with the aid of the Athenians, who exerted themselves to restore and repeople the city. After the death of Alexander, Colophon with some neighbouring cities was destroyed, and its inhabitants led away to settle in Ephesus. Notium appears to have escaped this calamity, for we find that in B.C. 190 Antiochus of Syria was compelled to retire from before its walls after an unsuccessful siege. To these representatives of the old Colophonians the Romans afterwards granted immunity, as a reward for their fidelity.

Colophon was the third of the seven cities which claimed the honour of having given birth to Homer. Mimnermus, the famous elegiac poet, was a native of Colophon; as were also the poets Antimachus, Hermesianax, Phœnix, and Nicander, the musician Polymnestus, and the satirist Xenophanes.

COLOPHON, in *Bibliography*, the concluding lines of early printed works, which, previous to the introduction of title-pages, usually contained the title, the date, the name of the author and of the printer, &c. The term is said to be derived from the Greek proverb τὸν Κολοφῶνα ἐπέθηκεν (*q. d.*, he gave the finishing stroke), alluding to the Colophonian cavalry, which was so excellent, according to Strabo, that victory was assured to that side on which it fought.

COLOPHONITE, in *Mineralogy*, a variety of garnet generally possessing a dark colour, and a vitreous, half fused-like appearance. It occurs massive, or in large granular concretions, and has a specific gravity of 4·0. It is found chiefly in the beds of magnetic iron at Arendal in Norway, and also in Piedmont and in Ceylon.

COLOPHONY, the dark-coloured resin which remains after the distillation of oil of turpentine. It is so called from Colophon in Ionia, which was noted in antiquity for the excellence and abundance of its resin. (See *Plin.* xiv. 20.)

COLORADO, a river of Mexico. See MEXICO.

COLORATURA, in *Music*, a general term for embellishments, such as trills, diminutions, &c. &c.

COLOSSÆ, a once large and important city of Phrygia Major, on the Lycus, a branch of the Mæander. The notices of Colossæ in ancient history are few and brief. Xerxes passed through it on his way to Greece B.C. 481; and at the close of that same century it was visited by Cyrus the younger. It is described by Xenophon in the "Anabasis" as being at this period a large and flourishing city. Like Laodicea, and many other cities in that part of Phrygia, Colossæ carried on a large trade in wool, and derived a large revenue from the skill of its inhabitants in dyeing that article. After the time of Cyrus, the city seems to have gradually decayed, till in the middle ages it disappeared altogether. Near its ruins there sprang up another town called Chonæ, the site of which is still visible under the name of Khonos. Excavations, which have been recently made in the neighbourhood of this place, have brought to light the ruins of a large city, which is believed, with good reason, to be Colossæ.

One of the epistles of the apostle Paul is addressed to the inhabitants of this city, in which one of the earliest of the Christian churches in Asia was planted.

COLOSSIANS, EPISTLE TO THE, a canonical epistle of the New Testament, addressed by St Paul to the Christians of Colossæ, a city of Phrygia. Its authenticity is supported by a body of evidence so ancient, uninterrupted, and universal, that few even of the extreme rationalists of the present century have ventured to deny it. The date of its composition, which is synchronous with that of the epistle to the Ephesians, has been variously assigned by critics to the captivity of Paul at Cæsarea or at Rome. Tradition is harmonious in favour of the latter, while the internal evidence brought forward on either side can hardly be regarded as decisive. The same doubt exists in regard to the question, whether or not Paul had visited Colossæ previously to the date of this epistle; but though no incidental statement in this or any other epistle can be brought forward to strike the balance between the plausibilities of either hypothesis, still, though possible, it is far from probable that the author's acquaintance which the apostle betrays in regard to the Christians and the Christianity of Colossæ could have been derived from any other source than a personal visit to the city. The aim of the apostle in writing this letter is manifestly to counteract the teaching of certain Jewish Christians, who coloured over the grosser features of Judaism—circumcision and observance of the Mosaic ritual—with theosophic speculation concerning the higher world of spirits and the corruption of matter, and as corollaries from these addicted themselves to the observance of angel-worship, and enjoined a refined system of bodily austerities. Their errors cannot be formally identified with the tenets of any heathen or any Christian school of philosophy; and the Essene teachers, whom they most closely approximate, were at that time to be found only in Syria and Palestine. The note given by St Paul descriptive of their tenets enables us to realize that embryonic Gnosticism which proved the fruitful germ of almost innumerable sects; and so strikingly applicable is his language to these as they arose, that some on that ground alone have regarded the epistle as a grand anachronism.

Colossus

COLOSSUS, a word of uncertain origin, used by the Greeks and Romans to signify a statue of a gigantic size. The most celebrated work of this kind was the Colossus of Rhodes, a statue of Apollo or the sun, so high that ships in full sail, according to the common account, could pass between its legs. There is, however, no authority for the statement that its legs were extended across the harbour. This colossus, which was regarded as one of the seven wonders of the world, was the work of Chares, who spent twelve years in making it. (See CHARES.) It was upwards of 105 feet in height; and there were few, says Pliny, that could embrace its thumb. It cost 300 talents. A spiral staircase led to its summit, whence might be descried Syria, and the ships proceeding to Egypt, in a great mirror suspended to the neck of the statue. This famous statue was overthrown and shattered by an earthquake about 56 years after its erection, B.C. 224. The fragments had lain on the ground for 923 years, when they were sold by the Saracens to a Jew of Emesa, who loaded 900 camels with the brass, A.D. 672.

According to Pliny, Rhodes was adorned by no fewer than 100 colossal statues of the sun; but all greatly inferior in size to the one here described.

Of the various colossi at Rome, the most famous were the following:—1. That of Jupiter, in bronze, upon the capitol; 2. a bronze statue of Apollo at the Palatine library; 3. a bronze statue of Augustus in the Forum Augusti; 4. a marble statue of Nero, said by Suetonius to have been 120 feet in height, and which originally was placed in the vestibule of the "golden house;" but, after the conflagration of that edifice, supplied with a new head by Vespasian, and converted into a statue of the radiated Apollo; 5. a gilded bronze equestrian statue of Domitian, in the forum. Frequent mention too is made in Herodotus of the colossi of Egypt.

Probably the largest modern work of this kind is the bronze colossal statue of Carlo Borromeo, the good archbishop of Milan, 66 feet in height. See ARONA, and BORROMEO.

Colostrum || Colour.

COLOSTRUM (Lat.), the first milk of any animal after bringing forth its young. (See BEESTINGS.) A mixture of turpentine with the yolk of an egg is also sometimes called by this name.

COLOUR (Lat. *color*), a property inherent in light, by which, according to its various proportions or quantities, or from some other cause, it excites different vibrations in the optic nerve, which, propagated to the sensorium, affect the mind with different sensations. See CHROMATICS, and OPTICS.

COLOUR, in *Heraldry*. The colours generally used in heraldry are red, blue, black, green, and purple; technically called *gules*, *azure*, *sable*, *vert* or *sinople*, and *purpure*. Tenne or tawny, and sanguine, are less common. Yellow and white again, called *or* and *argent*, are metals, not colours. The metals and colours are sometimes expressed in blazonry by the names of precious stones, or by those of planets or stars. See HERALDRY.

COLOUR, in the *Human Species*, difference of. See COMPLEXION; AMERICA, vol. ii., p. 677; MAN.

COLOUR, in *Painting*, is applied both to the drugs and to the tints produced by those drugs, variously mixed and applied. The principal colours used by painters are red and white lead, yellow and red ochres, several kinds of earth, umber, orpiment, lamp black, ivory black, black lead, vermilion, gamboge, lacca or lake, blue and green ashes, verdigris, bistre, raw and burnt siena, bice, smalt, carmine, ultramarine. For much interesting information regarding the pigments employed by the Greeks and Romans, the reader may consult Vitruvius, vii.; Pliny, xxxiii., xxxiv., xxxv.; Dioscorides, v.; and Theophrastus, *De Lapidibus*. See also *Philosoph. Trans. of Royal Soc.*, 1815, for the experiments and observations of Sir Humphry Davy on some ancient colours and paintings in the baths of Titus and of Livia, &c.

COLOUR, in *Plants*, is an attribute found to be very variable. Different colours are observed, not only in different individuals of the same species, but likewise in different parts of the same individual. Thus, marvel of Peru and sweet-william have frequently petals of different colours on the same plant. Three or four different colours are frequently found upon the same leaf or flower, as on the leaves of the amaranthus tricolor, and the flowers of the tulip, auricula, three-coloured violet, and others. To produce the most beautiful and striking variety of colours in such flowers, is the principal delight and business of the florist.

The vegetable colours, and their intermediate shades or gradations enumerated by botanists, are as follow:—

Water-colour, *hyalinus*.
WHITE, *albus*.
Lead-colour, *cinereus*.
BLACK, *niger*.
Brown, *fuscus*.
Pitch-black, *ater*.
YELLOW, *luteus*.
Straw-colour, *flavus*.
Flame-colour, *fulvus*.
Iron-colour, *gilvus*.
RED.
Flesh-colour, *incarnatus*.
Scarlet, *coccineus*.
PURPLE.
Violet-colour, *cæruleo-purpureus*.
BLUE, *cæruleus*.
GREEN, *viridis*.

These colours seem to be appropriated to particular parts of the plant. Thus, white is most common in roots, berries, and the petals of spring flowers; black in the roots and seeds, but rarely in the seed vessel, and scarcely ever in the petals. Yellow is frequent in the antheræ, or tops of the stamina; as likewise in the petals of autumnal flowers, and the compound ligulated flowers of Linnæus. Red is common in the petals of summer flowers, and in the acid fruits; blue and violet-colour in the petals; and green in the leaves and calyx, but rarely in the petals. In the interchanging of colours, which in plants is found to depend upon differences in heat, climate, soil, and culture, a sort of elective attraction is observed to take place. Thus, red is more easily changed into white and blue, blue into white and yellow, yellow into white, and white into purple. A red colour is often changed into a white, in the flowers of heath, mother of thyme, betony, pink, viscous campion, *cucubalus*, trefoil, orchis, fox-glove, thistle, cudweed, saw-wort, rose, poppy, fumitory, and geranium. Red passes into blue in pimpernel. Blue is changed into white in bell-flower, Greek-valerian, bind-weed, columbine, violet vetch, milkwort, goat's rue, viper's bugloss, comfrey, borrage, hyssop, dragon's head, scabious, blue-bottle, and succory; but it is changed into yellow in crocus. Yellow passes easily into white in melilot, agrimony, mullein, tulip, *blattaria* or moth-mullein, and corn marigold. White is changed into purple in wood-sorrel, thorn-apple, peas, and daisy. Colour.

Although plants are sometimes observed to change their colour upon being moistened with coloured juices, yet that quality in vegetables seems not so much owing to the nature of their nourishment as to the action of the internal and external air, heat, light, and the primitive organization of the parts. In support of this opinion it may be observed that there is far less variety in the colours of roots than of the other parts of the plants; the pulp within the skin being usually white, sometimes yellow, rarely red. That this effect is produced by their small intercourse with the external air, appears from the circumstance, that the upper parts of roots, when they happen to stand naked above the ground, are often dyed with several colours. Thus the tops of sorrel roots turn red; those of turnips, mullein, and radishes, become purple; and many others are converted into green, whilst those parts of the same roots which lie more under ground are commonly white. The green colour is so proper to leaves, that many, as those of sage, the young sprouts of St John's wort, and others which are reddish when in the bud, acquire a perfect green upon being fully expanded. In like manner, the leaves of the sea-side grape (*polygonum*), which when young are entirely red, become, as they advance in growth, perfectly green; except the middle and transverse ribs, which retain their former colour.

As flowers gradually open and are exposed to the air, they throw off their old colour and acquire a new one; in fact, no flower has its proper colour until it is fully expanded. Thus the purple stock-julyflowers are white or pale in the bud; and in like manner bachelor's buttons, blue-bottle, poppy, red daisies, and many other flowers, though of divers colours when blown, are all white in the bud. Nay, many flowers change their colour thrice successively. Thus, the very young buds of lady's looking-glass, bugloss, and the like, are all white; the larger buds purple or murrey; and the open flowers blue.

With respect to the colours of the juices of plants it may be observed, that most resinous gums are tinctured; some, however, are limpid; and that which drops from the domestic pine is clear as rock-water. The milk of some plants is pale, as in burdock; of others white, as in dandelion, euphorbium, and scorzonera; and of others yellow, as in lovage, and greater celandine. Most mucilages have little colour, taste, or smell. Of all the colours above enumerated, green is the most common to plants, and black the most rare.

Colour, being a quality in plants so apt to change, ought never to be employed in distinguishing their species. These ought to be characterized from circumstances not liable to alteration by culture or other accidents. The same inconstancy of colour observed in the flowers, is likewise to be

Colour. found in the other parts of plants. Berries frequently change from green to red, and from red to white. Even in ripe fruits, the colour, whether white, red, or blue, is apt to vary; particularly in apple, pear, plum, and cherry trees. Seeds are more constant in point of colour than the vessel which contains them. In the seeds, however, of the poppy, oats, pea, bean, and kidney-bean, variations are frequently observed. The root, too, although not remarkably subject to change, is found to vary in some species of carrot and radish. Leaves frequently become spotted, as in a species of orchis, hawk-weed, ranunculus, knot-grass, and lettuce; but seldom relinquish their green colour altogether. Those of some species of amaranthus, or flower-gentle, are beautifully coloured. The spots which appear on the surface of the leaves are of different colours, liable to vary, and not unfrequently disappear altogether. The leaves of officinal lung-wort, and some species of sow-bread, sorrel, trefoil, and ranunculus, are covered with white spots; those of dog's-tooth violet, with purple and white; those of several species of ranunculus and orchis, with black and purple; those of amaranthus tricolor, with green, red, and yellow; those of ranunculus acris, and a species of bog bean, with red or purple. The under surface of the leaves of some species of pimpernel and the sea-plantain is marked with a number of dots or points; a white line runs through the leaves of Indian reed, black-berried heath, and a species of Canary grass: and the margin or brim of the leaf, in some species of box, honeysuckle, ground ivy, and the evergreen oak, is of a silver-white colour. The whole plant is often found to assume a colour that is unnatural or foreign to it. The varieties in some species of eryngo, mug-wort, orrach, amaranthus, purslane, and lettuce, furnish examples of this.

Such being the inconstancy of colours in all the parts of the plant, specific names derived from that quality are very properly deemed erroneous by Linnæus; whether they respect the colour of the flower, fruit, seeds, roots, leaves, or express in general the beauty or deformity of the entire plant, with a particular view to that circumstance. But of this impropriety, committed by former botanists, Linnæus himself is not always guiltless. Thus the two species of *sarracena*, or the side-saddle flower, are distinguished by the colour of their petals into the yellow and purple sarracena; although the shapes and figure of the leaves afford much more constant as well as striking characters. The same may be said of his *Lupinus albus* and *luteus*; *Reseda alba, glauca,* and *lutea*; *Angelica atropurpurea*; *Dictamnus albus*; *Lamium album*; *Selago coccinea*; *Sida alba*; *Passiflora rubra, lutea, incarnata,* and *cærulea*; and of many others, in which the specific name is derived from a character or quality that is so liable to vary in the same species.

In conclusion, of all sensible qualities, colour is the least useful in indicating the virtues and powers of vegetables. The following general positions on this subject are laid down by Linnæus, and seem sufficiently confirmed by experiment:—A yellow colour generally indicates a bitter taste; as in gentian, aloe, celandine, turmeric, and other yellow flowers. Red indicates an acid or sour taste; as in cranberries, barberries, currants, raspberries, mulberries, cherries, the fruit of the rose, sea-buckthorn, and service-tree. Herbs which turn red towards autumn have likewise a sour taste; as sorrel, wood-sorrel, and bloody-dock. Green indicates a crude alkaline taste, as in leaves and unripe fruits. A pale colour denotes an insipid taste; as in endive, asparagus, and lettuce. White promises a sweet luscious taste; as in white currants and plums, sweet apples, &c. Lastly, black indicates a harsh, nauseous, disagreeable taste; as in the berries of deadly night-shade, myrtle-leaved sumach, herb-Christopher, and others—many of which are not only unpleasant to the taste, but pernicious and deadly in their effects. See also BOTANY, vol. v., pp. 107 and 151.

Colours. *Incapacity of distinguishing.* This peculiarity of vision was till lately supposed to be a very rare phenomenon. It appears first to have attracted attention in England, and some imperfectly described cases were recorded in the *Phil. Trans.* in the latter half of the preceding century. These examples were supposed to be unique, till the great chemist John Dalton announced himself in 1794 as exhibiting the peculiarity under notice, and described the cases of more than twenty persons similarly circumstanced. Later researches in England, France, Switzerland, Germany, Belgium, and America, have shown that this condition of vision is far from uncommon. Various names have been proposed for it, such as *Daltonism* from Dalton (an objectionable appellation which English writers all decline to use), *achromatopsy, dyschromatopsy, chromatopseudopsy,* &c. The most convenient English name is that of *colour-blindness*, suggested by Sir David Brewster, which, though not strictly accurate, is sufficiently distinctive to warrant its use even as a scientific term. Colour.

Colour-blindness is of two kinds. The one which is exceedingly rare is characterized by an inability to perceive any colour properly so called, the eye being only conscious of black and white, or rather of a very dark, and a very light gray. Living examples of this extreme colour-blindness have been recently described by English and foreign writers.

The other kind of colour-blindness, which is very common, shows itself in an inability to distinguish certain colours from each other, and to distinguish the very light tints of all colours from white, and the very dark shades from black. Those who err thus generally see in the rainbow only two colours, *blue* and *yellow*, but in the prismatic solar spectrum, looked at from a short distance, several additional coloured bands are distinguished.

The colours most liable to be confounded with each other are, 1. *Red* full and bright, including *crimson, scarlet* and the redder shades of *orange*, with full and bright *green*. 2. *Brown*, including *dull red*, with dark or *dull green*. 3. *Purple*, including *pink, crimson, lilac, lavender*, and other mixtures of red and blue throughout nearly all their shades, with *blue*. 4. *Green* with *blue*, even by daylight—the most common probably of all the forms of colour-blindness. 5. *Red* (including crimson and scarlet), with *black*. 6. Light tints of all colours, such as straw colour, and the equally pale shades of pink, blue, green, &c., with *white*. 7. Dark shades of all colours, such as claret, purple, olive-blue, with *black*. Popular interest has been chiefly excited by the mistakes of colour-blind persons between red and green; but in a scientific point of view the most singular mistake is that of full red for black, inasmuch as it implies that the eye thus deceived not only does not see red *as* red, but does not see it as any colour, or as in any way visible at all. Red light is thus equivalent to no light, and does not make even a luminous impression on the retina. The colour best distinguished by the colour-blind is *yellow*, and other colours are rarely mistaken for it. *Blue*, when pure and bright, is also perfectly distinguished, but *purples* and *greens* are often mistaken for blue.

Colour-blindness is greatly more common among males than females, but the relative proportion of cases in the two sexes has not been ascertained. Among males there is reason to believe that 1 in 20 is colour-blind in some degree; and that 1 in 50 is colour-blind to the extent of mistaking for each other the colours in the preceding list.

Colour-blindness, when marked, generally shows itself in more than one member of the same family, and has been traced from parent to child, through as many as five generations. It seldom, however, includes all the members of a family, and the whole of the females of a generation often escape. The eyes of the colour-blind present in general no peculiarity in appearance or internal structure, and the power of vision in reference to everything but colour is per

Colt || Columba.

fectly normal, and often appears even superior to that of those who do not mistake colours.

The cause of colour-blindness is not known, but the great majority of authors on the subject are agreed in referring it to some peculiarity of structure in the retina or brain. It appears to be quite incurable, but some assistance in distinguishing colours is derived from the substitution of artificial light for daylight; and yellow spectacles have proved of some service by day.

The subject is of practical importance from the great extent to which coloured signals are employed on railways and at sea; but especially on the former, where the colours preferred, viz., red and green, are among the greatest stumbling blocks of the colour-blind.

The fullest account of this peculiarity of vision will be found in the papers of Professor E. Wartmann of Geneva, the first of which was published in French in 1840, and translated into English in 1846, in *Taylor's Scientific Memoirs* for that year; the second entitled *Deuxième Mémoire* sur le *Daltonisme*, &c., is published in the *Memoires lus à la Société de Physique de Genève*, 1849. Some account of it is given in Mr W. Cooper's article VISION in the Cyclopædia of Anatomy. The latest English researches on the subject are contained in a series of papers by Dr George Wilson in the *Edinburgh Monthly Journal of Medical Science* for 1853-54.

COLT, the young male of the horse kind. See HORSE.

COLUBER. See index to SERPENTS.

COLUMB-KILL. See IONA.

COLUMBA, the PIGEON, a genus of birds. See index to ORNITHOLOGY.

COLUMBA, ST, a native of Ireland, in allusion to whose name one of the Hebrides received the appellation of Icolmkill, and also that of Iona—from a Hebrew word signifying a dove. In the year 565, this holy man left his native country, with the pious design of preaching the gospel to the Picts. It appears that he left Ireland with warm resentment, vowing never to settle within sight of his native land. He went first to Oronsay; but finding that place too near to Ireland, he removed to Hy, which was the name of Iona at that period.

Columba was soon distinguished for the sanctity of his manners; and a miracle which he wrought impressed so strongly the Pictish king Bradeus, that the latter immediately made a present of the little island to the saint. It seems that at first this prince had not only refused Columba an audience, but had even proceeded so far as to order the palace-gates to be shut against him. The saint, however, was not to be excluded in this way, and by the power of his word instantly caused the gates to fly open. As soon as he was in possession of Iona, Columba founded a cell of monks, borrowing his institutions from a certain oriental monastic order. It is said that the first religious persons in Iona were canons regular, of whom the founder was the first abbot; and that the monks, till the year 716, differed from those of the Church of Rome, both in the observance of Easter and in the clerical tonsure. In his insular retreat Columba led an exemplary life, and was highly respected for the sanctity of his manners. He is the first on record who pretended to the faculty of *second sight;* for he is said to have told the victory of Aidan over the Picts and Saxons at the very instant it happened. He had the honour of burying in his island Convallius and Kinnatil, two kings of Scotland, and of crowning a third. At length the saint, worn out with age, died in Iona in the arms of his disciples, and was interred there; but, as the Irish pretend, his corpse was in after times translated to Down, where, according to the epitaph, his remains were deposited beside those of St Bridget and St Patrick. The ancient lives of Columba are full of legendary stories about his miracles and prophecies, and quite worthless in a historical point of view. See Pinkerton's *Lives of the Saints*, art. Columba; Johnson's *Tour to the Hebrides;* Campbell's *Life of St Columba.* Columbanus || Columbia.

COLUMBANUS, an Irish monk, who was educated in the monastery of Bangor, and is said to have translated the Psalms. He left the monastery A.D. 590 along with 12 youths whom he was training as ecclesiastics, and repairing to France, established himself in a wilderness in the Vosges, where the ruins of an ancient castle (*Anagrates*) afforded shelter to the band. Here they were exposed to the greatest privations; but their superior learning and piety soon attracted crowds of admirers, for whose accommodation convents sprung up at Luxeuil and Fontenay. The enemies of Columbanus, however, taking advantage of some peculiar usages which he had brought from Ireland, accused him to the pope, and ultimately carried their suit before a Frankish synod in 602. A more powerful conspiracy was at the same time organized against him at the court, by Brunehault, the mother of Thierry II. king of Burgundy, who was indignant at the rebukes administered by the fearless missionary to her profligate son. She was joined in her scheme by a large party of Burgundian nobles and prelates, who were offended by the rigorous austerity of the monk, and at last procured an order commanding his return to Ireland. With a few chosen followers Columbanus retired to Nantes, and thence withdrew into Switzerland, where he preached to the Suevi and Allemanni. He afterwards went to Italy and founded the monastery of Bobbio, in which he remained till his death. The order of the Columbans was merged in that of the Benedictines in the beginning of the eighth century. (Neander's *Memorials of Christian Life.*)

COLUMBARIUM, in *Roman Antiquity*, the receptacle for funeral urns; so called from the resemblance of its small niches to a pigeon-house.

COLUMBIA, U.S. The district of Columbia was originally a tract of land of 100 square miles, ceded in 1790 by the States of Virginia and Maryland to the republic for the seat of the congress. It was situated on both sides of the Potomac river, about 120 miles from its mouth, and included the cities of Washington, Alexandria, and Georgetown. In 1846, however, the portion on the south side of the river was ceded back to Virginia. The present territory has an area of 60 square miles. The government of the district is vested solely in congress. The only laws, beyond the constitution of the United States, to which Columbia is subject, are those which were in force in Maryland at the period of its separation. The present district of Columbia contains only one county, that of Washington; and in this are comprised the cities of Washington and Georgetown. According to the census of 1850, the population amounted to 51,687, of whom 38,027 were whites, 9973 free coloured, and 3687 slaves. The employments of the district embrace almost every branch of national industry. Its manufactures and commerce are extensive, and its agriculture, though confined chiefly to the rearing of vegetables for the city-markets, is in a highly flourishing condition. The foreign commerce of the district is limited, and is carried on principally through the port of Alexandria, on account of the facility of transit afforded by the Chesapeake and Ohio canal.

COLUMBIA, the capital of the State of South Carolina, North America, stands on the east side of the Congaree river, immediately below the confluence of its main streams, the Broad and Saluda Rivers. The city is built upon an elevated plain 3 or 4 miles in extent, and gradually sloping in all directions. Its high situation contributes greatly to the health of the inhabitants, and affords an extensive view of the highly cultivated corn fields and cotton plantations of the surrounding district. It was founded in 1787, and is laid out on a rectangular plan, with streets 100 feet in width. The principal buildings are the state-house, 170 feet long by 60 feet wide, the county buildings, market-house, bank-

Columbia || Columbus.

ing-houses, academies, and churches. The college, founded in 1804, had in 1850 eight professors, 195 students, a library of 17,000 volumes, and a fine observatory. There are also two theological institutions in the town. The city possesses considerable manufactures, which have sprung up for the most part within the past decade; and its trade and commercial importance has greatly advanced since the completion of the lines of railway which diverge from it in all directions; and when the system proposed for South Carolina shall have formed junctions with the lines of the surrounding states, the commercial prosperity of this city will be indefinitely enhanced. The dwelling-houses are chiefly of wood, but many of them are of brick. Vessels of light draught can come up to the town, which is also the converging point of several railways. Pop. (1850) 6060.

COLUMBIA, a town of Lancaster county, Pennsylvania, on the east bank of the Susquehanna river, over which there is a bridge, 5960 feet long, resting on stone piers. It is connected with Havre de Grace by the Tide Water canal, and is a station on the Philadelphia and Columbia railway. It contains a town-hall, jail, 13 churches, and a number of other public buildings, and carries on a considerable trade with Baltimore and Philadelphia. Pop. 4340.

There are numerous other places of this name in the United States.

COLUMBIA RIVER. See OREGON TERRITORY.

COLUMBIUM, a metal discovered by Hatchett in 1801, in an American mineral. Several years afterwards it was rediscovered in a Swedish mineral, to which Eckeberg gave the name of Tantalite. Wollaston, however, showed that Eckeberg's new metal Tantalum was the same as Hatchett's Columbium. See CHEMISTRY.

COLUMBRETES, a cluster of islands belonging to Spain, off the coast of Valencia, about 70 miles from the shore in a north-easterly direction. They are of volcanic origin, and remarkably picturesque in appearance. The largest of the group is Colibri, supposed to be the ancient Ophiusa, so called from the Greek word for a snake, in which reptiles the island was believed at one time to abound. The ancient Ophiusa formed one of the cluster Pityusæ, the largest of which, Ebusus, was subsequently included among the Balearic Isles. The Columbretes were notorious in the middle ages, and even later, as affording a secure retreat to the corsairs and pirates of the Barbary States, who swarmed at that time in these seas.

COLUMBUS, CHRISTOPHER, the celebrated navigator and discoverer of the western world, was born not far from Genoa, about the year 1440. Although several illustrious families have contended for his alliance to them, his father Domenico, and his ancestors, appear to have followed the trade of woolcombers or carders, and were of humble though reputable origin. Columbus received his education at the university of Padua, and, having evinced an early passion for the sea, entered into nautical life at the age of fourteen. The first voyage in which we have any authentic accounts of his being engaged, was a warlike expedition fitted out at Genoa in 1459, when, associated with hardy and daring adventurers, he acquired so much distinction as to be intrusted with a separate command. After this, it is supposed, he was employed in various commercial, pious, and predatory expeditions against the Mohammedans and Venetians, in company with a famous corsair of his own name and family, and acquired reputation and experience in his profession. His son Fernando relates, that in an engagement off the coast of Portugal with four Venetian galleys, returning richly laden from Flanders, the vessel on board which he served, and one of the Venetian ships to which it was grappled, took fire. Columbus threw himself into the sea, seized an oar which was floating near him, and by this means, and his dexterity in swimming, reached the shore, although two leagues distinct. Proceeding thereafter to Lisbon, he was induced to take up his residence in that capital. Columbus.

Columbus became acquainted in Lisbon with the most eminent men in science and maritime art, whom the encouragement of Prince Henry of Portugal had attracted around him. At this period (anno 1470) he was in the vigour of manhood, of an engaging appearance, grave, courteous, and affable in his deportment, moderate and simple in his diet and apparel, eloquent in discourse, possessing high magnanimity, and a temper which, though irritable, was under the control of a gentle and enthusiastic piety. Here he married Dona Felipa, daughter of Bartolomeo Monis de Palestrello, an Italian cavalier lately deceased, and a distinguished navigator, who had discovered and colonized the island of Porto Santo. Having obtained possession of the journals and charts of this sea captain, and also hearing accounts of his voyages from his widow, Columbus was seized with an irresistible desire of visiting unknown regions. In order to indulge it, he made a voyage to Madeira, and continued during several years to trade with that island, the Canaries, Azores, the settlements in Guinea, and the other places which the Portuguese had discovered on the continent of Africa. By the experience acquired in such a number of voyages, Columbus became one of the most skilful navigators in Europe.

At the commencement of the fifteenth century, the intelligence of Europe, and particularly of Portugal, was directed in seeking everywhere for the "scattered lights of geographical knowledge." The lofty and enterprising mind of Prince Henry, matured by diligent researches and laborious investigation, conceived the idea of the circumnavigation of Africa; and under his auspices the Cape of Good Hope was doubled, and the commerce of the East thrown open to maritime adventure. At this period, whilst invention and skill were well nigh exhausted in the projection and accomplishment of this eventful discovery, the existence of the western world was never dreamt of; the Atlantic Ocean was regarded with awe and wonder, "seeming," says Washington Irving, "to bound the world as with a chaos, into which conjecture could not penetrate, and enterprise feared to adventure." The danger and tediousness of the voyage by Africa first set Columbus to ruminate whether a shorter and more direct passage to the East Indies could not be found out; and after long consideration, he became thoroughly convinced that, by sailing across the Atlantic in a westwardly direction, new countries, probably forming a part of the vast continent of India, would infallibly be discovered. He was led to this conviction by the theories of the ancients and the discoveries of the moderns, aided by his own experience and the advancement of science. Adopting as a fundamental principle, that the earth was a terraqueous globe, traversable round from east to west, he acquired a notion of its true figure. His eminent biographer, Washington Irving, relates, that "he divided the circumference from east to west at the equator, according to Ptolemy, into twenty-four hours, of fifteen degrees each, making three hundred and sixty degrees. Of these he imagined, comparing the globe of Ptolemy with the earlier map of Marinus of Tyre, that fifteen hours had been known to the ancients, extending from the Canary or Fortunate Islands, to the city of Thinæ, in Asia, the western and eastern extremities of the known world. The Portuguese had advanced the western frontier one hour more by the discovery of the Azores and Cape de Verde Islands; still

Columbus. about eight hours, or one third of the circumference of the earth, remained to be explored. This space he imagined to be occupied in a great measure by the eastern regions of Asia, which might extend so far as to approach the western shores of Europe and Africa. A navigator, therefore, by pursuing a direct course from east to west, must arrive at the extremity of Asia, or discover any intervening land. The great obstacle to be apprehended was from the tract of ocean that might intervene; but this could not be very wide, if the opinion of Alfraganus the Arabian were admitted, who, by diminishing the size of the degrees, gave to the earth a smaller circumference than was assigned to it by other cosmographers; a theory to which Columbus seems generally to have given much faith. He was fortified also by the opinion of Aristotle, Seneca, Pliny, and Strabo, who considered the ocean as but of moderate breadth, so that one might pass from Cadiz westward to the Indies in a few days."

Columbus received a decided confirmation of his theory in 1474, not only from Paolo Toscanelli, one of the ablest cosmographers of the day, and from the narrative of Marco Polo, a Venetian traveller, whose map proved of great assistance to our navigator in his first voyage of discovery; but also from the observations of several more modern navigators. Martin Vicenti, a Portuguese pilot, proceeding farther westward than usual, found a piece of artificially carved timber floating on the sea, and, as it was wafted by a westerly wind, conjectured that it might have come from some unknown land in that direction. Pedro Correo, the brother-in-law of Columbus, found a similar piece of wood on Porto Santo; and had also seen canes of an enormous size floating upon the waves, which resembled those described by Ptolemy as growing in India. After a course of westwardly winds, trees torn up by the roots were often driven upon the coast of the Azores; and at one time the dead bodies of two men, with singular features, different from those of any known race of people, were cast upon the island of Flores.

On these grounds Columbus formed the vast and daring enterprise which was destined to hand down his name to posterity with unfading honour; and, firmly established in a belief of the successful result of his projects, "he never," says Irving, "spoke in doubt or hesitation; but with as much certainty as if his eyes had beheld the promised land. A deep religious sentiment also mingled with his thoughts, and gave them at times a tinge of superstition, but of a sublime and lofty kind. He looked upon himself as standing in the hand of heaven, chosen from among men for the accomplishment of its high purpose; he read, as he supposed, his contemplated discovery foretold in holy writ, and shadowed forth darkly in the prophecies. The ends of the earth were to be brought together, and all nations, and tongues, and languages, united under the banners of the Redeemer."

The disturbed state of Portugal under Alphonso retarded the progress of discovery. The compass, though in general use, had not gained that reliance which induced mariners fearlessly to brave the dangers of the deep; and the project of a voyage through boundless wastes appeared extravagant and impracticable. Nothing daunted, however, by these disheartening symptoms, Columbus pursued his favourite schemes with ardour, and longed to put them into execution. So perilous an adventure was not, however, to be attempted without the patronage of some sovereign power; and John II. of Portugal having at this juncture ascended the throne, and being favourably inclined to the cause of discovery, Columbus made his proposals, which were graciously received by the monarch, and referred to a learned junto, consisting of Roderigo and Joseph, two physicians, and Diego Ortiz, bishop of Ceuta, all men of learning and science. Unfortunately, however, these were Columbus. the persons who had been the chief directors of the Portuguese navigations, and had advised to search for a passage to India by an opposite course to that which Columbus recommended as shorter and more certain. They could not therefore approve of his proposal without submitting to the double mortification of condemning their own theory and of acknowledging his superiority. The result of their conferences therefore was, that they recommended the king to fit out a caravel privately, and attempt the proposed discovery by the designated route, which they ascertained from charts and details craftily obtained from Columbus. John, in an evil hour, had the weakness to adopt this perfidious counsel. The caravel departed, but the pilots had neither the genius nor fortitude of Columbus; their courage failed, and putting back to the Cape de Verde Islands, they returned from thence to Lisbon, execrating the project as extravagant and irrational.

This ungenerous and unworthy attempt roused the indignation of Columbus, who immediately quitted Portugal, taking with him his infant son Diego, and made application to the government of Genoa; but this republic, weakened by the reverses of war, rejected a proposal that would have restored their ancient splendour, and might for a long period have "perpetuated the golden wand of commerce in the failing grasp of Italy." Columbus next carried his proposition to Venice, where he was equally unsuccessful. He also sent his brother Bartholomew to lay his plans before Henry VII. of England, having in the mean time sailed himself for Spain, where he arrived after having exhausted all his means.

Columbus, in this state of abject poverty, met with great hospitality from Friar Juan Perez de Marchena; and, encouraged by this worthy ecclesiastic and his friends, and assisted by the generosity of Martin Alonzo Pinzon, he set out for the Castilian court at Cordova in the spring of 1486. The moment was unpropitious for such a proposition, the Spanish sovereign being at the time engaged in military preparations against the Moorish kings. At length, through the intercession of Cardinal Gonzalez, he obtained an interview, and submitted his project to Ferdinand. True science had as yet made so little progress in Spain, that most of those to whom the consideration of his plan was referred were utterly ignorant of the first principles on which our adventurer founded his hopes. Some, from mistaken notions concerning the dimensions of the globe, contended that the voyage could not be performed in less than three years: others concluded that Columbus would find the ocean of infinite extent, according to the opinion of some ancient philosophers; or that if he should steer beyond a certain point, the convex figure of the globe would present a kind of mountain, up which the vessel could never sail with the most favourable wind. Even without entering into particular discussion, some rejected the scheme in general, making use of that maxim of the ignorant, "that it is presumptuous in any person to suppose that he alone possesses knowledge superior to all the rest of mankind united." Worn out with a series of disappointments and delays, and supporting himself by making maps and charts, Columbus, despairing of the Spanish patronage, began to look to other courts, in hopes of meeting more encouragement. He had already made preparations for this purpose, and taken measures for the disposal of his children during his absence, when Juan Perez solicited him to defer his journey, making application at the same time to Isabella, the result of which was a gracious invitation of Columbus back to court, accompanied with the present of a small sum to equip him for the journey. The monarchs were now pledged to attend to his proposals, and negotiations were set on foot to carry them into execu-

Columbus. tion. Columbus appeared before the persons appointed to confer with him, with the same confident hopes of success as formerly, and insisted on the same high recompense. He proposed that a small fleet should be fitted out under his command to attempt the discovery, and stipulating that he should be invested with the titles and privileges of admiral and viceroy of all the seas and lands he should discover, with one tenth of all gains, either by trade or commerce. He further offered to furnish an eighth of the cost, on condition of enjoying an eighth of the profits. His terms were, however, deemed inadmissible; the negotiation broke off, and Columbus, in indignation, mounting his mule, was already on the road to Cordova, with the intention of immediately proceeding to France, when he was overtaken by a messenger from the queen, who had been prevailed upon by the arguments of Quintanilla and St Angel, two of Columbus' patrons, again to favour his undertakings. The negotiations were now completed, and the capitulations were signed by Ferdinand and Isabella at Santa Fé on the 17th of April 1492. The articles of agreement were to the following effect:—That Columbus should be constituted high admiral in all the seas, islands, and continents he should discover, with similar honours and prerogatives to those enjoyed by the high admiral of Castile in his district. He was also nominated viceroy and governor-general over all the said lands and continents; and a tenth of all free profits arising from the merchandise and productions of the countries within his admiralty was granted to him for ever. Columbus, or his lieutenant, was to be sole judge of all causes and disputes arising out of traffic between those countries and Spain. He was further permitted to contribute an eighth part of the expense of expeditions to the countries he expected to discover, and was entitled in return to an eighth part of the profits. A principal object of Columbus in this undertaking was the propagation of the Christian faith, to which he was a zealous devotee. Expecting to arrive at the extremity of Asia, he hoped to spread the light of the gospel among the barbarian nations of the East; and so confident were his anticipations, that letters were actually given him by the sovereigns for the Grand Khan of Tartary. Although the royal documents were signed both by Ferdinand and Isabella, her separate crown of Castile defrayed all the expense; and the queen in consequence reserved for her subjects of that kingdom an exclusive right to all the benefits which might accrue from the success of the expedition.

The arrangement being finally completed, Columbus set sail on the 3d of August 1492, in three small vessels, only one of which (commanded by himself) was completely decked. The two others were commanded by Martin Alonzo Pinzon and Vicente Yañez Pinzon. The expedition had sailed nearly 200 leagues to the westward, when Columbus perceived that the needle of the compass, when night set in, had varied; a circumstance which filled the pilots with consternation. For this phenomenon he was obliged to invent a reason, which, though it did not satisfy himself, yet served to dispel their fears. As the squadron advanced, various indications of land, such as birds flying from the west, the water becoming less salt, and occasionally covered with weeds, animated and supported the courage of the crew; but at length murmurs and fears began to prevail amongst them. They had sailed for eleven days, wafted by a most propitious breeze, over a tranquil sea, without lowering or shifting a sail. The rude seamen began to be alarmed that no other winds blew but easterly, and that it would therefore be impossible for them ever to return home. A few light breezes from the west allayed for a time their apprehensions, and several small singing birds came in the morning and flew away at night. But the sailors lost all patience, and became so mutinous and refractory that it required the utmost address of Columbus to maintain his authority. The appearances of land, though frequent, were in many instances deceiving; and at last the seamen broke forth into loud clamours, and insisted upon abandoning the voyage. Fortunately, however, on the following day, the manifestations of land were such as no longer to admit of doubt. In the evening Columbus perceived a light glimmering at a distance, and the next morning land was clearly seen about two leagues distant. The sailors now burst forth into the most extravagant transports. They threw themselves at the feet of Columbus, implored his pardon, and pronounced him to be a person inspired by heaven with more than human sagacity and fortitude, to accomplish a design so far beyond the ideas and conceptions of all former ages. At daybreak, says his biographer Spotorno, on the 12th of October, the hero landed, "*e di grand'orma il nuovo mondo imprima*" (and with his great footstep impressed the new world). Columbus and his followers threw themselves on their knees; and rising, the admiral drew his sword, planted the cross, hoisted the royal standard, and in the presence of the astonished natives, who imagined that the Spaniards had dropped from heaven, took possession of these new countries in the names of the Castilian sovereigns, giving the island the name of San Salvador. Having visited several of the West India islands, and settled a colony in Hispaniola, he again set sail for Spain. On the voyage he fell in with the Pinta, which had separated from him for a long time through the wickedness of the captain, who had gone in search of gold. After encountering several violent tempests, Columbus arrived in the Tagus, near Lisbon, on the 4th of March 1493. He was treated with the most honourable attentions by the court of Portugal, and finally reached the port of Palos on the 15th of March. Columbus.

The triumphant return of Columbus excited the most unbounded transport. Wherever he went the air rang with acclamations, and he received such honours as are paid to sovereigns. The court was then at Barcelona, and Columbus took care immediately to acquaint the king and queen of his arrival. They were no less delighted than astonished with this unexpected event. The admiral was conducted into the city with all imaginable pomp. The sovereigns received him seated in state under a rich canopy of brocade of gold, surrounded by their principal nobility. When he approached they stood up, and, raising him as he kneeled to kiss their hands, ordered him to be seated in their presence, and give a circumstantial account of his voyage. When he had finished his oration, which he delivered with much modesty and simplicity, the king and queen, kneeling down, offered up solemn thanks to God for the discovery. Every possible mark of honour that could be suggested by gratitude or admiration was conferred on Columbus; the former capitulation was confirmed, his family was ennobled, and a fleet ordered to be equipped, to enable the navigator to go in quest of those more opulent countries which he still confidently expected to find.

The successful attainment of the splendid discovery of Columbus, great and manifold as were its advantages to mankind, was the prelude to the dark and troubled epoch of his life. By his second voyage to the western world he no doubt in part realized his expectations, extended his discoveries, and came back to Spain with substantial proofs of success; but the ostensible purpose of his return was to obtain reparation of injurious imputations which had been heaped upon him, and generally to have his privileges confirmed and enlarged so as to enable him to exercise his authority over the colonists, who had become re-

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factory and unmanageable. But his third voyage only accelerated his disastrous fate. The newly discovered possessions were distracted with the horrors of rebellion. The verdant and blooming isles, the expected abodes of peace and happiness, were converted into theatres of sanguinary conflicts and misery; and Columbus found himself an object of fear and execration. It was during this voyage that he landed on the coast of Paria, in South America. Meanwhile, his enemies in the old world were not idle. An investigation into his conduct was instituted under the control of Francisco Bovadilla, who was empowered, should he find the charge of mal-administration proved, to supersede Columbus, and assume the government of Hispaniola. The result was, that he and his brothers Diego and Bartolomeo, after having been treated with the greatest indignities, were sent to Spain in chains. From these disgraceful bonds he was immediately on his arrival released by the Spanish monarchs; but his complaints were tardily acknowledged; he again sunk into obscurity, and was reduced to such straitened circumstances that, according to his own account, "he had no place to repair to except an inn, and very frequently had not wherewithal to pay his reckoning."

At length he was again employed in a fourth voyage, with restricted powers. But the result was unpropitious; and he returned to Spain, dejected in mind and worn out with bodily infirmities. Death at last relieved him from his earthly afflictions. He expired on the 20th of May 1506, commending, with his latest breath, his spirit to God. A marble tomb was reared over his dust, bearing the inscription,

A Castilla y a Leon,
Nuevo mondo dio Colon.[1]

Columbus was a man of great and original genius, energetic in his conduct, and possessed of lofty, daring, but noble ambition. "The magnanimity of his nature," says Irving, "shone forth through all the troubles of his stormy career. Though continually outraged in his dignity, braved in his authority, foiled in his plans, and endangered in his person, by the seditions of turbulent and worthless men, and that, too, at times when suffering under anguish of body and anxiety of mind, enough to exasperate the most patient, yet he restrained his valiant and indignant spirit, and brought himself to forbear, and reason, and even to supplicate." His piety, though tinctured with superstition, was genuine and fervent. If on certain occasions his religion displayed itself in harshness and severity, the spirit of the age he lived in must be adverted to in palliation of his conduct. His temperament was deeply imbued with poetic enthusiasm. "It spread," remarks Irving, "a golden and glorious world around him, and tinged every thing with its own gorgeous colours. It betrayed him into visionary speculations, which subjected him to the sneers and cavils of men of cooler and safer but more grovelling minds. It filled his mind with solemn and visionary meditations on mystic passages of the Scriptures, and on the shadowy portents of the prophecies." "His soul," observes a Spanish writer, "was superior to the age in which he lived. For him was reserved the great enterprise of traversing a sea which had given rise to so many fables, and of deciphering the mystery of his age." "With all the visionary fervour of his imagination," adds Washington Irving, "its fondest dreams fell short of the reality. He died in ignorance of the real grandeur of his discovery. Until his last breath he entertained the idea that he had merely opened a new way to the old resorts of opulent commerce, and had discovered some of the wild regions of the East. He supposed Hispaniola to be the ancient Ophir which had been visited by the ships of king Solomon, and that Cuba and Terra Firma were but remote parts of Asia. What visions of glory would have broken upon his mind could he have known that he had in deed discovered a new continent, equal to the old world in magnitude, and separated by two vast oceans from all the earth hitherto known by civilized man! and how would his magnanimous spirit have been consoled, amidst the afflictions of age and the cares of penury, the neglect of a fickle public and the injustice of an ungrateful king, could he have anticipated the splendid empires which would arise in the beautiful world he had discovered, and the nations, and tongues, and languages which were to fill its lands with his renown, and to revere and bless his name to the latest posterity!" It will be remarked that Mr Irving, in accordance with the generally entertained belief of all his biographers, alludes to Columbus as being the first discoverer of the American continent. It is, however, certain that it was visited by the Icelanders in the end of the tenth and beginning of the eleventh centuries; and Sebastian Cabot discovered Newfoundland and Labrador in June 1497, nearly a year previous to the visit of Columbus on the coast of Paria. It also seems more than probable that Columbus was aware of Cabot's discovery. See CABOT.

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Few subjects have afforded more abundant matter for learned discussion than the records that from time to time have appeared relating to Columbus. His birth-place alone has given rise to much ingenious and unprofitable speculation. That point, as well as the dates of his birth, and several voyages, are now pretty correctly ascertained. The curious in such investigations are referred to the Spanish and Italian authors, particularly to *Dissertazione della Patria di Christophero Colombo*, Firenze; the *Lives of Columbus*, by Bossi and Spotorno; and the *Rélations des Quatre Voyages enterpris par Christopher Colomb*, par M. F. de Navarette, ouvrage traduit de l'Espagnol, Paris, 1828. See also *Memorials of Columbus*, by Spotorno; and *Histoire de l'Amiral Colomb*, par Fernando Colomb.

In addition to these points of minor and less general interest, several controversies have arisen bearing upon the claims of Columbus to the discovery of the western world; but such disputes, at least in so far as they affect the discovery of the *Columbian archipelago*, are proved to be idle and futile; as no doubt now remains of Columbus having been the first navigator of the old world who reached the island of San Salvador, and the first who visited the shores of the South American continent. One of the most current slanders on our navigator's fair fame, as related by Inca Garcilaso, was, that Alonzo Sanchez, sailing to the Canaries in 1484, reached the island of St Domingo, and communicated his voyage and route to Columbus. Some other Spanish writers notice the event without giving the name of the author of the discovery. Oviedo considers these relations as mere vulgar fables. We are, however, told by Columbus himself that he took advantage of such accounts as were transmitted to him by Spanish and Portuguese mariners, some of whom had sailed westward so far as to perceive what they considered to be indications of land. Gallo and Giustiniani, authors contemporaneous with Columbus, assert that Bartholomew Columbus first conceived the idea of western discovery, and communicated it to his brother; but Columbus has been triumphantly vindicated from these ungenerous aspersions by the unanimous testimony of the Spanish writers, among whom Las Casas, who knew both brothers, and preserved many papers belonging to Columbus, merits especial credence.

[1] To Castile and to Leon Colon gave a new world.

Columbus ‖ Column.

But if any doubts remained, they are completely removed by the written declaration of Ferdinand and Isabella, who, in a communication dated the 4th of August 1494, write thus to the admiral: "One of the principal reasons for which your discovery (the first) has caused so much joy to us is, that it is to be ascribed to your genius (por ser inventada), and that it has been commenced and terminated by your own individual endeavours, by your courage, your perseverance, and industry."

COLUMBUS, the capital of the state of Ohio, North America, stands on the E. side of the Scioto, immediately below the influx of the Whetstone, 110 miles N.E. of Cincinnati. The town is well laid out, the streets crossing each other at right angles; the private dwellings are generally neat and substantial, and many of them elegant. The old state-house was destroyed by fire in 1852, and a great number of historical documents of the state were irretrievably lost. The new state-house is a magnificent building, 304 feet long and 184 feet wide, covering an area of 55,936 square feet. The first floor contains 28 fire-proof rooms for the public offices, and the second floor contains the hall of representatives, 84 feet long and 72½ feet wide; the senate chamber, 72½ by 56 feet, the library, court-room, and 26 committee-rooms. The state penitentiary is an elegant edifice of hewn limestone, the centre being 56 feet long and four stories high, and the two wings each 200 feet long and three stories high. There are also asylums for the insane, the deaf and dumb, and the blind; several colleges, and numerous schools and churches. Columbus is the seat of numerous and extensive manufactures, and a place of considerable trade. Its population had risen from 6048 in 1840 to 17,883 in 1850.

COLUMBUS, the capital of Muscogee county, state of Georgia, North America, stands on the E. side of the Chattahoochee, immediately below the falls of that river. It has several large cotton and woollen factories and flour mills, and is one of the great commercial centres of Georgia, and a depôt of a large extent of rich cotton country. Pop. (1850) 5942.

COLUMELLA, LUCIUS JUNIUS MODERATUS, the most voluminous and important Roman writer on rural affairs, was a native of Gades (Cadiz), and flourished about A.D. 42. He was contemporary with Seneca, and resided chiefly at Rome. His works consist of a treatise entitled *De Re Rustica*, and another *De Arboribus*. The treatise *De Re Rustica* is divided into 12 books, of which the tenth is in verse. The treatise *De Arboribus* was incorporated in early editions with the other, thus making one work in 13 books. The editio princeps was printed by Jenson at Venice 1472, folio (very rare), in a collection of *Rei Rusticæ Scriptores varii*. The *Liber De Arboribus* was first separated from the other work in an edition published by Aldus, Venice, 1514, 4to. An excellent edition of Columella's works is contained in the *Rei Rusticæ Scriptores veteres Latini*, edited by Gesner, Lips. 1735, 2 vols. 4to, and reprinted there in 1773; but the most complete is that contained in the *Scriptores Rei Rusticæ* of Schneider, 4 vols. 8vo, Lips. 1794. Columella may be ranked among the best writers of the silver age. His works have been translated into English, French, Italian, and German.

COLUMN (Lat. *columna*), in *Architecture*, a pillar made to support and adorn a building, and composed of a base, a shaft, and a capital. See ARCHITECTURE.

COLUMNS, *denominated from their use*:—

Astronomical COLUMN is a kind of observatory, in the form of a lofty hollow tower with a spiral staircase.

Chronological COLUMN, that which bears some historical inscription digested according to the order of time; as by lustres, olympiads, fasti, epochas, annals, and the like. At Athens there were columns of this kind, on which was inscribed the whole history of Greece, digested into olympiads.

Funeral COLUMN, that which bears an urn in which the ashes of one deceased are supposed to be inclosed. Column.

Gnomonic COLUMN, a cylinder on which the hour of the day is represented by the shadow of a style.

Historical COLUMN, one whose shaft is adorned with a basso-relievo running in a spiral line its whole length, and containing the history of some great personage. Such are the Trajan and Antonine columns at Rome.

Indicative COLUMN, one that serves to show the tides, &c. Of this kind there is one of marble at Grand Cairo, on which the overflowings of the Nile are expressed, and by which the Egyptians are used to form a judgment of the succeeding seasons. Thus, when the water ascends to 23 feet, it is a prognostic of great fertility in Egypt.

Instructive COLUMN, that raised, according to Josephus (lib. i. cap. 3), by the sons of Adam, on which were engraven the principles of arts and sciences. Baudelot remarks that the son of Peisistratus raised another of this kind, of stone, containing the rules and precepts of agriculture.

Itinerary COLUMN, with several faces, placed at cross-ways in great roads, with inscriptions to show the different routes.

Lactary COLUMN, at Rome, according to Festus, a column in the herb market, with a cavity in its pedestal, in which young children abandoned by their parents were exposed, to be brought up at the public expense.

Legal COLUMNS, among the Lacedæmonians, were columns raised in public places, on which were engraven the fundamental laws of the state.

Limitrophous or *Boundary* COLUMN, that which shows the limits of a kingdom or country conquered. Such was that which, Pliny says, Alexander the Great erected at the extremity of the Indies.

Manubiary COLUMN (from *manubiæ*, spoil), a column adorned with trophies taken from an enemy.

Memorial COLUMN, one raised in memory of any remarkable event. Such is the Monument of London, built to perpetuate the memory of the burning of that city in 1666.

Menian COLUMN, any column which supports a balcony or meniana. The origin of this kind of column Suetonius and Ascanius refer to one Menius, who sold his house to be converted into a public edifice, and reserved to himself the right of raising a column on the outside to bear a balcony, whence he might see the public spectacles. This term was also applied to a pillory in the forum.

Military COLUMN, among the Romans, a column on which was engraven a list of the forces in the Roman army, ranged by legions in their proper order. They had another kind of military column called *columna bellica*, standing before the temple of Janus, at the foot of which the consul declared war by throwing a javelin towards the enemy's country.

Milliary COLUMN, a column of marble raised by order of Augustus in the middle of the Roman forum, from which, as a centre, the distances of the several cities and stations of the empire were reckoned by other milliary columns disposed at equal distances on all the great roads. This column was of white marble, the same with that which is now seen on the balustrade of an edifice in the capitol at Rome. Its proportion is massive, being a short cylinder, the symbol of the globe of the earth. It was called *milliarium aureum*, as having been gilt, at least the ball, by order of Augustus. It was restored by the Emperors Vespasian and Hadrian, as appears by the inscriptions.

Sepulchral COLUMN was anciently a column erected on a tomb or sepulchre, with an inscription on its base. Those over the tombs of persons of distinction were very large; those for the common people small. The latter were called *stelæ* and *cippi*.

Triumphal COLUMN, a column erected among the ancients in honour of a hero, and decorated with various

Columnarium || Comana.

kinds of crowns, corresponding to the number of his achievements in battle. Each crown had its particular name, as *vallaris*, which was fitted with spikes, in memory of his having forced a palisade; *muralis*, adorned with little turrets, or battlements, for having mounted an assault; *navalis*, of prows and beaks of vessels, for having vanquished at sea: *obsidionalis*, or *graminalis*, of grass, for having raised a siege; *ovans*, of myrtle, which expressed an ovation, or minor triumph; and *triumphalis*, of laurel, for a grand triumph.

COLUMNARIUM, in *Roman Antiquity*, a tax on the pillars of houses, first imposed by Julius Cæsar, in order to check the extravagant expenditure on palaces which then prevailed at Rome. The *ostiarium*, or tax on doors, was probably imposed at the same time.

COLURES (Lat. *colurι*), in *Astronomy* and *Geography*, two circles, one of which passes through the equinoctial points, and is denominated the equinoctial colure; the other intersects the equator at the distance of 90° from the former, and is called the solstitial colure. The term is chiefly employed in the older treatises on astronomy.

"The space of seven continued nights he rode
With darkness, thrice the equinoctial line
He circled, four times cross'd the carr of Night
From pole to pole, traversing each colure."—*Paradise Lost*, B. ix.

COLYBA, or COLYBUS, a term in the Greek liturgy, signifying an offering of corn and boiled pulse, in honour of the saints, and for the faithful deceased. Balsamon, Goar, Leo Allatius, and others, have written on the subject of *colybæ*.

COLYTON, a small market-town of England, county of Devon, on the Coly, near its junction with the Axe, 22 miles east of Exeter and 151 from London. The houses are mostly built of flint. It has a church with a fine screen and several interesting monuments, and an endowed school. Pop. of parish (1851) 2504.

COMA (κῶμα a swoon) a preternatural propensity to sleep; a kind of stupor induced by disease. Hence also the term *comatose*.

COMA *Berenices*, Berenice's hair, in *Astronomy*, a constellation of the northern hemisphere, composed of indistinct stars between the Lion's tail and Bootes. See BERENICE.

COMACCHIO, a strongly fortified town of Italy, States of the Church, legation of Ferrara, and 27 miles S.E. of that city. The town is unhealthy, being surrounded by salt marshes termed *Valli-di-Comacchio*. Pop. 5500, principally engaged in the eel fisheries and salt works. By the treaty of Vienna, this town is garrisoned by the Austrians.

COMANA (called also CHRYSE or AUREA, i.e. *the golden*, to distinguish it from Comana in Pontus), a city of Cappadocia, in a deep valley of the Anti-Taurus range, through which the river Sarus (Sihun) flows. This city was peculiarly celebrated in ancient times as the place where the rites of the goddess Artemis Tauropolos were celebrated with much solemnity. The worship of that deity is said to have been introduced by Orestes while on his way back from Tauric Scythia with the image of Minerva that had fallen from heaven. The service was carried on in a sumptuous temple and with great extravagance. To defray expenses, large estates had been set apart which yielded a more than royal revenue. The city of Comana, which was a mere appanage of the temple, was governed immediately by the chief priest, who was always a member of the reigning family, and took rank next to the king. The number of persons engaged in the service of the temple, even in Strabo's time, was upwards of 6000. Under Caracalla Comana became a Roman colony. Its site is now occupied by Al Bostan, a thriving town of about 10,000 inhabitants.

COMANA was also the name of a city in Pontus, which was said to have been colonized from the Cappadocian Comana. It stood on the river Iris (the *Tocat-su*), not very far from its source, and from its central situation was a favourite emporium of the Armenian merchants. Minerva was worshipped here with a pomp and ceremony in all respects analogous to those employed in the other city of this name. Under the Romans the town received the name of Hiero-Cæsarea, indicative of its sacred character. Some remains of Comana have been lately discovered at a place called Gumenek on the Tocat-su, a few miles from Tocat.

Comayagua || Combination

COMAYAGUA, formerly VALLADOLID LA NUEVA, a city of Central America, capital of the state of Honduras, and of a department of its own name. It is the seat of a bishop, and has a cathedral, college, ecclesiastical seminary, and about 20,000 inhabitants.

COMB, a well-known instrument for arranging the hair. Combs were formerly made by saws that cut out the interstices of the teeth; but they are now made by a sort of chisel with several edges that cut two combs at once out of the same piece of horn, tortoiseshell, or ivory,—the teeth of one coming out of the portion interposed between the teeth of the other. This process is called the *parting* of combs, and is exceedingly ingenious. See *Trans. Soc. Arts; Engineer's and Mechanics' Encyclop.*

COMB, or *Coomb*, an old corn measure, equal to four Winchester bushels.

COMBACONUM, a town of Southern India, in the province of Tanjore. This was the ancient capital of the Chola race, one of the oldest Hindu dynasties of which any traces remain, and from whom the whole coast of Coromandel, properly Cholamundel, derives its name. The present town has several wide and airy streets, and extends about two miles in length and one in breadth. The population in 1837 amounted to 30,000. The public bazaar forms a long and wide street, and is well stocked with provisions of all kinds. Distant from the sea-coast 30 miles. Lat. 10. 58., Long. 79. 26.

COMBAT. See BATTLE, and CHAMPION.

COMBE or COMB (Saxon), in the names of places, signifies a valley between hills; as Branscomb, Salcombe.

COMBER or CUMBER, a small market-town of Ireland, county of Down, at the N.W. extremity of Lough Strangford, 8 miles E.N.E. of Belfast. The town is tolerably well built, and in 1851 had 1790 inhabitants, chiefly employed in the linen manufacture.

COMBINATION, among individuals, may be defined to be a concert or agreement to bring about a certain result or object. In political economy the term is employed to designate an agreement or union among work-people to effect an increase of wages, or some modification of the terms or conditions under which they are engaged; and as this is a subject of much practical importance, we shall examine it a little in detail.

It was the practice of the legislature, subsequently to the reign of Edward I., to interfere respecting the stipulations in the contracts between masters and servants. And its deliberations being in most cases guided by the advice of the masters, it was natural that it should interfere rather to promote their particular interests, than that it might treat both parties with the same even-handed and impartial justice. But the gradual though slow dissemination of more enlarged principles of public economy having impressed all classes with a conviction of the general impolicy of such interference, it has latterly been rarely practised. The experience of nearly 500 years has shown that, while every attempt to set a maximum on the price of labour is oppressive and injurious to the workmen, it is of no real advantage to their employers; for it has been found that workmen have invariably become more persevering, sober, and industrious, according as their freedom

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has been extended, and as they have been relieved from the vexatious restraints to which they were formerly subjected.

But though the legislature has long ceased to dictate the terms on which masters should buy and workmen sell their labour, a set of laws were of late much extended, and were very frequently acted upon, by which workmen were severely punished for *combining* together to raise their wages, or to oppose their reduction. These laws had their origin in a dark and barbarous period. The dreadful plague that desolated England, in common with most other countries of Europe, in 1348 and 1349, having destroyed great numbers of the labouring poor, a greater competition took place for the services of those who survived, who, in consequence, obtained much higher wages. Parliament, however, instead of leaving this temporary rise of wages to which the poor had an unquestionable right, to be modified by the increase of population it would have occasioned, passed in 1350, the famous act (25th Edward III., cap. 1) for regulating wages. This statute directed that labourers should serve for such wages as were common in the districts in which they resided previously to the pestilence. But, as this gave rise to a great deal of cavilling, a statute was passed two years after, fixing the specific amount of the wages to be given to reapers, mowers, haymakers, thrashers, &c., and to the more common and important classes of artificers.[1] A variety of subsequent acts were passed, to enforce compliance with the regulations in the statute of wages, of the spirit of which some idea may be formed from the fact of its having been made *felony*, by a statute passed in 1425 (3d Henry VI., cap. 1), for masons to confederate or combine together to raise their wages above the statutory rate. And though this barbarous law has long ceased to be acted upon, it was not effaced from the statute-book till 1824, and may be considered as the parent stock from which the statute against combinations was derived.

This statute (39th and 40th Geo. III., cap. 105), after declaring all combinations to obtain an advance of wages to be unlawful, went on to enact, that workmen who should enter into a combination, either verbal or in writing, to obtain an advance of wages, to lessen the hours or time of working, to decrease the quantity of work, to persuade, intimidate, or, by money or otherwise, endeavour to prevail on other workmen not to accept employment; or who should, for the purpose of obtaining an advance of wages, endeavour to intimidate or prevail on any person to leave his employment, or to prevent any person employing him; or who, being hired, should, without any just or reasonable cause, refuse to work with other workmen, such workmen should, on the oath or oaths of one or more credible witnesses, before any two justices of the peace, within three calendar months after the offence had been committed, be committed to and confined in the common jail within their jurisdiction, for any time not exceeding three calendar months; or, at the discretion of such justices, should be committed to some house of correction within the same jurisdiction, there to remain, and be kept at hard labour, for any time not exceeding two calendar months.

The extreme severity of this enactment must strike every one. Justices of the peace belong to the order of masters; and, however respectable individually, they generally possess a full share of the peculiar feelings and prejudices of their class. To invest two of them with the power of imprisoning workmen for three months without the intervention of a jury, was certainly intrusting them with an authority very liable to be abused, and which, if it were to be exercised at all, should have been placed in hands less likely to act under a bias. The workmen could, it is true, appeal to the quarter sessions: but as this was only an appeal from one set of justices to another, it was of little importance. There were a variety of other clauses, discharging all workmen from attending any meeting for the purpose of combining, from contributing to defray the expenses incurred by persons acting contrary to this act, and compelling offenders to give evidence, &c. &c., under the above-mentioned penalties. Combinations were, also, punishable at common law as a misdemeanour.

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Such being the law, it may be supposed, perhaps, that no combination would be able to exist or be thought of. But, in point of fact, the law had quite another effect. It prevented open and avowed combinations; but it could not, and did not, prevent those of a secret, and, consequently, dangerous character. And though numberless attempts were made to enforce the law, and workmen were very often imprisoned for combining to raise wages, the practice of combination became all but universal, and frequently led to acts of an atrocious description. In consequence a very strong feeling began to grow up, which was not confined to the work-people, but extended to a large number of the masters, that the combination laws did more harm than good. In unison with this feeling a committee of the House of Commons was appointed in 1824 to inquire into the operation of the laws for preventing combinations among workmen, and for preventing their emigration, and the exportation of machinery. This committee collected a great deal of evidence on these subjects. And the impression made by it, and by the growing conviction of the impolicy of the combination laws, was such that a bill for their repeal, introduced by Mr Hume, the chairman of the committee, was soon afterwards carried through both houses, and passed into a statute.

But this statute having been found to be defective, another was passed in the course of the following year, the 6th Geo. IV., cap. 129, now the regulating statute on the subject. It legitimates meetings and agreements, whether verbal or written, for regulating the rate of wages and the hours of working. But, at the same time, it very properly imposes a penalty of three months' imprisonment on all attempts, whether by threats or violence, to hinder work-people not belonging to the combination from working on such terms as they may think proper, or to induce them to join the combination, or any club or association for dictating to their masters. A subsequent statute, 9th Geo. IV., cap. 31, makes assaults arising out of a combination to raise wages punishable by hard labour as well as imprisonment.

At present, therefore, combinations to raise wages or limit the hours of labour are perfectly legal, if they be unaccompanied by threats or violence. These measures have not, however, had all the effect which many of their supporters anticipated. And it must be admitted that the workmen have in many instances discovered a refractory and turbulent disposition, and that there is hardly a branch of industry in which they have not resorted to *strikes*, and entered into combinations to raise wages, and to dictate to their masters the mode in which they should be employed. But though much to be regretted, this, after all, is only what might have been fairly expected. Great stress had long been laid, in the public estimation, on the efficacy of the combination laws. The workmen had been punished for entering into combinations, because it was supposed that they might thereby force up wages to an undue elevation; and when such notions, though false and unfounded, were embodied in the statute book and proclaimed from the bench, it need not excite surprise that they were credited by the work-people. Nothing, indeed, could be more natural than that the latter, when they were

[1] See the Rates in Sir F. M. Eden's State of the Poor, vol. i., p. 33.

Combination. emancipated from the restraints of the law, should endeavour to avail themselves of what was supposed to be the powerful resource of combination. It should also be borne in mind that a large number of individuals began immediately to perceive that, whatever might be their influence in other respects, combinations might be turned to good account by those by whom they were organized and managed. But apart from the peculiar interests of such parties, it was but reasonable to suppose that for a while at least combinations would be in high favour with the working-classes; and that nothing but experience would suffice to convince them of their generally ruinous tendency.

Although, however, we regret and condemn many of the proceedings of the workmen, we are very far from thinking that they form any valid reason either for the revival of the Combination Act, or for the enactment of any similar statute.

Nothing can apparently be more reasonable than that workmen should be allowed freely to combine or associate together, for the purpose of adjusting the terms on which they will sell their labour. Wages, like every thing else, should always be left to be regulated by the fair and free competition of the parties in the market, without being interfered with by the legislature. "The property," says Adam Smith, "which every man has in his own labour, as it is the original foundation of all other property, so it is the most sacred and inviolable. The patrimony of a poor man lies in the strength and dexterity of his hands; and to hinder him from employing this strength and dexterity in what manner he thinks proper, without injury to his neighbours, is a plain violation of the most sacred property." But workmen are not allowed freely to dispose of their labour, if they be prevented from concerting with each other the terms on which they will sell it. Capacity to labour is to the poor what stock is to the capitalists. Now a hundred or a thousand capitalists may form themselves into a company, or combination, take all their measures in common, and dispose of their property as they may, in their collective capacity, judge most advantageous for their interests:—And why should not a hundred or a thousand labourers be allowed to do the same by their stock? Of all the varieties of property which a man can possess, the faculties of his mind and the powers of his body are most particularly his own. And to fetter him in the mode in which he is to exercise or dispose of these faculties and powers, is a manifest encroachment on the most inviolable of all rights, and can be justified only by an overwhelming necessity.

It is easy, however, to show that, in point of fact, no such necessity ever did or can exist. The wages of any set of workmen who enter into a combination for the purpose of raising them must be either—1*st*, below the natural and proper rate of wages in the branch of industry to which they belong; or, 2*d*, they must be coincident with that rate, or above it. Now, it is clear that, in the first case, or when wages are depressed below their natural level, the claim of the workmen for an advance is fair and reasonable: and it would obviously be unjust and oppressive to prevent them from adopting any measure, not injurious to the rights of others, which they may think best fitted to render their claim effectual. But a voluntary combination among workmen is certainly in no respect injurious to any right of their masters. It is a contradiction to pretend that masters have any right or title to the services of free workmen in the event of the latter not choosing to accept the price offered them for their labour. And as the existence of a combination to procure a rise of wages shows that they have not so chosen, and is a proof of the want of all concord and agreement between the parties, so it is also a proof that the workmen are fairly entitled to enter into it; and that, however injurious their proceedings may be to themselves, they do not encroach on the privileges or rights of others. Not only, therefore, is a voluntary combination, unaccompanied by violence, a fair exercise of the right of judging for themselves on the part of workmen, but when it is entered into for the purpose of raising wages that are unduly depressed, its object is proper and desirable. Few masters willingly consent to raise wages; and the claim of one or a few individuals for an advance of wages is likely to be disregarded so long as their fellows continue to work at the old rates. It is only when the whole or the greater part of the workmen belonging to a particular master or department of industry combine together, or when they act in that simultaneous manner which is equivalent to a combination, and refuse to continue to work without receiving an increase of wages, that it becomes the immediate interest of the masters to comply with their demand. And hence it is obvious, that without the existence either of an open and avowed, or of a tacit and real combination, workmen would not be able to obtain a rise of wages by their own exertions, but would be left to depend on the competition of their masters. Combination.

It is, however, abundantly certain that this competition will always raise wages that have been unduly depressed. And it was from not adverting to this fact, that the influence of the combination laws in depressing wages was so very greatly exaggerated. If the wages paid to the labourers in a particular employment be improperly reduced, the capitalists who carry it on obviously gain the whole amount of this reduction over and above the common and ordinary rate of profit obtained by the capitalists who carry on other employments. But a discrepancy of this kind cannot be of long continuance. Additional capital immediately begins to be attracted to the department where wages are low and profits high; and its owners are obliged, in order to obtain labourers, to offer them higher wages. It is clear, therefore, that if wages be unduly reduced in any branch of industry, they will be raised to their proper level, without any effort on the part of the workmen, by the competition of the capitalists. And looking generally at the various employments carried on in the country, we do not believe that the combination laws had any sensible influence over the average and usual rate of wages. That they occasionally kept them at a lower rate in some very confined businesses than they would otherwise have sunk to, may be true; though for that very reason they must have equally elevated them in others. This, however, is no good reason why the workmen engaged in employments in which wages happen from any cause to be unduly depressed, should be prohibited from adopting the only means in their power of doing themselves justice. When they are allowed freely to combine, their combination may occasion an immediate rise of wages; but when their combination is prevented, more or less time must always elapse before the high profits caused by the undue reduction of wages become generally known, and consequently before capital can be attracted from other businesses. And hence it is clear, that every attempt to prevent combination in such cases as this, is neither more nor less than an attempt to hinder workmen from making use of the only means by which their wages can be speedily and effectually raised to their *just level*. It is committing injustice in behalf of the strong, at the expense of the weaker party.

We admit that the object of the second class of voluntary combinations, or of those which take place when the wages of the combining workmen are already equal to or above their natural and proper rate, is improper and unreasonable. Still, however, it is easy to see that there is no more cause for the interference of the legislature in this case than in the former. There is no good reason why workmen should not, like the possessors of every other valuable and desirable article, be allowed to set whatever price they please upon their labour. If they combine to raise wages beyond their natural limits, or to enforce vexatious or improper condi-

Combination. tions in regard to their employment, it is all but certain that their combination will be unsuccessful. It may be taken for granted, that the masters will resist any really improper demand; and the slightest glance at the relative condition of the parties must satisfy every one that, supposing them to be in earnest in their opposition, they can hardly fail to succeed in defeating it. The workmen always suffer more from a *strike* than the masters. It is indeed true, as Adam Smith has observed, that in the long run they are as necessary to their masters as their masters are to them. But this necessity is far from being so immediate. The stock and credit of the master are in almost every instance much greater than the stock and credit of his labourers; and he is, therefore, able to maintain himself for a much longer time without their labour, than they can maintain themselves without his wages. In old-settled and fully-peopled countries, wages are seldom so high as to enable labourers to accumulate any considerable stock; and though the scanty funds of those engaged in strikes are frequently eked out by contributions from the work-people in other businesses, and in other parts of the kingdom, the combination never fails, provided the masters do not give way, to break to pieces.

It is also evident, that when workmen enter into a combination to enforce an unreasonable demand, or to raise wages that are already up to the common level, they can gain nothing, but must lose by entering into other employments to which they have not been bred; while it is equally evident that a small extra sum will be sufficient to entice other labourers to the business they have left. All the great departments of industry have so many closely allied branches, that a workman who is instructed in any of them can, without much training or difficulty, apply himself to some of the others. And thus the workmen who enter into the combination will not only fail of their object, and be obliged to return to their work, but, owing to the influx of other labourers into their business during the *strike*, they will probably be compelled to accept of a lower rate of wages than they previously enjoyed.

Many extensive combinations have been broken up by the masters acting on this principle, or by their bringing work-people from other districts, or other businesses, to supply the place of those in the combination. At first, these work-people may not be so skilful or expert as those who have seceded; but these deficiencies soon become insensible, and are more than compensated by the greater command the masters have over the new hands, who, it is commonly stipulated, shall not enter into any union or association with other workmen for the purpose of raising wages, regulating the hours of work, &c.

The combination of the coal miners of the north in 1844, when about 40,000 hands struck for a modification of the conditions under which they had previously been employed and an advance of wages, though one of the most formidable that has hitherto existed, was defeated in the way now mentioned. It was carefully organized, and had, when it began operations, a reserve fund of about L.24,000, besides receiving subscriptions from trades'-unions in most parts of the country But the coal-owners determined not to give way, and made every exertion to bring miners and other labourers from Scotland, Wales. and Ireland, to supply the place of those who had seceded. The result justified the wisdom of their determination; for the turn-outs, after an obstinate strike of from four to five months' duration, in which they exhausted every resource, and suffered the greatest privations, were compelled to abandon every one of their pretensions, and to beg to be allowed to resume their employment, under the same regulations as formerly, at their old, and in some cases even at lower wages. And this, with but few exceptions, is the ordinary result of the best organized combinations.

The substitution of machinery for manual labour has done more perhaps than anything else to put down combinations in manufacturing employments. And though injurious to the work-people, combinations for an improper purpose are sometimes advantageous, by the stimulus they give to the improvement of machinery. In corroboration of this statement, it is only necessary to refer to the machines for wool-combing, mule-spinning, and others of the same kind, which were invented and introduced to emancipate the masters from the dictation of unions, and the unreasonable demands and proceedings of the wool-combers, cotton-spinners, &c. They have been completely successful; and have, in truth, not only rendered these employments comparatively independent of combinations, but have materially improved and cheapened the products of the manufactures into which they have been introduced. Combination.

Even in the rare cases in which workmen from some peculiar circumstances, such as their employers having entered into extensive contracts to be completed within specified periods, have succeeded in obtaining an improper advance of wages, it has uniformly in the end been injurious to them. This result is brought about in various ways—by the high wages attracting too many labourers to the business, by the various expenses attendant on a combination, which make a heavy deduction from the wages of those engaged in it, by the demand for the articles being checked or lessened by the greater cost of their production, and so forth. Nothing, indeed, but the merest ignorance could make it be supposed that wages could be really increased by such proceedings. They depend on a principle which they cannot affect, that is, on the proportion between capital and population; and cannot be increased except by the increase of the former as compared with the latter.

For these reasons, we think it is impossible that any one, who will calmly consider the subject, should resist coming to the conclusion, that a combination for an improper object, or to raise wages above their proper level, must cure itself, or that it must necessarily bring its own chastisement along with it. In some instances, strikes have been entered into from hostile feelings against obnoxious masters; and not unfrequently the workmen are seduced into them by the artful representations of agitators in whom they place undeserved confidence, and who make them the means of advancing their own selfish ends, without caring for the misery they may entail on their dupes. But, in the majority of cases, a strike can hardly fail, under ordinary circumstances, to be a subject of the most serious concern to workmen who have either forethought or experience. And the privations to which it unavoidably exposes them form a strong presumption that they are honestly impressed with a conviction that the advance of wages which they claim is fair and reasonable, and that the strike has been forced upon them by the improper resistance of the masters. Even in those cases in which wages are notoriously depressed below their proper level, workmen will, if they consult their own interests, be shy about striking, and will resort to it only as a last resource. Such a proceeding instantly deprives them, and those that are dependent on their exertions, of their accustomed means of subsistence. In the event of their masters delaying, for any considerable period, to come to an accommodation, they are obliged, from inability to support themselves, to depend for a while on the grudging and stinted contributions of others; and when this humiliating resource is exhausted, they must return to the business they have left, or else engage in employments to which they have not been bred, and which are not congenial to their habits. It is not, therefore, easy to suppose that workmen, when they become acquainted with the real effects of combinations, will rashly enter into them, and proceed to a strike for the purpose of obtaining unreasonable or exorbitant

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wages. But if they should be at any time foolish enough to do so, their efforts will, no doubt, be ineffectual; and besides exposing themselves to great temporary hardship and distress, they will in the end have to accept the terms dictated by their masters.

But notwithstanding the dear-bought experience of their generally injurious influence, strikes and combinations to raise wages have seldom been so prevalent as in the past year, 1853. They seem to have originated in a variety of circumstances; partly and principally, perhaps, in the diminution of the supply of labour, occasioned by the extraordinary emigration to Australia and the United States, and partly in the increase of the exports, and the exaggerated statements put forth in relation to the profits of the manufacturers. There can, indeed, be no doubt that these circumstances warranted an increase of wages; and they have, in truth, been materially increased during the last three or four years. But we need not be surprised that this increase has not satisfied the excited expectations of the work-people, and that they have entered, in various places, into strikes and combinations to force up wages to a still higher elevation. The probability, however, seems to be that they will be unsuccessful.[1] But however the struggle may terminate, it is doubtful, despite the heavy losses and privations the workmen have entailed upon themselves, whether their proceedings will be generally injurious to the masters. Consentaneously with the Preston strike, which involved the cessation from work of several thousand hands, a stagnation began to take place in several departments of the cotton trade; and the manufacturers, supposing the strike had not occurred, would have been obliged to diminish the rate of production, either by working at short hours, or by shutting up some of their works. And hence the strike, though injurious to the particular masters whose workmen entirely withdrew from their employment, was in the mean time advantageous to the others. It removed some of their competitors from the field; and effected that reduction in the supply of goods which, otherwise, could only have been brought about by a general agreement among the manufacturers.

When, therefore, the work-people employed in the cotton, woollen, or other departments of industry, in any particular town or district, combine to force up wages or to reduce the hours of work, they should recollect that they are not the only persons engaged in the employment. It is most likely carried on in many other places. And it is plain that nothing could be more advantageous to the employers in Manchester, than that their competitors in Preston, Oldham, &c., should be crippled, or that they should have the whole market to themselves. And thus it is that the folly and obstinacy of the work-people in one part of the country, though injurious to their employers, and ruinous, perhaps, to themselves, may, notwithstanding, redound to the advantage of the employers in other quarters.

But suppose that a combination is not confined to a single district, that it is general, that it embraces all, or nearly all, the work-people employed in one or other of the great departments of industry. This is the most favourable position in which the work-people can be placed for carrying their point; and yet, if the advance of wages which they claim be one to which they are not fairly entitled, the extension of the combination will make it only the more disastrous to themselves. In cases of this sort, instead of the works in a particular district being shut, they are closed over the whole kingdom; so that our foreign competitors on the Continent and America have the entire market to themselves, and are enriched, and their business extended, by the depression and infatuation of their rivals. This is a very serious consideration; and one which the work-people should never lose sight of.

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The latter should also bear in mind, when they engage in strikes and combinations to force up wages, that capital is not bound to any peculiar locality. Manufactures have been driven, in more than one instance, from one part of this country to another, through the disorderly and turbulent conduct of the work-people.

The silk trade of Paisley, Macclesfield, and Manchester, owes its rise to the proceedings of the unionists of Spitalfields. A similar cause forced a part of the carpet trade of Kidderminster to Kilmarnock, annihilated the blanket trade of Kilkenny, and the ship-building trade of Dublin; and has most seriously injured the last-mentioned branch of industry in Liverpool. Several villages in the vicinity of Leeds are indebted for their manufacturing importance to the outrageous proceedings of the work-people in that town. But the mischief may go farther than this. Strikes and combinations, on a great scale, like those at present (March 1854) existing, though they may not drive capital from the north to the south, or *vice versâ*, may force it to another country. No doubt there is generally a considerable disinclination to employ capital abroad. But that disinclination has its limits, and may be overcome either by the temptation of greater profits, or by the desire to emancipate one's self from the dictation of work-people, or rather of the agitators by whom their proceedings are usually directed. The extent to which English capital is vested in the stocks, and in the railways, and other public works, of the United States, France, and other foreign countries, shows that it is by no means so difficult as is often supposed to overcome the reluctance to employ capital in foreign investments. And the more intimate the intercourse becomes among different nations, the more will this reluctance be diminished. These circumstances should not be forgotten by those who are contemplating strikes and combinations. It must not be imagined that this is the only country in which manufacturing industry may be successfully prosecuted. Many parts of Prussia, Saxony, Switzerland, and France, have extensive and flourishing manufactures. And we do not know anything half so likely to stimulate their industry, and to make their competition still more dangerous than at present, as the strikes and combinations so frequent in England. They not only paralyze the proceedings of our manufacturers, but they tempt them to become partners in foreign houses, to construct mills on the Rhine or the Seine, rather than on the Irwell or the Clyde, and to carry abroad their machinery and their best workmen. And we are sorry to have to say that these are not speculative or eventual circumstances. They are being realized at this very moment (1853–54). Whoever may be the really blameable parties, the *felo de se* proceedings at present carried on threaten to inflict the same sort of injury on the trade and manufactures of the United Kingdom that the bigotry of Louis XIV. inflicted on those of France.

It appears from the authentic statements published by Messrs Du Fay and Co. of Manchester,[2] than whom there are no higher authorities on such subjects, that the demand for raw cotton in 1853 increased 7½ per cent. in Germany, Russia, and Holland, while it fell off 1½ per cent. in Great Britain. This startling fact is accounted for as follows, by the gentlemen referred to:—

"The decreased consumption of cotton in this country has been caused by strikes for higher wages, at a time when the general state of trade and other circumstances did not warrant the advance. But whilst the consumption of cotton has decreased here, it has increased in America and other

[1] This anticipation has been fully realized. The Preston and other strikes have terminated, after much loss and the endurance of great hardships by the workmen, by their agreeing to accept the terms offered at the outset by the masters.

[2] Circular, 1st February 1854.

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countries, and will, we can assure our friends, still further increase, if the turn-outs do not speedily cease. It has, perhaps, never been sufficiently considered by the industrious classes of this and neighbouring districts, that they are raising a competition to the masters and to themselves elsewhere, by persisting in the dangerous course which they now pursue. The capacity for production in different parts of the world, at competing prices, is very nicely balanced; and this country possesses now very few advantages over rival manufacturing countries. If an article is for any length of time neglected here, or not produced in sufficient quantities, it will be manufactured in other countries; and a trade once transferred is not easily recovered. This view of the disadvantages of the present strikes and labour question has not, as far as we are aware, been brought home to those most interested in it; we should, indeed, be glad to have it in our power to convince both masters and men of the importance of considering the subject in this light, in order to bring their disputes to a speedy end, and thus to prevent serious injuries to the entire trade of this country."

This is the worst view that can be taken of the influence of strikes and combinations; and the desire to obviate it would, if anything could, warrant the interference of government for their suppression. But the grand principle of the freedom of industry must not be infringed upon. We must take it with its disadvantages as well as its advantages; and trust, as we may safely do, to experience, and the good sense and better training of the masters and work-people, to lessen the former and to increase the latter. Even if it were conceded that it might be expedient for government to interfere to put down combinations to raise wages above their proper level, or to frame improper regulations in regard to the employment of work-people, the concession would be of no real value to the apologists of combination laws; for the result of the combination is, in fact, the only certain test by which we can pronounce whether the advance of wages claimed by the workmen and the regulations proposed by them were fair and reasonable or the reverse. If government were to refer to the masters for information on the subject, they would, most likely, be told that the best founded claim for a rise of wages was unjust and ill-founded; and if, on the other hand, they were to refer to the workmen, who have as good a right to be consulted as the others, the most exorbitant and unreasonable demand would be said to be moderate and proper, and such as could not be equitably refused. It is only by the fair and free competition of the parties in the market, that we discover which of these opposite and contradictory assertions is most consistent with truth. There neither are, nor is it in the nature of things that there can be, any other means of coming to a correct conclusion on the subject. If the workmen be in the right, they will, as they ought, succeed in their object: if they be wrong, they will be defeated, and the injury they will do to themselves will render them more cautious about again embarking in a similar struggle. Enlighten all parties as much as you possibly can with regard to the circumstances which determine the rate of wages and the condition of the labouring classes, and with regard also to the state of industry here and elsewhere. But when this has been done you had better stop. The interference of government in the decision of questions between masters and their work-people can be productive only of evil. Having no means of informing themselves of the real merits of the case, its agents must, if they act at all, necessarily act blindly and capriciously. And even if they had such information, it would be unadvisable for them to interfere, it being abundantly certain that every combination for an improper object will be more easily and effectually put down without their assistance than with it.

The great evil of the combination laws consisted, as already observed, in the mistaken notions respecting their influence which they generated in the minds both of workmen and masters. They taught them to believe that there was one measure of justice for the rich, and another for the poor. They consequently set the interests and the feelings of these great classes in direct opposition to each other, and did more to engender hatred between the different orders of society—to render the masters despotic and capricious, and the workmen idle, turbulent, and depraved—than can easily be imagined by those not pretty intimately acquainted with the former state of society in the manufacturing districts. Instead of putting down combinations, they rendered them universal, and gave them a dangerous character. For the fair and open, though frequently foolish and extravagant, proceedings of men endeavouring to advance themselves in society, and to sell their labour at the highest price, the combination laws gave us nocturnal meetings, private cabals, and oaths of secrecy. There was not a workman to be found who did not consider it a bounden duty to embrace every opportunity of acting in the teeth of their most positive enactments. And all the means which the intelligence, the cunning, and the privations of workmen could suggest, for defeating and thwarting their operation, were resorted to from a conviction of their partiality and unfairness.

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At the period now referred to, instances of violence, sometimes ending in assassination, were anything but uncommon. In 1812, for example, Mr Horsfall, an eminent manufacturer, was waylaid and shot by a band of assassins congregated for the purpose, and several mills were at the same time attacked and destroyed. In the end the combination was suppressed, but not till seventeen of the combined workmen had been executed at York. How much soever we may regret several of the late strikes, they have happily few features in common with those under the old combination laws. No man's life or property has been imperilled, and the proceedings of the work-people have been characterized by a decorum and abstinence from threats and violence that reflect on them the highest credit. The advance they have already made would seem to warrant the conclusion that they must, at no very distant period, discover that no combination, whether with or without violence can raise wages above the impassable level to which the competition of the masters is sure to elevate them.

It appears, therefore, on every ground both of justice and expediency, that the repeal of the combination laws was a wise and salutary measure. Until that event, the terms of the contract between masters and workmen could not be said to be adjusted, as it always ought to be, on the principle of free and unrestrained competition. We readily allow that combinations of workmen and of masters may be, and, indeed, frequently are, formed for the accomplishment of improper objects. But it is quite clear that these combinations will, when let alone, inevitably cure themselves; and that the efforts of government to suppress them, besides being uncalled for and unnecessary, would be oppressive and unjust. Every individual who is not a slave is entitled to demand any price for his labour that he thinks proper. And if one individual may do this, may not fifty, or five thousand, demand the *same* price? A criminal act cannot be generated by the mere multiplication of acts that are perfectly innocent. We are not to confound the power and the right to set a price on labour with the reasonableness of that price. It is the business of those who buy labour, and not of government, to decide whether the price set on it is reasonable or not. If they think it is unreasonable they may, and they certainly will, refuse to buy it, or to hire the workmen; and as the latter cannot long subsist without employment, necessity will oblige them to moderate their demands.

It will be observed, that the observations we have now made apply exclusively to the justice and policy of attempting to prevent *voluntary* combinations among workmen; and

Combination || Combustion.

we trust they will not be understood as being intended to countenance in the slightest degree the attempts that are sometimes made by combined workmen forcibly to prevent others from working except on the conditions they have fixed for the guidance of their own conduct. Every such attempt is an obvious breach of the peace; and if not repressed by prompt and suitable punishment, would be subversive not only of the freedom of industry, but of the national welfare. The reason that combinations among numerous bodies are rarely injurious is, that the motives which individuals have to break off from the combination are so numerous and powerful, that it can seldom be maintained for any considerable period. But if those who adhere to combinations were to be allowed to maltreat and obstruct those who secede from them, this principle would be subverted, and combinations might become so very injurious as to require the interference of the legislature for their suppression. This, therefore, does not really seem to be a case in which there is much room for doubt or difference of opinion. It is plain, that we must either reduce the workmen to a servile condition, or authorize them to refuse to work, or to sell their labour, except under such conditions as they may choose to specify. But when they are allowed this much, they are allowed *all* they are entitled to; and if they go one step further—if they attempt to carry their point by violence, either towards their masters or their fellow-workmen—they are guilty of an offence that strikes at the foundations of the manufacturing and commercial prosperity of the country, and which no government can or ought to tolerate. It is indispensable that that system of intimidation which the workmen in some places have endeavoured to organize should, at all hazards, be effectually put down. And to secure this object, every practicable means should be adopted for facilitating the prosecution, speedy conviction, and punishment of those who are guilty of obstructing and intimidating others.

These remarks proceed from no unfriendly feeling towards the workmen, but from a desire to do them service. It is the extreme of folly to suppose that any combination can maintain wages at an artificial elevation. It is not on the dangerous and generally ruinous resource of combination, but on the forethought, industry, and frugality of workpeople, that their wages, and their condition as individuals, must always depend. If they attempt, by adding violence to combinations, to force wages up to an artificial level, one of two things will follow; they will either draw down on themselves the vengeance of the law, or they will bring about their permanent degradation by forcing the transfer of that capital, from which alone they derive their subsistence, to other businesses, or to countries where it will be better protected. (See Treatise on the Circumstances which determine the Rate of Wages, and the Condition of the Labouring Classes, by the author of this article.) (J. R. M)

COMBINATION, in *Mathematics*, the union of numbers or of quantities in every possible way; or the variation or alteration of any number of quantities or other things in all the different manners possible. See MATHEMATICS, and PROBABILITY.

COMBUST (Lat. *combustus*), in *Astronomy*. When a planet is in conjunction with the sun, or within the distance of half the sun's disk, it is said to be combust, or in combustion. According to some writers a planet is combust when its distance from the sun does not exceed eight degrees and a half.

COMBUSTION. See CHEMISTRY.

COMBUSTION, SPONTANEOUS HUMAN. Notwithstanding the difficulty with which the animal body is consumed by fire in its ordinary state, in certain circumstances it has been observed to become so inflammable as to undergo a kind of spontaneous combustion. The following cases of this strange but fortunately rare occurrence may be quoted to show the nature of the phenomena.

A woman about 60 years of age, in the county of Down, Ireland, retired to bed one evening with her daughter, both in a state of intoxication, as was their constant habit. A little before day-break some members of the family were awakened by an extremely offensive smell that pervaded the house, and which was observed to proceed from the apartment in which the old woman and her daughter lay. The smoke was found to proceed from the body of the old woman, which appeared to be burning with internal fire. The body was as black as coal, and the smoke appeared to proceed from every part of it. The combustion was arrested with difficulty, though there was no flame. Her daughter, who slept in the same bed, sustained no injury; nor did the combustion extend to the bed or bed-clothes, which were quite uninjured, though stained with the smoke. This case is also related by Dr Apjohn.

From the various cases which have been recorded, both by British and foreign writers, it appears that the victims of this strange affection were mostly females advanced in life, and addicted to indulgence in spirituous liquors; that the combustion spread with extreme rapidity; the flame, when present, was of a lambent and flickering nature, very difficult to extinguish by water, and not readily communicable to inflammable bodies placed near it; that a strong empyreumatic odour was exhaled, and a fetid moist sooty deposit generally remained on the furniture of the apartment; and lastly, that the trunk alone was usually consumed, while portions of the head and limbs were commonly left uninjured.

Several theories have been suggested to explain this curious phenomenon. By some it has been attributed to the alcoholic impregnation of the body by the continued indulgence in spirituous liquors; it being a known fact that the bodies of drunkards yield on distillation a considerable quantity of alcohol; and that it has even been discovered in the substance of the brain. This impregnation, however, would not of itself account for the fact, inasmuch as animal matter steeped in alcohol will not become reduced to ashes even though set fire to, without the aid of combustibles. M. Marc, a French physician, supposes the phenomena to be caused by the generation of inflammable gaseous products within the tissues of the body: and provided one of these gaseous products were oxygen, it is quite conceivable that such might lead to the combustion of the body. As phosphorus occurs as a large constituent of some of the tissues, if we suppose that phosphuretted hydrogen (a gas which takes fire whenever it comes in contact with the oxygen of the air), is the inflammable gas generated, and that it fills the bowels and pervades the tissues, it would both account for the rapidity and spontaneity of the combustion. It must, however, be confessed that as yet the cause of this strange occurrence has not been satisfactorily ascertained.

Comedy || Comercolly

COMEDY, that branch of dramatic composition which represents common and private life, and of which the object is professedly to correct the vices and follies of mankind by means of ridicule, and to recommend virtue; though in reality the ultimate end is amusement. The word in Latin is *comœdia*, and in Greek κωμωδία, either from κῶμος a *merry-making* and ᾠδή a *song*, or, according to Bentley, from κώμη, the *village song*. An account of the ancient comedy is given under DRAMA.

Comedy is distinguished from farce—the former representing nature as she is, while the latter distorts and overcharges her. They both paint from the life, but with different views; the one to make nature known, the other to make her ridiculous.

COMERCOLLY, a town of Bengal, district of Pubna, on the bank of the Gorace. This stream, according to Bishop Heber, has here the width of the Thames at Vauxhall; and being navigable at all seasons of the year, the town has become a great emporium of commerce. Long. 89. 11. E., Lat. 23. 52. N.

COMET.

Comet. In the article Astronomy we have given a general description of the orbits and physical appearances of comets. In the present article it is our purpose to give a solution of the problem of determining the approximate elements of a comet's orbit from three geocentric observations,—a problem of very great importance in astronomy, since it is only from the circumstance of moving in the same orbit, that the identity of a comet, in its successive revolutions, can be inferred with certainty.

The astronomy of comets may be said to have originated with Tycho Brahé, who showed that, by reason of the smallness of their parallaxes, their distances from the earth must be greater than that of the moon. Before this era they had been generally regarded as meteors casually engendered in the atmosphere, and having no permanent duration or connection with the solar system. The conclusions of the Danish astronomer were confirmed by the observations of Galileo, Snell, and Kepler, on the comet which appeared in the beginning of the seventeenth century; and as it was now certain that the comets do not belong to the earth, but move in the region of the planets, the determination of their orbits, and their relations to the other known bodies of the universe, became a problem of the highest interest. Kepler attempted to represent their apparent paths by supposing them to move in straight lines, with a variable velocity; and on this hypothesis the orbits of several comets were computed by Dominic Cassini, with a degree of success that might appear remarkable, were it not known that the apparent path of a comet differs little from a straight line during a considerable portion of the time that it is visible from the earth. But it could not fail soon to be perceived that the hypothesis of rectilinear motion is not only improbable in itself, but inconsistent with accurate observation. Hevelius demonstrated, in his *Cometographia*, published in 1668, that the path of the comet of 1665 was curvilinear, and concave towards the sun; and he even supposed the orbit *might* be a parabola, without hinting, however, that the sun is placed in the focus. But the individual who, before the grand discoveries of Newton, approximated most nearly to a correct knowledge of the true nature of the cometary orbits, was Dorfel, protestant minister of Wieda, a village near Plauen, in Upper Saxony. Dörfel observed the comet of 1680–1, from the 22d of December till the end of the following January, and recognised its identity on its emerging from the sun's rays, after passing through the perihelion of its orbit; and he proved the orbit to be a parabola, having the sun in the focus. The observations of Dorfel were published in 1681, consequently before the appearance of the *Principia*, in a small work, which has become so extremely rare, that neither Montucla nor Delambre had been able to procure a copy of it. To Dorfel, therefore, belongs the honour of having been the first to point out the true orbit of a comet, though his merit has passed almost unnoticed in consequence of the more important discoveries which followed so soon after. It is not known whether Newton was aware of the observations of Dörfel; but it is certain that the latter had no idea of the great principle of attraction, in virtue of which the comets as well as the planets perform stated revolutions about the sun. In his hands the parabolic orbit was simply an astronomical hypothesis, connected with no system, and framed only to satisfy a few observations. Newton, on the other hand, demonstrated that the comets form a part of the solar system, that they describe orbits about the sun in virtue of his attractive force, obeying the same laws of motion as the planets; and he showed, moreover, in what manner the elements of their orbits may be computed, on the parabolic hypothesis, from three geocentric observations of their longitudes and latitudes. Comet.

Newton has given, in the *Principia*, two different solutions of the problem of determining a parabolic orbit from three observations. In the first he supposes that a small portion of the trajectory may be regarded as a straight line, described with a uniform motion, so that its segments, intercepted by straight lines drawn from the earth to the comet, at the times of the respective observations, are proportional to the intervals of time between the observations. According to this supposition, the ratio of these segments is known. It follows, also, since the portion of the trajectory included between the extreme observations is a straight line, that its projection on the plane of the ecliptic is also a straight line, and divided similarly to the trajectory itself, by the projections of the straight lines joining the places of the earth and the comet. In order, therefore, to determine the projected orbit, it might seem to be only necessary to draw a straight line in such a manner that its segments, intercepted by straight lines whose positions are given (being determined by the observed longitudes), shall have to each other given ratios. But this problem, in the case in which there are only three observations, or three given straight lines, is altogether indeterminate; for having assumed any point whatever in one of the three given straight lines, it is always possible to draw through that point a straight line, which shall be divided into segments having a given ratio, by the other two given straight lines. But it is obvious that the position of the transversal line will be different for every different position of the assumed point; consequently the number of solutions is infinite. When the number of observations is four, the problem is to draw a straight line, so that it may be divided into parts having given ratios to one another, by four straight lines given in position. In this state of the data, it becomes, generally speaking, determinate, and admits of only a single solution. This problem had been already resolved by Dr Wallis and Sir Christopher Wren, and to their solutions Newton added two others of his own. There is still a case, however, in which, even when four straight lines are given, the problem is indeterminate; and it happens, by a remarkable coincidence, that it is this case precisely which occurs in the application to the cometary motions. If the position of the four given lines is such that *two* transversal lines can be drawn so that the segments of both of them are respectively proportional to given lines, then innumerable other straight lines may be drawn which shall be all cut in the same ratio. Now this is the case with regard to the four straight lines which join the places of the earth and comet at the instants of the respective observations. During the short interval that elapses between the extreme observations, the earth, as well as the comet, may be regarded as moving in a straight line with a uniform velocity, so that the orbit of the earth, and the trajectory of the comet, are both divided into segments proportional to the intervals between the observations, and consequently proportional to each other. This circumstance, which was first pointed out by Boscovich, renders the problem inapplicable to astronomy; for although the earth's motion should not be regarded as entirely rectilinear and uniform, yet the data necessarily approach so

Comet. near to the indeterminate case, that no satisfactory conclusion can be deduced from them. Hence all attempts to compute the orbit of a comet in this manner have failed. (See Playfair's Memoir on the Origin and Investigation of Porisms, in vol. iii. of the *Edinburgh Transactions*, or in the third volume of his *Works*.)

The second method proposed by Newton forms Proposition 41 of the third book of the *Principia*. Though unexceptionable in theory, it leads, when actually applied to the determination of an orbit, to computations excessively complicated and laborious, and is consequently now entirely disused. It is probable that it was this method which was followed by Dr Halley, who computed the orbits of a great number of comets, though he has nowhere explained the process of computation he adopted. It is illustrated by Dr David Gregory in his *Astronomia Physica*, and by Lemonnier in his *Théorie des Comètes*.

The problem of the comets remained for many years in the state in which it was left by Newton, and astronomers were still in want of a practical method by which a parabolic orbit could be determined with tolerable ease and accuracy. In the absence of a direct solution, it was usual to have recourse to the methods of trial and error, and to approximate, by successive suppositions, to an orbit that would nearly represent the observations. This method was practised by Bradley, and by Lemonnier in his *Institutions Astronomiques*. Lacaille also published a method of the same kind in 1746, which was long followed by the continental astronomers, and is recommended by Delambre as possessing some advantages over those which are now generally preferred. In fact, all the methods which have yet been devised involve more or less of hypothesis, and require to be corrected by successive trials. Various other solutions of the problem were published about the same time, among which, those of Sejour, Hennert, Templehoff, and Bouguer, may be mentioned, though they are now entirely abandoned. The celebrated Boscovich, also, in the third volume of his *Opera Pertinentia ad Opticam et Astronomiam*, undertook to consider this subject; and the solution which he gave is remarkable, as being the first in which the velocity of the comet in its orbit was taken into account as one of the essential conditions of the problem. It is, however, excessively complicated, and contains a mixture of algebraic formulæ and graphical operations susceptible of very little accuracy. Delambre, in speaking of this method, doubts if it was ever employed in the actual computation of an orbit by any astronomer, excepting the author himself, or perhaps some of his friends, though it is destitute neither of science nor address. (*Astr. du XVIIIme Siècle*, p. 653.) But the most important work which appeared on the subject of the cometary motions, previous to the investigations of Lagrange and Laplace, was that of Lambert, entitled *Insigniores Orbitæ Cometarum Proprietates*. Among the formulæ which it contains relative to the motion of a body in a parabolic orbit, there is one, extremely remarkable on account of its elegance, which gives the time of describing an arc in terms of its chord, and the two radii vectores drawn through its extremities. This formula, which retains the name of *Lambert's Theorem*, though Gauss has shown that it really belongs to Euler, is of great use in the cometary theory, as it affords a very easy means of correcting the hypothetical values which it is necessary to substitute in the equations of the problem. Lambert also pointed out rules for determining, without solving the equations, whether the distance of the comet from the sun is greater or less than the distance of the sun from the earth, a knowledge of which circumstance affords considerable aid in forming a first hypothesis, and serves to abridge the preliminary computations.

Notwithstanding the repeated attempts of so many celebrated astronomers and mathematicians, the problem of determining a cometary orbit had not received a direct or satisfactory solution, when it was taken up by Lagrange in the *Berlin Memoirs* for 1778. After examining and pointing out the defects of the different methods then known, Lagrange gave a new method, which has formed the basis of the greater part of the analytical solutions which have been proposed since. The principle of his analysis is at once simple and direct. It will be recollected that the data of the problem are three observed positions of the comet, or three geocentric longitudes and latitudes. Lagrange first gives formulæ to express the co-ordinates of the comet at the epochs of the first and third observations, in terms of its co-ordinates at the second observation; he then proceeds to substitute these values in the differential equations of motion; and in this manner, without making any hypothesis respecting the nature of the orbit, he obtains the necessary number of independent equations for eliminating the three co-ordinates, together with their differential co-efficients, leaving three final equations, in which the unknown quantities are the three distances of the comet from the earth at the epoch of the respective observations. On eliminating two of these distances, the resulting equation is found to rise to the eighth degree. It is easily reducible to the seventh; but unfortunately there are no other means of determining its roots than by repeated trials according to the methods of false position. Assuming, however, that a sufficiently approximate value of the comet's distances from the earth has been found in this way, it is thence easy to deduce its corresponding radii vectores, or distances from the sun, together with the angles they include, from which data all the elements of the orbit can be determined without difficulty.

Theoretically considered, the solution of Lagrange may be considered as perfect; but when it comes to be actually applied in the computation of an orbit, difficulties arise which can only be overcome, or eluded, by certain modifications of the general method, which the illustrious author has not explained. He did not himself attempt the applications, or he could not have failed to perceive, and would doubtless have provided for, the circumstances which, in following his method, occasion so much embarrassment to the computer. Lagrange made some important additions to his original analysis in the *Berlin Memoirs* for 1783, and it is also explained in the second volume of the *Mécanique Analytique*.

Another method of obtaining a solution of the problem, entirely different from the above, was proposed by Laplace in the *Memoirs of the Academy of Sciences* of Paris for 1780, and is developed with all the necessary details, in the second book of the *Mécanique Céleste*. The peculiarity of Laplace's method consists in its being supposed that a small portion of the orbit is accurately known from observation; that is to say, it is assumed that the longitude and latitude of the comet at a given epoch, together with the first and second differentials of those quantities, have been precisely determined. From these data the elements of the orbit can be deduced more simply than by any other method yet proposed; but it is found in practice that the determination of the first and second differentials of the comet's longitude and latitude is generally a matter of difficulty or uncertainty, and in some cases altogether impracticable. Laplace had at first imagined, that when a considerable number of observations have been obtained, as is most frequently the case, the differential values of the longitude and latitude would be found with greater accuracy by combining the whole of the observations; but it was subsequently shown by Legendre, that when more than a few observations are employed, the errors unavoid-

Comet. ably introduced in the arithmetical operations necessary for interpolating the observed places of the comet, are such as to increase, instead of diminishing, the errors of observation. It is therefore advantageous to confine ourselves to the number of observations strictly necessary, namely three; and to employ the remaining observations in correcting the elements deduced from these three. With three observations only, it cannot be expected that the results will have a high degree of accuracy; but when approximate values of the elements of an orbit have been found, it is in general easy to introduce such corrections as will give an orbit representing the observations within the limits of unavoidable errors. Laplace's method affords the simplest means of obtaining such approximations of any hitherto proposed, and is applicable perhaps in as great a number of cases as any other; it is consequently very frequently adopted by computers. Cases indeed occur in which it fails altogether, as happened in regard to the comet of 1814; but the same thing takes place with every other method that has yet been devised; nor is it always possible to discover, till actual trial has been made, the particular circumstances connected with the position or motion of the comet, which render one method more applicable than another.

Of the numerous methods of determining the approximate elements of an orbit from three observations, that of Olbers is one of the simplest and most direct, though the approximations which it gives are not very exact. Olbers supposes the orbit to be a parabola; a supposition which gives one equation more than the number of unknown quantities. He supposes, moreover, that the chord of the arc which joins the places of the comet at the epoch of the first and third observations, is divided, by the radius vector corresponding to the middle observation, into segments proportional to the intervals of time between the observations. The last supposition can only be admitted when the intervals between the observations are nearly equal; if a considerable inequality exists in the intervals, and more especially, if, at the same time, the radius vector of the comet is less than that of the earth, it leads to very inaccurate results. The author, indeed, shows how the errors of the hypothesis may be in some degree corrected; but, after all, his approximation includes only quantities of the second order in respect of the time. This may be sufficient in some cases; but in general it will be necessary to include quantities of the third order. The method of Olbers is explained at considerable length in the third volume of Delambre's *Astronomie*.

In 1806 Legendre published his *Nouvelles Méthodes pour la determination des Orbites des Comètes;* a work very remarkable, not only by reason of the important light it threw on the question under consideration, but also on account of its containing the first exposition of the method of combining the results of a great number of observations, known by the name of the *method of least squares*, and which is so extensively useful in many questions of natural philosophy and astronomy. The method of determining an orbit given in this memoir is in some respects the same as that of Lagrange; but the equations of the problem are put under a form which admits of an easier application, and gives surer results; and the circumstances are fully developed and explained, which had so frequently caused Lagrange's method to fail in actual trial. Legendre also adopted a different method of treating the fundamental equations of the problem. Instead of deducing the elements of the orbit from two radii vectores and the contained angle, he eliminates those radii, and deduces expressions for the three rectangular co-ordinates of the comet at the epoch of the mean observation, and their three differential co-efficients regarded as functions of the time. When the co-ordinates and their differential co-efficients have been determined, the elements of the orbit can be easily deduced from them by known methods applicable to orbits of all descriptions. In the case in which the intervals between the observations are equal (and this condition can in general be satisfied by interpolating the observed places of the comet), the equations take a remarkably simple form, and the analytical solution is obtained with great facility. In the general case, that is to say, when the intervals between the observations are unequal, the equations are somewhat more complicated; but they have still an analogous form, and the additional labour required for their computation is perhaps compensated by the absence of preliminary interpolation, and by the greater certainty that arises from employing directly the data furnished by observation. This method of determining an orbit is exhibited in a very clear and elegant manner by Pontécoulant in his *Théorie Analytique du Système du Monde*, tome ii. Comet.

In the *Transactions of the Royal Society* for 1814, Mr Ivory has given a method of obtaining a first approximation to the orbit of a comet, explained with all the perspicuity and analytical elegance which so peculiarly characterize the writings of this eminent and justly celebrated mathematician. Mr Ivory's solution is founded on the same principles as that of Olbers, but it gives a nearer approximation, and is also adapted to a case in which the ordinary methods fail, namely, when the comet and the earth are nearly at the same distance from the sun. Like Olbers, and indeed Newton, Mr Ivory supposes the chord of the parabolic arc, described in the interval between the extreme observations, to be divided by the radius vector corresponding to the middle observation in the ratio of the times between the observations; a supposition which, as we have already remarked, though it simplifies the analysis and computations, cannot always be admitted, and which, in fact, leads, in some cases, to very sensible errors. It has been objected to this solution, that it is needlessly encumbered with auxiliary formulæ.

The facility with which an orbit can be computed according to this method, induced Legendre to resume the investigation of the subject, in order to obtain, if possible, from the same method, more approximate elements. In 1820 a second supplement was published to the *Nouvelles Méthodes*, containing a solution grounded on the same principles as those of Olbers and Ivory. Instead of assuming, however, like those two mathematicians, the chord of the parabolic arc to be divided by the radius vector of the middle observation in the ratio of the elapsed times, Legendre finds an expression for the value of each of its segments in terms of the time; and the degree of approximation ultimately obtained depends on the number of terms of the series expressing those values that are included in the computation. This method possesses several advantages. In the first place, it requires no preliminary interpolations; in the second place, it is simple, and can be understood without a very high degree of algebraic skill; and lastly, which is of most importance, it will be found to give, we believe, in a great majority of cases, especially when the intervals between the observations are considerably unequal, a nearer approximation than any of the other methods, with the same degree of labour. For these reasons we have adopted it in the present article. In particular cases other methods may be found more applicable; but the same objection may be made to those of Laplace, Olbers, and indeed every other which has been proposed. No method will answer equally well in every case.

The last work on this subject to which we shall refer is a paper by Mr Lubbock, in the *Memoirs of the Royal Astronomical Society*, vol. iv. part i., 1830. We have already remarked, that the final equation which gives the radius

Comet. vector of the comet, or its distance from the earth, rises to the seventh degree, and that consequently the solution of the problem can only be obtained by the method of trial and error. Mr Lubbock proposes the following method of finding a value of the radius vector by means of a quadratic equation. The accelerating forces acting on the comet, in the direction of the three rectangular co-ordinates of its orbit, the sun's mass being unit, are,

$$\frac{d^2x}{dt^2} + \frac{x}{r^3} = 0, \quad \frac{d^2y}{dt^2} + \frac{y}{r^3} = 0, \quad \frac{d^2z}{dt^2} + \frac{z}{r^3} = 0;$$

from the integration of which the following equation is obtained, which gives the square of the velocity, namely,

$$\frac{dx^2 + dy^2 + dz^2}{dt^2} - \frac{2}{r} + \frac{1}{a} = 0 \ldots\ldots\ldots\ldots (1)$$

But since $r^2 = x^2 + y^2 + z^2$, we have also, in consequence of the above three equations,

$$\frac{d^2.r^2}{2dt^2} = \frac{dx^2 + dy^2 + dz^2}{dt^2} - \frac{1}{r};$$

therefore,

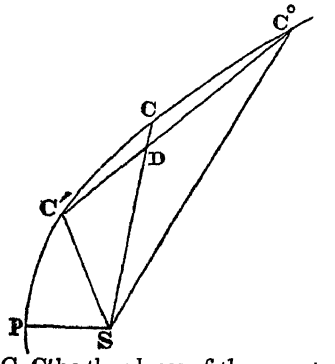
$$\frac{d^2.r^2}{2dt^2} = \frac{2}{r} - \frac{1}{a} - \frac{1}{r}, \text{ or } \frac{d^2.r^2}{2dt^2} - \frac{1}{r} + \frac{1}{a} = 0 \ldots..(2)$$

Assuming the intervals between the observations to be equal, and rejecting powers of the time above the square, the author first expresses the differential co-efficients in equations (1) and (2) in terms of finite differences. He next substitutes for the variables their values in terms of ϱ, the comet's distance from the earth at the second observation; then, making a infinite, and neglecting quantities divided by r^3, he eliminates $\frac{1}{r}$, and obtains a quadratic equation which gives an approximate value of ϱ. By this means, the necessity of having recourse to repeated trials is obviated; but the accuracy of the equations is impaired by the approximate values introduced, and as the intervals are supposed equal, the method is not always applicable.

The reduction of the problem to the solution of a quadratic equation is not new; it was already accomplished by Sejour, and also by Olbers. (See Delambre, *Astr. du XVIIIme Siècle*, p. 733.)

In all the methods which we have here alluded to, it is assumed that the comet moves in a parabolic orbit, and their success is owing entirely to this assumption. But it is certain that the true orbit of some comets, and most probably of all comets, is an ellipse, and not a parabola. The question will therefore naturally suggest itself, whether it would not be better to investigate an ellipse at once, than to concern ourselves about a parabolic orbit, which, with whatever care it may be computed, can never be perfectly exact, nor even be expected to satisfy observations made at considerably distant intervals. To this it may be replied, that on the first appearance of a comet it can seldom be of any use to seek an ellipse, the computation of which is greatly more tedious. For every practical purpose it is sufficient to have a parabola which represents the observations within a few seconds; first, because in the case of a comet the observations are scarcely ever more accurate than the computations founded on this assumption; and, secondly, because the approximation obtained by supposing the orbit to be a parabola, will enable us to determine the position of the node, the inclination of the orbit, and the perihelion distance, more exactly than we can expect to find them on the return of the comet, the perturbations of the planets giving rise to variations in the elements of the orbit probably exceeding the errors of the first computation. It is enough that we are able to recognise its identity. When this has been done we have the periodic time, and consequently the greater axis of the orbit. With these data we are enabled to compute the other elements by the methods employed for determining the elliptic orbits of the planets. Comet.

The problem of determining a cometary orbit resolves itself into two parts. In the first it is required to assign an orbit which will represent all the observations made during a single appearance of the comet; and in the second, to compute the effects of the disturbing forces of the planets, so as to predict the changes which will take place in the form and position of the orbit during an indefinite number of revolutions. The *perturbations*, however, which are computed in the same manner whether the disturbed body be a comet or a planet, form a problem of PHYSICAL ASTRONOMY by far too important to be undertaken in this place. We will therefore confine ourselves to the approximate determination of a parabolic orbit from three observations. The method which we have followed, as we have already intimated, is that which was proposed by Legendre in the second Supplement to his *Nouvelles Méthodes*.



1. Let C°, C, C′ be the places of the comet at the instants of the first, second, and third observations respectively. Let the interval between the first and second observations be denoted by θ, and that between the second and third by θ'; then, if the epoch, or instant from which the time is reckoned, be made to fall on the second observation, and be denoted by t, the epochs of the first and third observations will be respectively $t - \theta$, and $t + \theta'$. Next, let x, y, z, be the rectangular co-ordinates of C referred to the plane of the ecliptic and a straight line drawn through S, the centre of the sun, to the first point of Aries, the origin of the co-ordinates being at S. Similarly, let x°, y°, z°, be the co-ordinates of C°, and x', y', z', those of C′. The first step of the process is to find expressions for x°, y°, z°, and x', y', z', in terms of x, y, z, the latter being regarded as functions of the time t.

By Taylor's theorem we have

$$x^\circ = x - \frac{dx}{dt}\cdot\frac{\theta}{1} + \frac{d^2x}{dt^2}\cdot\frac{\theta^2}{1\cdot 2} - \frac{d^3x}{dt^3}\cdot\frac{\theta^3}{1\cdot 2\cdot 3} +, \text{ \&c.}$$

$$x' = x + \frac{dx}{dt}\cdot\frac{\theta'}{1} + \frac{d^2x}{dt^2}\cdot\frac{\theta'^2}{1\cdot 2} + \frac{d^3x}{dt^3}\cdot\frac{\theta'^3}{1\cdot 2\cdot 3} +, \text{ \&c.};$$

in which series the intervals θ and θ' may be regarded as so small, that the values of x° and x' will be determined with sufficient exactness when the terms affected with the fifth, and all the higher powers of θ and θ', are omitted.

Let r°, r, r', be the three radii vectores of the comet corresponding to the three observations, or the distances SC°, SC, SC′. The accelerating forces acting on the comet at C in the directions of the co-ordinates are expressed by the equations

$$\frac{d^2x}{dt^2} = -\frac{x}{r^3}, \quad \frac{d^2y}{dt^2} = -\frac{y}{r^3}, \quad \frac{d^2z}{dt^2} = -\frac{z}{r^3},$$

the mass of the sun being assumed to be unit, and the mass of the comet being neglected in comparison of that of the sun.

Comet. By differentiating the first of the above equations, we get

$$\frac{d^3x}{dt^3} = -\frac{dx}{r^3dt} + \frac{3xr^2dr}{r^6dt} = \frac{3xrdr}{r^5dt} - \frac{dx}{r^3dt},$$

or, by making $\frac{rdr}{dt} = k$,

$$\frac{d^3x}{dt^3} = \frac{3k}{r^5}.x - \frac{1}{r^3}.\frac{dx}{dt}.$$

Differentiating again, and making the necessary reductions, we obtain

$$\frac{d^4x}{dt^4} = \left(\frac{3}{r^5}.\frac{dk}{dt} - \frac{3\cdot5\cdot k^2}{r^7} + \frac{1}{r^6}\right)x + \frac{2\cdot3\cdot k}{r^5}.\frac{dx}{dt}.$$

If we now substitute these values of $\frac{d^2x}{dt^2}$, $\frac{d^3x}{dt^3}$, and $\frac{d^4x}{dt^4}$, in the foregoing series for x° and x', we shall have, on rejecting the superfluous terms,

$$x^\circ = x\left(1 - \frac{1}{r^3}.\frac{\theta^2}{1\cdot2} - \frac{3k}{r^5}.\frac{\theta^3}{1\cdot2\cdot3}\right) + \frac{dx}{dt}\left(-\theta + \frac{1}{r^3}.\frac{\theta^3}{1\cdot2\cdot3} + \frac{2\cdot3k}{r^5}.\frac{\theta^4}{1\cdot2\cdot3\cdot4}\right)$$

$$x' = x\left(1 - \frac{1}{r^3}.\frac{\theta'^2}{1\cdot2} + \frac{3k}{r^5}.\frac{\theta'^3}{1\cdot2\cdot3}\right) + \frac{dx}{dt}\left(\theta' - \frac{1}{r^3}\frac{\theta'^3}{1\cdot2\cdot3} + \frac{2\cdot3k}{r^5}.\frac{\theta'^4}{1\cdot2\cdot3\cdot4}\right).$$

For the sake of abridging, let us assume

$$v = 1 - \frac{\theta^2}{2r^3} - \frac{k\theta^3}{2r^5}, \quad u = -\theta + \frac{\theta^3}{6r^3} + \frac{k\theta^4}{4r^5},$$

$$v' = 1 - \frac{\theta'^2}{2r^3} + \frac{k\theta'^3}{2r^5}, \quad u' = \theta' - \frac{\theta'^3}{6r^3} + \frac{k\theta'^4}{4r^5},$$

and we shall have

$$x^\circ = vx + u\frac{dx}{dt}, \qquad x' = v'x + u'\frac{dx}{dt}.$$

It is evident that y° y' and z° z' may be expressed exactly in the same manner; hence the co-ordinates of the comet at the first and third observations are given in terms of its co-ordinates at the middle observation and their differential co-efficients, by the following system of equations, due to Lagrange:

$$\left.\begin{aligned} x^\circ &= vx + u\frac{dx}{dt} & x' &= v'x + u'\frac{dx}{dt} \\ y^\circ &= vy + u\frac{dy}{dt} & y' &= v'y + u'\frac{dy}{dt} \\ z^\circ &= vz + u\frac{dz}{dt} & z' &= v'z + u'\frac{dz}{dt} \end{aligned}\right\} \quad (1)$$

If from these equations we eliminate $\frac{dx}{dt}, \frac{dy}{dt}, \frac{dz}{dt}$, we shall find, on making $w = vu' - v'u$,

$$u'x^\circ - ux' = wx, \quad u'y^\circ - uy' = wy, \quad u'z^\circ - uz' = wz; \quad (2)$$

but from the values of v, u, v', u', given above, we have evidently

$$w = (\theta' + \theta) - \frac{(\theta' + \theta)^3}{6r^3} + \frac{k}{4r^5}(\theta' + \theta')^3(\theta' - \theta);$$

therefore, by eliminating v, u, and w, from equations (2), there results

$$x(y^\circ z' - y'z^\circ) + y(z^\circ x' - z'x^\circ) + z(x^\circ y' - x'y^\circ) = 0,$$

an equation to a plane, which denotes that the three points C°, C, C′, are situated in the same plane with S, the origin of the co-ordinates.

2. Let the chord of the arc C°C′ intersect the radius SC in D, and let the ratio of C°D to C′D be that of λ to λ'. Make $\lambda + \lambda' = 1$, and the chord C°C′ $= c$; we have then C°D $= \lambda c$ and C′D $= \lambda' c$. Farther, let DC $= er$, so that SD $= r(1 - e)$, e being an infinitely small quantity of the second order in respect of θ and θ', which are supposed infinitesimals of the first order. Com.

In order to find the ratio of λ to λ', suppose the three points C°, D, C′, to be projected on the plane of the ecliptic; then the projections of the lines C°D and C′D will necessarily be to one another in the same ratio as these lines themselves, that is, as λ to λ'. But the co-ordinates of the projections of C°, D, and C′, in the direction of the axis of x, are respectively x°, $(1 - e)x$, and x'; therefore also

$$(1 - e)x - x^\circ : x' - (1 - e)x :: \lambda : \lambda',$$

whence

$$\lambda\{x' - (1 - e)x\} = \lambda'\{(1 - e)x - x^\circ\};$$

and, since $\lambda + \lambda' = 1$,

$$\lambda x' + \lambda' x^\circ = (1 - e)x.$$

Substituting in this last equation the values of x' and x° given by equations (1), we get

$$(\lambda v' + \lambda' v)x + (\lambda u' + \lambda' u)\frac{dx}{dt} = (1 - e)x;$$

and by proceeding in the same manner, we shall find relatively to y and z,

$$(\lambda v' + \lambda' v)y + (\lambda u' + \lambda' u)\frac{dy}{dt} = (1 - e)y;$$

$$(\lambda v' + \lambda' v)z + (\lambda u' + \lambda' u)\frac{dz}{dt} = (1 - e)z.$$

In these last equations the quantities $x\,y\,z, \frac{dx}{dt}\frac{dy}{dt}\frac{dz}{dt}$, are independent of any particular values of $v\,u\,v'\,u'$; they cannot therefore hold true, unless we have also the two equations of condition $\lambda v' + \lambda' v = 1 - e$, and $\lambda u' + \lambda' u = 0$. Joining to these the equation $\lambda + \lambda' = 1$, we shall have, in order to determine λ, λ', and e, the following system of equations:

$$\lambda v' + \lambda' v = 1 - e, \quad \lambda u' + \lambda' u = 0, \quad \lambda + \lambda' = 1. \quad (3)$$

From the second and third of these we get $\lambda = \frac{-u}{u' - u}$, $\lambda' = \frac{u'}{u' - u}$; and consequently from the first, $1 - e = \frac{u'v - uv'}{u' - u} = \frac{w}{u' - u}$. Hence

$$\lambda = \frac{-u}{u' - u}, \quad \lambda' = \frac{u'}{u' - u}, \quad 1 - e = \frac{w}{u' - u}. \quad (4)$$

The accuracy of the values now found of λ, λ', and e, will depend on the number of terms of the series represented by u, u', and w, that are taken into account. We shall distinguish three different degrees of approximation.

I. Retaining only the first terms of the series, or those which depend on the simple powers of θ and θ', we have $u = -\theta$, $u' = \theta'$, $w = \theta' + \theta$, and $u' - u = \theta' + \theta$, whence

$$\lambda = \frac{\theta}{\theta' + \theta}, \quad \lambda' = \frac{\theta'}{\theta' + \theta}, \quad e = 0; \quad (5)$$

consequently $\frac{\lambda}{\lambda'} = \frac{\theta}{\theta'}$, that is to say, the chord which joins the places of the comet at the extreme observations is divided, by the radius vector belonging to the middle observation, into segments proportional to the intervals between the observations. This is the approximation of Newton

Comet. and Olbers. In the method we are about to follow, the results thus obtained serve only to direct the subsequent calculations.

II. By including a second term of the series represented by u, u', and w, we have

$$-u = \theta - \frac{\theta}{6r^3}, \quad u' = \theta - \frac{\theta^3}{6r^3},$$

$$w = \theta' + \theta - \frac{(\theta'+\theta)^3}{6r^3}, \; u' - u = \theta' + \theta - \frac{\theta^3+\theta^3}{6r^3},$$

whence

$$\lambda = \frac{-u}{u'-u} = \frac{\theta\left(1 - \frac{\theta^2}{6r^3}\right)}{\theta' + \theta - \frac{\theta^3+\theta^3}{6r^3}} = \frac{\theta}{\theta'+\theta} \cdot \frac{1 - \frac{\theta^2}{6r^3}}{1 - \frac{\theta^2 - \theta\theta' + \theta^2}{6r^3}}$$

and therefore by division

$$\lambda = \frac{\theta}{\theta'+\theta} + \frac{\theta'\theta}{\theta'+\theta} \cdot \frac{\theta' - \theta}{6r^3}.$$

In like manner, from the equation $\lambda' = \frac{u'}{u'-u}$ we find

$$\lambda' = \frac{\theta'}{\theta'+\theta} - \frac{\theta'\theta}{\theta'+\theta} \cdot \frac{\theta' - \theta}{6r^3}.$$

$$\text{But } 1 - e = \frac{\theta' + \theta - \frac{(\theta'+\theta)^3}{6r^3}}{\theta + \theta - \frac{\theta^3+\theta^3}{6r^3}} = 1 - \frac{3\theta'\theta}{6r^3}$$

Whence we have in this case the following values of λ, λ', and e, namely,

$$\left.\begin{aligned} \lambda &= \frac{\theta}{\theta'+\theta} + \frac{\theta'\theta}{\theta'+\theta}\left(\frac{\theta' - \theta}{6r^3}\right) \\ \lambda' &= \frac{\theta'}{\theta'+\theta} - \frac{\theta'\theta}{\theta'+\theta}\left(\frac{\theta' - \theta}{6r^3}\right) \\ e &= \frac{\theta'\theta}{2r^3} \end{aligned}\right\} \quad (6)$$

The values of λ, λ', and e, thus found, will be sufficiently exact in ordinary cases; but it will sometimes be necessary to carry the approximation farther, and to include the third terms of the series represented by u, u', and w.

III. In order to obtain convenient expressions when a third term of the series is taken into account, it will be necessary to introduce the extreme radii vectores r° and r'. For this purpose we may suppose $r^\circ = r - dr$, and $r' = r + dr$; but we have already assumed $k = \frac{rdr}{dt}$, therefore $dr = \frac{kdt}{r} = \frac{k\theta}{r}$. Hence

$$r^\circ = r - \frac{k\theta}{r}, \quad r^\circ r = r^2 - k\theta,$$

whence $(r^\circ r)^{\frac{3}{2}} = r^3 - \frac{3}{2}rk\theta$, and consequently

$$\frac{1}{6(r^\circ r)^{\frac{3}{2}}} = \frac{1}{6r^3 - 9rk\theta} = \frac{1}{6r^3} + \frac{k\theta}{4r^5}.$$

In the same manner we find

$$\frac{1}{6(rr')^{\frac{3}{2}}} = \frac{1}{6r^3 + 9rk\theta} = \frac{1}{6r^3} - \frac{k\theta'}{4r^5}.$$

Substituting these expressions in the series denoted by u and u', we get

$$-u = \theta\left\{1 - \frac{\theta^2}{6(r^\circ r)^{\frac{3}{2}}}\right\}, \quad u' = \theta'\left\{1 - \frac{\theta^2}{6(rr')^{\frac{3}{2}}}\right\},$$

$$u' - u = \theta' + \theta - \left\{\frac{\theta^3}{6(rr')^{\frac{3}{2}}} + \frac{\theta^3}{6(r^\circ r)^{\frac{3}{2}}}\right\}; \quad \text{Comet.}$$

consequently,

$$\lambda = \frac{-u}{u'-u} = \frac{\theta\left\{1 - \frac{\theta^2}{6(r^\circ r)^{\frac{3}{2}}}\right\}}{\theta' + \theta - \left\{\frac{\theta^3}{6(rr')^{\frac{3}{2}}} + \frac{\theta^3}{6(r^\circ r)^{\frac{3}{2}}}\right\}},$$

whence by division,

$$\lambda = \frac{\theta}{\theta'+\theta} + \frac{\theta'\theta}{(\theta'+\theta)^2}\left\{\frac{\theta^2}{6(rr')^{\frac{3}{2}}} - \frac{\theta^2}{6(r^\circ r)^{\frac{3}{2}}}\right\}.$$

By proceeding in a similar manner with respect to λ', we find

$$\lambda' = \frac{\theta'}{\theta'+\theta} - \frac{\theta'\theta}{(\theta'+\theta)^2}\left\{\frac{\theta^2}{6(rr')^{\frac{3}{2}}} - \frac{\theta^2}{6(r^\circ r)^{\frac{3}{2}}}\right\}.$$

To find e, we have in this case

$$1 - e = \frac{w}{u'-u} = \frac{\theta' + \theta - \frac{(\theta'+\theta)^3}{6r^3} + \frac{k}{4r^5}(\theta'+\theta)^3(\theta'-\theta)}{\theta' + \theta - \frac{\theta^3+\theta^3}{6r^3} + \frac{k}{4r^5}(\theta'^4 - \theta^4)}$$

$$= \frac{(\theta'+\theta)\left\{1 - \frac{(\theta'+\theta)^2}{6r^3} + \frac{k}{4r^5}(\theta'^2+\theta^2)(\theta'-\theta)\right\}}{(\theta'+\theta)\left\{1 - \frac{\theta^2 - \theta\theta' + \theta^2}{6r^3} + \frac{k}{4r^5}(\theta^2+\theta^2)(\theta'-\theta)\right\}};$$

hence, on dividing and neglecting the terms which involve the fourth and higher powers of θ and θ',

$$1 - e = 1 - \frac{\theta'\theta}{2r^3} + \frac{k\theta'\theta(\theta'-\theta)}{2r^5}.$$

But $r^\circ = r - \frac{k\theta}{r}$, $r' = r + \frac{k\theta}{r}$, therefore $r^\circ rr' = r^3 + k(\theta' - \theta)r - \frac{k^2\theta'\theta}{r}$. The last term of this expression is a quantity of the order of those that may be neglected; therefore simply

$$\frac{1}{r^\circ rr'} = \frac{1}{r^3 + k(\theta'-\theta)r} = \frac{1}{r^3} - \frac{k(\theta'-\theta)}{r^5}.$$

Substituting this in the above expression for $1 - e$, it becomes

$$1 - e = 1 - \frac{\theta\theta'}{2r^\circ rr'}, \text{ whence } e = \frac{\theta'\theta}{2r^\circ rr'}.$$

It follows, therefore, that this third degree of approximation gives

$$\left.\begin{aligned} \lambda &= \frac{\theta}{\theta'+\theta} + \frac{\theta'\theta}{(\theta'+\theta)^2}\left\{\frac{\theta^2}{6(rr')^{\frac{3}{2}}} - \frac{\theta^2}{6(r^\circ r)^{\frac{3}{2}}}\right\} \\ \lambda' &= \frac{\theta'}{\theta'+\theta} - \frac{\theta'\theta}{(\theta'+\theta)^2}\left\{\frac{\theta^2}{6(rr')} - \frac{\theta^2}{6(r^\circ r)^{\frac{3}{2}}}\right\} \\ e &= \frac{\theta'\theta}{2r^\circ rr'} \end{aligned}\right\} \quad (7)$$

3. We now proceed to apply the above results to the solution of the problem.

Let α°, α, α', be the three geocentric longitudes of the comet at the instants of the first, second, and third observations respectively; β°, β, β', its three geocentric latitudes; ϱ°, ϱ, ϱ', the three curtate distances, that is to say, the three distances of the comet from the earth projected on the plane of the ecliptic; A°, A, A′, the three corresponding heliocentric longitudes of the earth; and R°, R, R′, the three radii vectores of the earth. Finally, let $X^\circ Y^\circ$, XY, X′Y′, be the co-ordinates of the earth, referred to the centre of the sun, so that

$$\left.\begin{array}{lll} X^\circ = R^\circ \cos. A^\circ, & X = R \cos. A, & X' = R' \cos. A' \\ Y^\circ = R^\circ \sin. A^\circ, & Y = R \sin. A, & Y' = R' \sin. A' \end{array}\right\} \quad (8)$$

For the sake of abridging, let us assume

$$\left.\begin{array}{llll} m^\circ = \cos. a^\circ & n^\circ = \sin. a^\circ & p^\circ = \tan. b^\circ \\ m = \cos. a & n = \sin. a & p = \tan. b \\ m' = \cos. a' & n' = \sin. a' & p' = \tan. b' \end{array}\right\} \quad (9)$$

then, on transferring the origin of the co-ordinates from the centre of the sun to the earth, we shall have relatively to the points C°, C, C′,

$$\left.\begin{array}{llll} x^\circ = m^\circ \varrho^\circ + X^\circ & x = m\varrho + X & x' = m'\varrho' + X' \\ y^\circ = n^\circ \varrho^\circ + Y^\circ & y = n\varrho + Y & y = n'\varrho' + Y' \\ z^\circ = p^\circ \varrho^\circ & z = p\varrho & z' = p'\varrho' \end{array}\right\} \quad (10)$$

It has already been shown (2) that

$$\lambda x' + \lambda' x^\circ = (1 - e)\, x,$$

and it is obvious that the same condition must be fulfilled in regard to y and z, or the projection of the chord C° C′ on the other two co-ordinate planes. Hence we have the following system of equations:—

$$\left.\begin{array}{l} \lambda x' + \lambda' x^\circ - (1 - e)\, x = 0 \\ \lambda y' + \lambda' y^\circ - (1 - e)\, y = 0 \\ \lambda z' + \lambda' z^\circ - (1 - e)\, z = 0 \end{array}\right\} \quad (11)$$

Substituting in these last equations (11) the values of $x\ y\ z$, $x^\circ\ y^\circ\ z^\circ$, $x'\ y'\ z'$, given in equations (10), and making at the same time

$$\left.\begin{array}{l} M = \lambda X' + \lambda' X^\circ - (1 - e) X \\ N = \lambda Y' + \lambda' Y^\circ - (1 - e) Y \end{array}\right\} \quad (12)$$

we obtain

$$\left.\begin{array}{l} 0 = \lambda m'\varrho' + \lambda' m^\circ \varrho^\circ - (1 - e)\, m\varrho + M \\ 0 = \lambda n'\varrho' + \lambda' n^\circ \varrho^\circ - (1 - e)\, n\varrho + N \\ 0 = \lambda p'\varrho' + \lambda' p^\circ \varrho^\circ - (1 - e)\, p\varrho \end{array}\right\} \quad (13)$$

on which equations the solution of the problem essentially depends. Before we proceed to their discussion, however, it will be necessary to find more convenient expressions for M and N.

4. In order to express X° Y°, X′ Y′, the co-ordinates of the earth, which belong to the extreme observations, in a function of the time, and of the co-ordinates X Y relative to the time $\theta = 0$, let us assume, as in § 1,

$$V = 1 - \frac{\theta^2}{2R^3} - \frac{K\theta^3}{2R^5}, \qquad U = -\theta + \frac{\theta^3}{6R^3} + \frac{K\theta^4}{4R^5},$$

$$V' = 1 - \frac{\theta'^2}{2R^3} + \frac{K\theta'^3}{2R^5}, \qquad U' = \theta' - \frac{\theta'^3}{6R^3} + \frac{K\theta'^4}{4R^5},$$

and we shall have

$$X^\circ = VX + U\frac{dX}{dt}, \qquad X' = V'X + U'\frac{dX}{dt};$$

the symbols V, U, R, K, having now the same signification relatively to the orbit of the earth which v, u, r, k, had before relatively to the orbit of the comet.

In consequence of these last equations, and of the equations (4), we have

$$\lambda X' = -\frac{uV'}{u' - u}\cdot X - \frac{uU'}{u' - u}\cdot\frac{dX}{dt}$$

$$\lambda' X^\circ = \frac{u'V}{u' - u}\cdot X + \frac{u'U}{u' - u}\cdot\frac{dX}{dt}$$

$$(1 - e)X = \frac{w}{u' - u}\, X,$$

and substituting these values, in the first of equations (12),

$$M = \frac{u'V - uV' - w}{u' - u}\cdot X + \frac{u'U - uU'}{u' - u}\cdot\frac{dX}{dt}.$$

Substituting now for u', u, V, V′, their values in terms of θ and θ', we obtain $u'V - uV' = \theta' + \theta - \frac{\theta'\theta\,(\theta' + \theta)}{2R^3} - \frac{\theta'^3 + \theta^3}{6r^3} + \left(\frac{K\theta'\theta}{2R^5} + \frac{k(\theta'^2 + \theta^2)}{4r^5}\right)(\theta^2 - \theta'^2)$;

but

$$u' - u = \theta' + \theta - \frac{\theta'^3 + \theta^3}{6r^3} + \frac{k}{4r^5}(\theta'^4 - \theta^4),$$

therefore, by dividing, and retaining only the terms which do not exceed the third order in respect of θ' and θ,

$$\frac{u'V - uV'}{u' - u} = 1 - \frac{\theta'\theta}{2R^3} + \frac{K\theta'\theta}{2R^5}(\theta' - \theta),$$

whence

$$\frac{u'V - uV' - w}{u' - u} = e - \frac{\theta'\theta}{2R^3} + \frac{K\theta'\theta}{2R^5}(\theta' - \theta).$$

In like manner we have

$$u'U - uU' = \frac{\theta'\theta\,(\theta'^2 - \theta^2)}{6}\left(\frac{1}{r^3} - \frac{1}{R^3}\right);$$

therefore, by division,

$$\frac{u'U - uU'}{u' - u} = \frac{\theta'\theta\,(\theta' - \theta)}{6}\left(\frac{1}{r^3} - \frac{1}{R^3}\right).$$

The value of M therefore becomes

$$M = \left\{e - \frac{\theta'\theta}{2R^3} + \frac{K\theta'\theta}{2R^5}(\theta' - \theta)\right\} X + \frac{\theta'\theta\,(\theta' - \theta)}{6}\left(\frac{1}{r^3} - \frac{1}{R^3}\right)\frac{dX}{dt}.$$

It will be remarked that the quantity $\frac{\theta'\theta}{2R^3} - \frac{K\theta'\theta}{2R^5}(\theta' - \theta)$ is exactly analogous to that which has already been denoted by e. Let us therefore suppose it to be represented by E, and the last equation will become

$$M = (e - E)\, X + \frac{\theta'\theta\,(\theta' - \theta)}{6}\left(\frac{1}{r^3} - \frac{1}{R^3}\right)\frac{dX}{dt};$$

but on rejecting quantities involving higher powers than the third of θ and θ', we have obviously

$$\frac{\theta' - \theta}{3}(e - E) = \frac{\theta'\theta\,(\theta' - \theta)}{6}\left(\frac{1}{r^3} - \frac{1}{R^3}\right);$$

therefore ultimately

$$M = (e - E)\left\{X + \frac{\theta' - \theta}{3}\cdot\frac{dX}{dt}\right\}.$$

Since the epoch or instant from which the time is reckoned is supposed to fall on the second observation, it is evident that $\frac{\theta' - \theta}{3}$ is the instant corresponding to the mean time of the three observations. Let the value of X at this instant be denoted by X_1, and the corresponding values of R and A by R_1 and A_1, then

$$M = (e - E)X_1.$$

By proceeding exactly in the same manner with regard to N, we shall find

$$N = (e - E)Y_1;$$

therefore, on substituting for X and Y their values in terms of R and A, we have at the mean time of the three observations

$$\left.\begin{array}{l} M = (e - E)\, R_1 \cos. A_1 \\ N = (e - E)\, R_1 \sin. A_1 \end{array}\right\} \quad (14)$$

5. We now resume the equations (13). The unknown quantities which they contain are the three curtate distances $\varrho^\circ\ \varrho\ \varrho'$, together with r, the radius vector of the comet, which is involved in the values of λ, λ', and e. They may be combined in various ways, and the different combinations will afford so many different expressions for ϱ°, ϱ, and ϱ', which will be more or less easily computed according to the circumstances of the case. The most obvious solu-

Comet. tion will be obtained by eliminating ϱ°, ϱ, and ϱ'. For this purpose the third of equations (13) gives

$$\varrho^\circ = \frac{(1-e)\,p\varrho - \lambda p'\varrho'}{\lambda' p^\circ},$$

and on substituting this value of ϱ° in the first and second of these equations, they become respectively

$$0 = (m'p^\circ - m^\circ p')\,\lambda\varrho' + (m^\circ p - mp^\circ)(1-e)\,\varrho + p^\circ \mathrm{M}$$
$$0 = (n'p^\circ - n^\circ p')\,\lambda\varrho' + (n^\circ p - np^\circ)(1-e)\,\varrho + p^\circ \mathrm{N}.$$

On eliminating $\lambda\varrho'$ from the two equations now found, we get

$$\varrho = \frac{p^\circ}{1-e}\cdot\frac{(n'p^\circ - n^\circ p')\,\mathrm{M} - (m'p^\circ - m^\circ p')\,\mathrm{N}}{(m'p^\circ - m^\circ p')(n^\circ p - np^\circ) - (m^\circ p - mp^\circ)(n'p^\circ - n^\circ p')}$$

an equation which becomes by reduction

$$\varrho = \frac{1}{1-e}\cdot\frac{(m^\circ \mathrm{N} - n^\circ \mathrm{M})\,p' - (m'\mathrm{N} - n'\mathrm{M})\,p^\circ}{(m'n^\circ - m^\circ n')p + (mn' - m'n)p^\circ + (m^\circ n - mn^\circ)p'};$$

and on restoring the values of M, N, m, n, p, &c. given by equations (14) and (9), and recollecting that sin. $(x-y)$ = sin. x cos. y − cos. x sin. y, we get

$$\varrho = \frac{e-\mathrm{E}}{1-e}\cdot \mathrm{R}_1 \times$$
$$\frac{\sin.(\mathrm{A}_1 - a^\circ)\tan. b' - \sin.(\mathrm{A}_1 - a')\tan. b^\circ}{\sin(a^\circ - a')\tan. b + \sin.(a' - a)\tan. b^\circ + \sin.(a - a^\circ)\tan. b'} \quad (15)$$

Let us assume

$$\mathrm{P} = \sin.(\mathrm{A}_1 - a^\circ)\tan. b' - \sin.(\mathrm{A}_1 - a')\tan. b^\circ$$
$$\mathrm{Q} = \sin.(a^\circ - a')\tan. b + \sin.(a' - a)\tan. b^\circ + \sin.(a - a^\circ)\tan. b';$$

this assumption gives

$$\varrho = \frac{\mathrm{P}}{\mathrm{Q}}\cdot\frac{e-\mathrm{E}}{1-e}\cdot \mathrm{R}_1;$$

but on carrying the approximation only to quantities of the third order in respect of the time, $\frac{e-\mathrm{E}}{1-e} = \frac{\theta'\theta}{2}\left(\frac{1}{r^3} - \frac{1}{\mathrm{R}^3}\right)$; therefore if we make $\frac{\theta'\theta \mathrm{PR}_1}{2\mathrm{Q}} = h$, the last equation will become

$$\varrho = h\left(\frac{1}{r^3} - \frac{1}{\mathrm{R}^3}\right) \quad (16)$$

6. The equation which has now been obtained contains two unknown quantities ϱ and r; but another equation between the same variables may be readily found from the equations (10). These give, on restoring the values of m, n, p, X, and Y_1

$$x = \varrho \cos. a + \mathrm{R} \cos. \mathrm{A},$$
$$y = \varrho \sin. a + \mathrm{R} \sin. \mathrm{A},$$
$$z = \varrho \tan. b,$$

whence, by squaring and adding

$$x^2 + y^2 + z^2 = \varrho^2(1 + \tan.^2 b) + 2\varrho \mathrm{R} \cos.(\mathrm{A} - a) + \mathrm{R}^2;$$

but $x^2 + y^2 + z^2 = r^2$; and $1 + \tan.^2 b = \frac{1}{\cos.^2 b}$; therefore

$$r^2 = \mathrm{R}^2 + 2\varrho \mathrm{R} \cos.(\mathrm{A} - a) + \frac{\varrho^2}{\cos.^2 b}. \quad (17)$$

We have now arrived at two equations between r and ϱ, by means of which the values of those quantities become known. In order to eliminate r, let equation (16) be put under the form

$$r^3(h + \mathrm{R}^3\varrho) = h\mathrm{R}^3,$$

the square of which is

$$r^6(h + \mathrm{R}^3\varrho)^2 = h^2 \mathrm{R}^6;$$

then, by substituting in this the value of r^6 given by equation (17) raised to the cube, there results

$$\left\{\mathrm{R}^2 + 2\varrho \mathrm{R} \cos.(\mathrm{A} - a) + \frac{\varrho^2}{\cos.^2 b}\right\}^3 \cdot (h + \mathrm{R}^3\varrho)^2 = h^2 \mathrm{R}^6, \quad \text{Comet.}$$

an equation of the eighth degree in respect of the unknown quantity ϱ. It is evident, however, that on being developed, $h^2 \mathrm{R}^6$ will disappear from both sides of it, after which the whole will be divisible by ϱ; it belongs, therefore, in fact, only to the seventh degree. On being resolved by approximation it will give a value of ϱ, but in practice it is more commodious to determine r and ϱ simultaneously from the equations (16) and (17), by the ordinary methods of false position.

7. Although the equations (16) and (17) thus appear to lead to a complete solution of the problem, it seldom happens in practice that an orbit can be determined in this manner. The reason of this is, that the quantity which we have represented by Q is always very small (it is not difficult to prove that it is of the third order in respect of θ), and liable to be greatly affected by the errors of observation. If Q = 0, we have the equation

$$\sin.(a^\circ - a')\tan. b + \sin.(a' - a)\tan. b^\circ + \sin.(a - a^\circ)\tan. b' = 0,$$

which denotes that the three apparent places of the comet are situated in the same great circle of the sphere. The value of Q therefore depends solely on the deviation of the comet's apparent path from a great circle of the heavens, during the short interval between the extreme observations; and this deviation is in general so small, that a slight error of observation, which it is impossible to guard against, may cause it to become evanescent, or even to change its sign. On this account the equation (16), which is called by Legendre the *doubtful equation*, can only be employed in very favourable circumstances; and it becomes necessary, in the greater number of cases, to have recourse to other methods of solution. Some conclusions may, however, be deduced from it, which will materially assist in guiding the subsequent calculations.

In the first place, as the curtate distance ϱ is necessarily a finite quantity, if the denominator of the fraction expressed by h vanishes, that is, if Q = 0, the numerator must vanish at the same time. Now this can happen only in two ways: either by supposing P = 0, or $\frac{1}{r^3} = \frac{1}{\mathrm{R}^3}$. If we suppose P = 0, we have the equation

$$\sin.(\mathrm{A}_1 - a^\circ)\tan. b' - \sin.(\mathrm{A}_1 - a')\tan. b^\circ = 0,$$

which indicates that the place of the sun at the instant $\frac{\theta' - \theta}{3}$, corresponding to the mean time of the three observations, is situated in the same great circle of the sphere with the three apparent places of the comet. Now it is easy to see, that although the sun may not be exactly in the same great circle with the three apparent places of the comet, yet if it is near one of the intersections of that circle with the ecliptic, the quantity P will be very small, and the equation (16) in consequence will not lead to any satisfactory result.

In the second place, if Q vanishes while the value of P continues so great that its sign would not be changed by supposing its component parts to vary to the extent of the errors of observation, we must then have $\frac{1}{r^3} = \frac{1}{\mathrm{R}^3}$, or $r = \mathrm{R}$; that is to say, the comet and the earth are at the same distance from the sun. This circumstance, therefore, also renders equation (16) indeterminate. It may be remarked, however, that in this case we obtain an easy approximation to the value of ϱ from equation (17), which, when r is equal to R, becomes

$$\varrho = 2\,\mathrm{R} \cos.^2 b \cos.(180 + \mathrm{A} - a),$$

Comet. where 180 + A is the longitude of the sun at the instant of the middle observation.

In the third place, when the quantities P and Q are both so great that their signs can be determined without ambiguity, equation (16) will show whether the distance of the comet from the sun is greater or less than the radius vector of the earth. For since ϱ is necessarily positive, the sign of $\frac{P}{Q}$ must be the same as that of $e - E$ or $\frac{1}{r^3} - \frac{1}{R^3}$; consequently, the sign of $\frac{P}{Q}$ being known, we also know whether r is greater or less than R.

8. Since the state of the observations will seldom permit equation (16) to be employed with advantage, it becomes necessary to attempt some other combination of the three fundamental equations (13). Instead of eliminating the three curtate distances ϱ, ϱ°, ϱ' from these equations, we may determine two of them, for example ϱ° and ϱ', in terms of the third, ϱ; by which means we shall obtain at least the ratios of these distances to one another. This may be effected in various ways; but we shall confine ourselves to the two following combinations, the one or other of which will be applicable in every case.

Let the first of the equations (13) be multiplied by N, and the second by M; the difference of the products is

$$\lambda\varrho'(Nm' - Mn') + \lambda'\varrho^\circ(Nm^\circ - Mn^\circ) - (1-e)\varrho(Nm - Mn) = 0.$$

Combining this with the third equation, so as to eliminate first ϱ' and then ϱ°, we get

$$\varrho^\circ = \frac{(1-e)\varrho}{\lambda'} \cdot \frac{(Nm - Mn)\,p' - (Nm' - Mn')\,p}{(Nm^\circ - Mn^\circ)\,p' - (Nm' - Mn')\,p^\circ}$$

$$\varrho' = \frac{(1-e)\varrho}{\lambda} \cdot \frac{(Nm^\circ - Mn^\circ)\,p - (Nm - Mn)\,p^\circ}{(Nm^\circ - Mn^\circ)\,p' - (Nm' - Mn')\,p^\circ};$$

and, on substituting the values of M, N, m, &c. before found,

$$\left.\begin{aligned} \varrho^\circ &= \frac{(1-e)\varrho}{\lambda'} \cdot \frac{\sin.(A_1 - a)\tan.b' - \sin.(A_1 - a')\tan.b}{\sin.(A_1 - a^\circ)\tan.b' - \sin.(A_1 - a')\tan.b^\circ} \\ \varrho' &= \frac{(1-e)\varrho}{\lambda} \cdot \frac{\sin.(A_1 - a^\circ)\tan.b - \sin.(A_1 - a)\tan.b^\circ}{\sin.(A_1 - a^\circ)\tan.b' - \sin.(A_1 - a')\tan.b^\circ} \end{aligned}\right\} \quad (18)$$

These two equations will give the ratios $\frac{\varrho^\circ}{\varrho}$, $\frac{\varrho'}{\varrho}$, in all cases when the common denominator (the quantity we have already denoted by P) is not so small as to render the expressions indeterminate. In general they will be most applicable when the motion of the comet in latitude is greater than its motion in longitude.

The other combination to which we have alluded, is formed by employing only the two first of the equations (13). Let the first be multiplied by n', and the second by m'; the difference of the products gives

$$\varrho^\circ = \frac{(1-e)\,\varrho\,(mn' - m'n) + Nm' - Mn'}{\lambda'\,(m^\circ n' - m'n^\circ)}.$$

In like manner, if we multiply the first by n°, and the second by m°, in order to eliminate ϱ°, we find

$$\varrho' = \frac{(1-e)\,\varrho\,(m^\circ n - mn^\circ) - Nm^\circ + Mn^\circ}{\lambda\,(m^\circ n' - m'n^\circ)}.$$

On substituting the values of M, N, m, n, &c. in these last equations, they become

$$\left.\begin{aligned} \varrho^\circ &= \frac{(1-e)\varrho \cdot \sin.(a' - a) + (e - E)R_1 \sin.(A_1 - a')}{\lambda' \sin.(a' - a^\circ)} \\ \varrho' &= \frac{(1-e)\varrho \cdot \sin.(a - a^\circ) - (e - E)R_1 \sin.(A_1 - a^\circ)}{\lambda \sin.(a' - a^\circ)} \end{aligned}\right\} \quad (19)$$

The equations now found will be most applicable when the motion of the comet in longitude is greater than its motion in latitude. Comet.

It may be proper to remark, that on employing the equations (18) or (19) to determine the ratio of the curtate distances, we may suppose in the first trials $e = 0$, $E = 0$, $\lambda = \frac{\theta}{\theta' + \theta}$, $\lambda' = \frac{\theta'}{\theta' + \theta}$. On this supposition the equations (19) become simply

$$\left.\begin{aligned} \varrho^\circ &= \frac{\theta' + \theta}{\theta'} \cdot \frac{\varrho \sin.(a' - a)}{\sin.(a' - a^\circ)} \\ \varrho' &= \frac{\theta' + \theta}{\theta} \cdot \frac{\varrho \sin.(a - a^\circ)}{\sin.(a' - a^\circ)} \end{aligned}\right\} \quad (20)$$

11. From what has now been shown it may be inferred that the equations (13) can in general be used only in determining the ratios of ϱ° and ϱ' to ϱ; on account of the smallness and consequent uncertainty of the denominator Q, they leave the absolute value of ϱ indeterminate. It is therefore necessary to seek some other equation among the variables employed, before we can obtain a complete solution of the problem. For this purpose we must have recourse to some of the properties connected with the comet's motion in its orbit. No hypothesis has as yet been made respecting the nature of the orbit. If we suppose it to be a parabola, the laws of parabolic motion will give a new equation, without introducing any other variable than those which have already been employed, which may either be combined with equation (16), for the purpose of determining r and ϱ directly, or which may be employed to correct the results obtained by assigning a hypothetical value to ϱ in the equations (18) or (19). There are various methods of introducing the condition derived from the nature of the parabolic motion; but, in the method of solution which we here follow, it is most convenient to employ the theorem of Lambert, which gives the time of describing a parabolic arc in terms of its chord, and the two radii vectores drawn to its extremities. Before demonstrating this theorem, however, it will be proper to show how the chord may be computed.

Let c be the chord which joins C°C'. The co-ordinates of its extremities being $x'y'z'$, $x^\circ y^\circ z^\circ$, we have

$$\begin{aligned} c^2 &= (x' - x^\circ)^2 + (y' - y^\circ)^2 + (z' - z^\circ)^2 \\ &= x'^2 + y'^2 + z'^2 + x^{\circ 2} + y^{\circ 2} + z^{\circ 2} \\ &\quad - 2x'x^\circ - 2y'y^\circ - 2z'z^\circ; \end{aligned}$$

that is,

$$c^2 = r'^2 + r^{\circ 2} - 2(x'x^\circ + y'y^\circ + z'z^\circ).$$

But by reason of the equations (8) and (10),

$x'x^\circ = \varrho'\varrho^\circ m'm^\circ + m^\circ\varrho^\circ R'$ cos. A' $+ m'\varrho' R^\circ$ cos. A° $+$ R'R° cos. A' cos. A°, $y'y^\circ = \varrho'\varrho^\circ n'n^\circ + n^\circ\varrho^\circ R'$ sin. A' $+ n'\varrho' R^\circ$ sin. A° $+$ R'R° sin. A' sin. A°, and $z'z^\circ = \varrho'\varrho^\circ p'p^\circ$, therefore, by adding and substituting for m, n, p, &c. their values given in equations (9)

$$\begin{aligned} x'x^\circ + y'y^\circ + z'z^\circ &= \varrho'\varrho^\circ \cos.(a' - a^\circ) + \varrho^\circ R' \cos.(A' - a^\circ) \\ &\quad + \varrho' R^\circ \cos.(A^\circ - a') \\ &\quad + \varrho'\varrho^\circ \tan. b' \tan. b^\circ + R'R^\circ \cos.(A' - A^\circ) \end{aligned}$$

hence, denoting the right hand side of this equation by F,

$$c^2 = r'^2 + r^{\circ 2} - 2F. \quad (21)$$

Comparing this last equation with

$$c^2 = r'^2 + r^{\circ 2} - 2r'r^\circ \cos.\varphi,$$

which is given by the triangle C°SC', we have $F = r'r^\circ \cos.\varphi$, or $\cos.\varphi = \frac{F}{r'r^\circ}$, φ being the angle included between the two radii vectores r' and r°.

12. We now proceed with the demonstration of Lambert's theorem.

According to the doctrine of central forces, when a

Comet. body describes an orbit in virtue of a force varying inversely as the square of the distance, the square of the velocity at the distance r is given by the equation

$$\frac{1}{r} - \frac{1}{a} = \frac{dx^2}{dt^2} + \frac{dy^2}{dt^2},$$

in which a is the major axis of the orbit, and the sum of the masses is supposed equal to unit. In the case of the parabola, the major axis is infinite, and the equation becomes simply

$$\frac{1}{r} = \frac{dx^2}{dt^2} + \frac{dy^2}{dt^2}.$$

Let D be the perihelion distance SP, and ψ the true anomaly, or the angle PSC. We have then $x = r\cos.\psi$, $y = r\sin.\psi$, whence $\frac{dx^2}{dt^2} + \frac{dy^2}{dt^2} = \frac{dr^2 + r^2 d\psi^2}{dt^2}$, and consequently

$$\frac{2}{r} = \frac{dr^2 + r^2 d\psi^2}{dt^2}.$$

But from the property of the parabola $r = 2D - r\cos.\psi$; whence $r(1 + \cos.\psi) = 2D$, or $r\cos.^2\frac{1}{2}\psi = D$, therefore

$$r = D(1 + \tan.^2\tfrac{1}{2}\psi).$$

Let $\tan.\frac{1}{2}\psi = u$; then $dr = 2Dudu$; and $du = \frac{\frac{1}{2}d\psi}{\cos.^2\frac{1}{2}\psi} = \frac{1}{2}d\psi(1 + \tan.^2\frac{1}{2}\psi)$, whence $d\psi = \frac{2du}{1+u^2}$. Substituting these expressions in the equation $\frac{2}{r} = \frac{dr^2 + r^2 d\psi^2}{dt^2}$, it becomes $dt^2 = 2D^3(1+u^2)^2 du^2$, whence $dt = \sqrt{2D^3}(1+u^2)du$; which, on being integrated, becomes

$$t = \sqrt{2D^3}(u + \tfrac{1}{3}u^3).$$

Let u', u° be the values of u in this equation at the times $t + \theta'$, $t - \theta$ respectively; we have then

$$t + \theta' = \sqrt{2D^3}(u' + \tfrac{1}{3}u'^3)$$
$$t - \theta = \sqrt{2D^3}(u^\circ + \tfrac{1}{3}u^{\circ 3}),$$

and, by subtracting,

$$\theta' + \theta = \sqrt{2D^3}\{u' - u^\circ + \tfrac{1}{3}(u'^3 - u^{\circ 3})\}.$$

In order to transform this expression into another containing only $r^\circ r'$ and c, let ψ° be the anomaly corresponding to C°, ψ that corresponding to C′, $\varphi = \psi - \psi^\circ =$ angle C°SC′, and $\tan.\frac{1}{2}\varphi = v$. We have then $\psi = \psi^\circ + \varphi$, and consequently $\tan.\frac{1}{2}\psi = \tan.\frac{1}{2}(\psi^\circ + \varphi) = \frac{\tan.\frac{1}{2}\psi^\circ + \tan.\frac{1}{2}\varphi}{1 - \tan.\frac{1}{2}\psi^\circ \tan.\frac{1}{2}\varphi}$, that is, $u' = \frac{u^\circ + v}{1 - u^\circ v}$. Now, if we put

$$Z = u' - u^\circ + \tfrac{1}{3}(u'^3 - u^{\circ 3}),$$

we shall have evidently

$$Z = (u' - u^\circ)\{1 + \tfrac{1}{3}(u'^2 + u'u^\circ + u^{\circ 2})\}$$
$$= (u' - u^\circ)\{1 + \tfrac{1}{3}[(u' - u^\circ)^2 + 3u'u^\circ]\},$$

therefore, substituting $\frac{u^\circ + v}{1 - u^\circ v}$ for u',

$$Z = \frac{v(1+u^{\circ 2})}{1 - u^\circ v}\left\{1 + \frac{u^{\circ 2} + u^\circ v}{1 - u^\circ v} + \tfrac{1}{3}\frac{v^2(1+u^{\circ 2})^2}{(1-u^\circ v)^2}\right\};$$

that is,

$$Z = \frac{v(1+u^{\circ 2})^2}{(1-u^\circ v)^2}\left\{1 + \tfrac{1}{3}\frac{v^2(1+u^{\circ 2})}{1 - u^\circ v}\right\};$$

hence the formula for the time becomes

$$\theta + \theta' = \sqrt{2D^3}\cdot\frac{v(1+u^{\circ 2})^2}{(1-u^\circ v)^2}\left\{1 + \tfrac{1}{3}\frac{v^2(1+u^{\circ 2})}{1 - u^\circ v}\right\}.$$

Again, the triangle C°SC′ gives the equation

$$c^2 = r'^2 + r^{\circ 2} - 2r'r^\circ\cos.\varphi,$$

but $\tan.\frac{1}{2}\varphi = v$; therefore, from the trigonometrical formulæ, $\cos.\varphi = \frac{1 - v^2}{1 + v^2}$, whence, substituting and reducing

$$(r' + r^\circ)^2 - c^2 = \frac{4r'r^\circ}{1 + v^2}.$$

For the sake of abridging, we shall put

$$r' + r^\circ + c = 2s, \quad r' + r^\circ - c = 2d,$$

whence $r' + r^\circ = s + d$, $c = s - d$, and $(r' + r^\circ)^2 - c^2 = 4sd$. Comparing these with the above equation, we have $\frac{r'r^\circ}{1+v^2} = sd$, whence $v = \frac{(r'r^\circ - sd)^{\frac{1}{2}}}{(sd)^{\frac{1}{2}}}$.

Now the polar equation to the parabola gives

$$r^\circ = D(1+u^{\circ 2}),\ r' = D(1+u'^2) = D\cdot\frac{(1+u^{\circ 2})(1+v^2)}{(1-u^\circ v)^2},$$

therefore $sd = \frac{r'r^\circ}{1+v^2} = D^2\frac{(1+u^{\circ 2})^2}{(1-u^\circ v)^2}$, and consequently,

$$\frac{1+u^{\circ 2}}{1-u^\circ v} = \frac{(sd)^{\frac{1}{2}}}{D}.$$

From the same values of r° and r' we get

$$r' + r^\circ = D(1+u^{\circ 2})\left\{1 + \frac{1+v^2}{(1-u^\circ v)^2}\right\}$$
$$= \frac{2D(1+u^{\circ 2})}{1-u^\circ v} + \frac{Dv^2(1+u^{\circ 2})^2}{(1-u^\circ v)^2},$$

but $r' + r^\circ = s + d$, and $\frac{1+u^{\circ 2}}{1-u^\circ v} = \frac{\sqrt{sd}}{D}$, therefore

$$s + d = 2\sqrt{sd} + \frac{v^2 sd}{D}, \text{ whence } v = \sqrt{D}\cdot\frac{\sqrt{s} - \sqrt{d}}{\sqrt[4]{sd}}.$$

Substituting these values of v and $\frac{1+u^{\circ 2}}{1-u^\circ v}$ in the equation for the time, it becomes

$$\theta + \theta' = \sqrt{2}\sqrt{sd}(\sqrt{s} - \sqrt{d})\left\{1 + \tfrac{1}{3}\frac{(\sqrt{s} - \sqrt{d})^2}{\sqrt{sd}}\right\},$$

that is

$$\theta + \theta' = \frac{\sqrt{2}}{3}(\sqrt{s} - \sqrt{d})(s + \sqrt{sd} + d),$$

or

$$\theta + \theta' = \frac{\sqrt{2}}{3}(s^{\frac{3}{2}} - d^{\frac{3}{2}});$$

and, finally, on restoring the values of s and d,

$$\theta + \theta' = \tfrac{1}{6}(r' + r^\circ + c)^{\frac{3}{2}} - \tfrac{1}{6}(r' + r^\circ - c)^{\frac{3}{2}}. \quad (24)$$

This is the very elegant theorem found by Euler, but commonly attributed to Lambert, by means of which we are enabled to correct the hypothetical values successively given to ρ, till a value of that quantity is found which will satisfy all the equations as nearly as the observations will admit.

13. We shall now collect into one view the different processes indicated in the preceding investigations; and in order to throw every necessary light on the subject, we shall give at the same time an example of the actual computation of an orbit from Legendre. The comet is that of 1805, and the data from which the computation is made are contained in the following table:

Epochs.	Longitudes.	Latitudes.
October 22·68488	$a^\circ = 163^\circ\ 20'\ 53''$	$b^\circ = 22^\circ\ 59'\ 53''$
30·68670	$a = 183\ 48\ 32$	$b = 15\ 37\ 21$
34·72088	$a' = 191\ 46\ 15$	$b' = 12\ 2\ 29$

Comet. I. The first step is to compute the arc described by the mean motion of the earth in the time $\theta + \theta'$. Let this arc be represented by Θ; then since θ and θ' are expressed in mean solar days, we have $\Theta = \frac{2\pi(\theta+\theta)}{365{\cdot}25638}$, 2π being the circumference of a circle whose radius is unit, and 365·25638 the mean solar days in a sidereal year. The logarithm of Θ will therefore be found by adding the constant logarithm 8·2355821 (which is the logarithm of $\frac{2\pi}{365{\cdot}25638}$) to the logarithm of $\theta + \theta'$.

From the above table we have $\theta = 8{\cdot}00182$ days, $\theta' = 4{\cdot}03418$ days, $\theta + \theta' = 12{\cdot}03600$ days; hence taking the logarithms of these numbers, and adding 8·2355821, we have the following results expressed in logarithms:

$\theta = 9{\cdot}1387708$	$\theta' = 8{\cdot}8413373$
$\theta + \theta' = 9{\cdot}3160643$	$\theta + \theta' = 9{\cdot}3160643$
$\frac{\theta}{\theta+\theta'} = 9{\cdot}8227065$	$\frac{\theta'}{\theta+\theta'}$ 9·5252730

It may be here remarked, that although the computations are considerably shortened when $\theta = \theta'$, a condition which may in general be satisfied by interpolation, yet it is preferable to avoid any preliminary calculations, and to employ the direct results of observation. The intervals, however, should not be greatly different; and as the solution is founded on the supposition that quantities of the fourth order in respect of the time may be neglected, the longest interval cannot safely exceed ten days. In the present example, θ is considerably greater than θ'; it therefore affords no facilities for computation, and the approximations must be carried as far as the method admits.

II. The places of the sun at the time of the respective observations are next to be taken from the solar tables. These places, increased by 180°, give the three longitudes of the earth A°, A, A′. The same tables also give the corresponding distances R°, R, R′; and the quantities A_1 and R_1, which denote the longitude and radius vector of the earth at the time $t + \frac{1}{3}(\theta + \theta')$, corresponding to the mean epoch of the three observations, will be obtained with sufficient accuracy by assuming $A_1 = \frac{1}{3}(A° + A + A')$, and $\log. R_1 = \frac{1}{3}\log.(R°RR')$.

At the epochs given in the above table, we find from the solar tables,

A° = 29° 19′ 50″	log. R°...9·997421
A = 37 19 48	log. R ...9·996496
A′ = 41 22 26	log. R′...9·996053

By taking a mean among these numbers we shall have

$A_1 = 36°\ 0'\ 41''$
$\log. R_1 \ldots 9{\cdot}9966567.$

III. With the results now found, we may proceed to compute the quantities P, Q from the expressions given in § 5, namely,

$P = \sin.(A_1 - a°)\tan. b' - \sin.(A_1 - a')\tan. b°$
$Q = \sin.(a° - a')\tan. b + \sin.(a' - a)\tan. b° + \sin.(a - a°)\tan. b'.$

For this purpose the following logarithms are required:

$\sin.(a' - a)$ 9·1414978	$\tan. b°$ 9·6278110
$\sin.(a' - a°)$ 9·6775831	$\tan. b$ 9·4465812
$\sin.(a - a°)$ 9·5435305	$\tan. b'$ 9·3290147
$\sin.(a' - A_1)$ 9·6133857	
$\sin.(a° - A_1)$ 9·9004139	

On computing P and Q by means of these numbers, we find $P = 0{\cdot}0046585$, and $Q = 0{\cdot}0002617$. The signs of both are positive, and though Q is thus a very small number, yet its sign could not become negative without supposing errors in the observations amounting to four or five minutes. By reason of the smallness of P and Q, no use can be made of the equation (16); we can only infer from it, since P and Q have the same sign, that $r < R$; that is to say, the distance of the comet from the sun is less than the sun's distance from the earth. Comet.

IV. It is now necessary to make a supposition with regard to the value ϱ. In general a few trials will suffice to give an approximate value, by means of which $\varrho°$ and ϱ' may be computed from the formulæ (18) or (19), according to the different cases. In the first trials we may suppose $E = 0$, $e = 0$, $\lambda = \frac{\theta}{\theta+\theta'}$, $\lambda' = \frac{\theta'}{\theta+\theta'}$; but when approximations to the values of $\varrho°$ and ϱ' have been obtained on this supposition, we must employ the more exact expressions given in the formulæ (6.) In the present case, on account of the great inequality between θ and θ', the values of $\varrho°$ and ϱ' deduced from the supposition of $E = 0$, $e = 0$, &c. would not have that degree of approximation which would render them of any use in directing the subsequent hypotheses; we may therefore have recourse at once to the second degree of approximation. The formulæ (6) give

$$e = \frac{\theta\theta'}{2r^3},\quad E = \frac{\theta\theta'}{2R^3},$$

$$\lambda = \frac{\theta}{\theta+\theta'}\left(1 - \frac{\theta'(\theta-\theta')}{6r^3}\right),\quad \lambda' = \frac{\theta'}{\theta+\theta'}\left(1 + \frac{\theta(\theta-\theta')}{6r^3}\right),$$

from which we deduce

$$\frac{1-e}{\lambda} = \frac{\theta+\theta'}{\theta}\left(1 - \frac{\theta'(2\theta+\theta')}{6r^3}\right),$$
$$\frac{1-e}{\lambda'} = \frac{\theta+\theta'}{\theta'}\left(1 - \frac{\theta(2\theta'+\theta)}{6r^3}\right),$$
$$\frac{e}{\lambda} = \frac{\theta'(\theta+\theta')}{2r^3},\quad \frac{e}{\lambda'} = \frac{\theta(\theta+\theta')}{2r^3},$$
$$\frac{E}{\lambda} = \frac{\theta'(\theta+\theta')}{2R^3},\quad \frac{E}{\lambda'} = \frac{\theta(\theta+\theta')}{2R^3}.$$

In order to convert these formulæ into numbers, we must recollect that if b is a small number in comparison of a, we have $\log.(a+b) = \log. a + \frac{b}{a}M$, where M denotes the modulus of the tables, or the number 4342945, the logarithm of which is 6·6377843; and reciprocally, if we have $\log. x = \log. a + b$, then $x = a + \frac{ab}{M}$. According to these formulæ

$$\log.\frac{1-e}{\lambda} = \log.\frac{\theta+\theta'}{\theta} - \frac{\theta'(2\theta+\theta')}{6r^3}\cdot M.$$

Now $\log.\frac{\theta+\theta'}{\theta} = 0{\cdot}1772935$; and to find the number $\frac{\theta'(2\theta+\theta')}{6r^3}M$, we have $2\theta + \theta' = 20{\cdot}03782$ days, therefore

$\log.(2\theta+\theta') =$	1·3018505
add	8·2355821
$\log.\theta' =$	8·8413373
	8·3787699
$\log. 6 =$	0·7781513
$\log.\frac{\theta'(2\theta+\theta')}{6} =$	7·6006186

If therefore we denote by (L) the number whose logarithm is L, we shall have

$$\log.\frac{1-e}{\lambda} = 0{\cdot}1772935 - (7{\cdot}6006186)\frac{M}{r^3};$$

Comet. and passing to numbers

$$\frac{1-e}{\lambda} = (0{\cdot}1772935) - (7{\cdot}7779121)\,\frac{1}{r^3}.$$

By proceeding in the same manner, we find

$$\log.\frac{1-e}{\lambda'} = 0{\cdot}4747270 - (7{\cdot}8022223)\,\frac{M}{r^3},$$

whence

$$\frac{1-e}{\lambda'} = (0{\cdot}4747270) - (8{\cdot}2769493)\,\frac{1}{r^3}.$$

The following logarithms are found without difficulty:

$$\log.\frac{e}{\lambda} = \log.\frac{\theta'(\theta+\theta')}{2r^3} = 7{\cdot}8563716 - \log. r^3$$

$$\log.\frac{e}{\lambda'} = \log.\frac{\theta(\theta+\theta')}{2r^3} = 8{\cdot}1538051 - \log. r^3$$

$$\log.\frac{E}{\lambda} = \log.\frac{\theta'(\theta+\theta')}{2R^3} = 7{\cdot}8668836$$

$$\log.\frac{E}{\lambda'} = \log.\frac{\theta(\theta+\theta')}{2R^3} = 8{\cdot}1643171.$$

In the present example the motion in longitude is more considerable than in latitude; it is therefore preferable to employ the equations (19), namely,

$$\varrho^\circ = \frac{(1-e)\,\varrho\sin.(a'-a) + (E-e)\,R_1\sin.(a'-A_1)}{\lambda'\sin.(a'-a^\circ)}$$

$$\varrho' = \frac{(1-e)\,\varrho\sin.(a-a^\circ) + (e-E)\,R_1\sin.(a^\circ-A_1)}{\lambda\sin.(a'-a^\circ)};$$

to compute which, the following logarithms are required in addition to those already found, namely,

$$\log.\frac{\sin.(a'-a)}{\sin.(a'-a^\circ)} = 9{\cdot}4639147$$

$$\log.\frac{R_1\sin.(a'-A_1)}{\sin.(a'-a^\circ)} = 9{\cdot}9324593$$

$$\log.\frac{\sin.(a-a^\circ)}{\sin.(a'-a^\circ)} = 9{\cdot}8659474$$

$$\log.\frac{R_1\sin.(a^\circ-A_1)}{\sin.(a'-a^\circ)} = 0{\cdot}2194875,$$

by adding which to the values of $\frac{1-e}{\lambda}$, &c. the above two equations become

$$\varrho^\circ = \varrho(9{\cdot}9386417) - \frac{\varrho}{r^3}(7{\cdot}7408640) + (8{\cdot}0967764) - \frac{1}{r^3}(8{\cdot}0862644)$$

$$\varrho' = \varrho(0{\cdot}0432409) - \frac{\varrho}{r^3}(7{\cdot}6438595) - (8{\cdot}0863711) + \frac{1}{r^3}(8{\cdot}0758591)$$

V. Having assumed a hypothetical value of ϱ, the radius vector r will be obtained from the equation (17), namely,

$$r^2 = R^2 + 2\varrho R\cos.(A-a) + \varrho^2\sec.^2 b,$$

which, on taking the logarithms of the known quantities, becomes

$$r^2 = 0{\cdot}9839930 - \varrho(0{\cdot}2185267) + \varrho^2(0{\cdot}0326962);$$

and on substituting this value of r in the above two equations, we shall obtain the values of ϱ° and ϱ'.

It is now necessary to calculate r°, r', and c. With regard to r° and r', we have the two equations, corresponding to equation (17),

$$r^{\circ 2} = R^{\circ 2} + 2\varrho^\circ R^\circ\cos.(A^\circ-a^\circ) + \varrho^{\circ 2}\sec.^2 b^\circ,$$
$$r'^2 = R'^2 + 2\varrho' R'\cos.(A'-a') + \varrho'^2\sec.^2 b',$$

which being reduced to numbers, become

$$r^{\circ 2} = 0{\cdot}9881934 - \varrho^\circ(0{\cdot}1403596) + \varrho^{\circ 2}(0{\cdot}0719354),$$
$$r^{\circ\prime} = 0{\cdot}9819876 - \varrho'(0{\cdot}2363369) + \varrho^2(0{\cdot}0193249).$$

Comet.

The chord c is determined by the equation

$$c^2 = r'^2 + r^{\circ 2} - 2F,$$

in which F =

$$R^\circ R'\cos.(A'-A^\circ) + \varrho^\circ\varrho'\{\cos.(a'-a^\circ) + \tan. b'\tan. b^\circ\} + \varrho^\circ R'\cos.(A'-a^\circ) + \varrho' R^\circ\cos.(A^\circ-a').$$

On taking the logarithms of the constant quantities, this becomes

$$F = 0{\cdot}9634042 - \varrho^\circ(9{\cdot}7199492) - \varrho'(9{\cdot}9766975) + \varrho^\circ\varrho'(9{\cdot}9867701).$$

Lastly, the error of the hypothesis will be found from the equation of the time

$$6(\theta+\theta') = (r^\circ + r' + c)^{\frac{3}{2}} + (r^\circ + r' - c)^{\frac{3}{2}} = 1{\cdot}2422687.$$

As the present object is merely to illustrate the method of computation, it is unnecessary to begin with an assumption very far from the truth. Suppose, in the first place, $\varrho = 0{\cdot}6 = (9{\cdot}7781512)$. This will give the following results:

$r^2 = 0{\cdot}3797624 = (9{\cdot}5795120)$, $r = (9{\cdot}7897560)$
$\varrho^\circ = (9{\cdot}6695087)$, $\varrho' = (9{\cdot}8389800)$
$r^{\circ 2} = 0{\cdot}6003290 = (9{\cdot}7783893)$
$r'^2 = 0{\cdot}2906613 = (9{\cdot}4634172)$

$r^{\circ 2} + r'^2 = 0{\cdot}8909903$
$2F = 0{\cdot}7537670$

$c^2 = 0{\cdot}1372233 = (9{\cdot}1374278)$

$r^\circ = (9{\cdot}8891946) = 0{\cdot}7748089$
$r' = (9{\cdot}7317086) = 0{\cdot}5391475$

$r^\circ + r' \ldots\ldots = 1{\cdot}3139564$
$c = (9{\cdot}5687139) = 0{\cdot}3704366$

$r^\circ + r' + c = a = 1{\cdot}6843930$
$r^\circ + r' - c = b = 0{\cdot}9435208$

$a^{\frac{3}{2}} = 2{\cdot}1860775$
$b^{\frac{3}{2}} = 0{\cdot}9164888$

$a^{\frac{3}{2}} - b^{\frac{3}{2}} = 1{\cdot}2695887$
but $6(\theta+\theta') = 1{\cdot}2422687$
Error + $\cdot 0273200$

For a second hypothesis let us make $\varrho = 0{\cdot}58 = (9{\cdot}7634280)$. On going through the same calculations, there will result

$r^\circ + r' + c = a = 1{\cdot}6833303$, $a^{\frac{3}{2}} = 2{\cdot}1840703$
$r^\circ + r' - c = b = 0{\cdot}9631377$, $b^{\frac{3}{2}} = 0{\cdot}9452192$

$a^{\frac{3}{2}} - b^{\frac{3}{2}} = 1{\cdot}2388511$
$6(\theta+\theta') = 1{\cdot}2422687$
Error — $\cdot 0034176$

Let $n = \frac{\cdot 0034176}{\cdot 02732 + \cdot 0034176} = 0{\cdot}11119$, then the true value of any quantity which is denoted by A in the first hypothesis, and by B in the second, will be $B - n(B-A)$. Computing from this formula, there results,

$\varrho^\circ = (9{\cdot}6569463)$ $r^\circ = (9{\cdot}8906184)$
$\varrho = (9{\cdot}7650651)$ $r = (9{\cdot}7935971)$
$\varrho' = (9{\cdot}8259598)$ $r' = (9{\cdot}7362737)$
$c = (9{\cdot}5577858)$.

VI. In most cases the solution which has now been obtained would be sufficiently approximate; but in the present case, on account of the great inequality between

Comet. the intervals θ and θ', it is necessary to recommence the calculations, and to determine λ, λ', and e from the more accurate expressions which form the third degree of approximation. Let

$$\delta = \frac{M\theta^2}{6(r^\circ r)^{\frac{3}{2}}} - \frac{M\theta'^2}{6(rr')^{\frac{3}{2}}};$$ the equations (7) give

$$\log.\lambda = \log.\left(\frac{\theta}{\theta+\theta}\right) - \frac{\theta'}{\theta+\theta'}\cdot\delta,\ e = \frac{\theta\theta'}{2r^\circ rr'},$$

$$\log.\lambda' = \log.\left(\frac{\theta'}{\theta+\theta'}\right) + \frac{\theta}{\theta+\theta'}\cdot\delta,\ E = \frac{\theta\theta'}{2R^\circ RR'},$$

from which, employing the approximate values of r°, r, and r', already obtained, there results

$\delta = (7{\cdot}3643107)$, $(e - E) = (8{\cdot}1358552)$,
$\lambda = (9{\cdot}8219310)$, $(1 - e) = (9{\cdot}9919393)$,
$\lambda' = (9{\cdot}5268112)$.

If we now proceed to substitute these results in the equations (19), we shall find the following expressions for ϱ° and ϱ':

$$\varrho^\circ = \varrho(9{\cdot}9290428) - (8{\cdot}5415033),$$
$$\varrho' = \varrho(0{\cdot}0359557) - (8{\cdot}5334117),$$

in which the only indeterminate quantity is ϱ. We must now make another hypothesis with respect to ϱ. If we assume the value given by the last approximation, namely $\varrho = (9{\cdot}7650651)$, we shall find that it is considerably too small, and that the first approximation is consequently insufficient, owing to the imperfect values it gave of the quantities λ and λ', and e.

Let us suppose $\varrho = 0{\cdot}6045 = (9{\cdot}7813963)$. By proceeding as before with the corrected values now found, we obtain

$\varrho^\circ = (9{\cdot}6799602)$, $\varrho' = (9{\cdot}8393705)$,
$r^{\circ 2} = 0{\cdot}5973194 = (9{\cdot}7762067)$
$r'^2 = 0{\cdot}2905081 = (9{\cdot}4631582)$
$c^2 = 0{\cdot}1313662 = (9{\cdot}1184836)$

whence

$r^\circ + r' + c = a = 1{\cdot}6742972$, $a^{\frac{5}{2}} = 2{\cdot}1664512$
$r^\circ + r' - c = b = 0{\cdot}9494078$, $b^{\frac{5}{2}} = 0{\cdot}9250798$

$a^{\frac{5}{2}} - b^{\frac{5}{2}} = 1{\cdot}2413714$
$6(\theta + \theta') = 1{\cdot}2422687$

Error — ·0008973

Suppose, therefore, $\varrho = 0{\cdot}6055 = (9{\cdot}7821141)$. Computing as above, we shall find

$r^\circ + r' + c = a = 1{\cdot}6742754$, $a^{\frac{5}{2}} = 2{\cdot}1664090$
$r^\circ + r' - c = b = 0{\cdot}9485938$, $b^{\frac{5}{2}} = 0{\cdot}9238902$

$a^{\frac{5}{2}} - b^{\frac{5}{2}} = 1{\cdot}2425188$
$6(\theta + \theta) = 1{\cdot}2422687$

Error + ·0002501

Let $n = \frac{2501}{8973 + 2501} = 0{\cdot}218$; the mean between the two values of the same quantity in the two hypotheses is B + (A — B) (0·218), by taking which, there results $r^\circ = (9{\cdot}8880427)$, $r = (9{\cdot}7886828)$, $r' = (9{\cdot}7314028)$. These values being considerably different from those found by the first approximation, it becomes necessary to have recourse to a third operation.

The values of λ, λ', and $1 - e$, deduced from the values of r°, r, r' now found, are
$\lambda = (9{\cdot}8219155)$, $\lambda' = (9{\cdot}5268419)$, $1 - e = (9{\cdot}9918188)$.

In order to find a more exact value of A_1 than results from taking the mean of the three longitudes of the earth, Comet. we may make use of the equations (13), namely,

$$0 = \lambda m'\varrho' + \lambda' m^\circ\varrho^\circ - (1 - e)\, m\varrho + M,$$
$$0 = \lambda n'\varrho' + \lambda' n^\circ\varrho^\circ - (1 - e)\, n\varrho + N,$$

in which $M = (e - E)\, R_1 \cos. A_1 = \pi \cos. A_1$, $N = \pi \sin. A_1$, and we shall have in the present example

$\pi \cos. A_1 = \lambda(9{\cdot}8713530) + \lambda'(9{\cdot}9378419) - (1 - e)\,(9{\cdot}8969484)$
$\pi \sin. A_1 = \lambda(9{\cdot}8162347) + \lambda'(9{\cdot}6874819) - (1 - e)\,(9{\cdot}7792587)$

whence, substituting for λ, λ', and $(1 - e)$, the above values,

$\pi \cos. A_1 = (8{\cdot}0399020)$, $\tan. A_1 = (9{\cdot}8969484)$
$\pi \sin. A_1 = (7{\cdot}9115731)$, $A_1 = 36^\circ\ 39'\ 20''$,
$\pi = (8{\cdot}1355982)$.

The value of A_1, thus found, differs considerably from that which was employed in the previous approximation, namely, $A_1 = 36^\circ\ 0'\ 41''$.

On substituting π for $(e - E)\, R_1$, the equations (19) become

$$\varrho = \frac{(1 - e)\,\varrho \sin.(a' - a) - \pi \sin.(a' - A_1)}{\lambda' \sin.(a' - a^\circ)},$$

$$\varrho' = \frac{(1 - e)\,\varrho \sin.(a' - a) + \pi \sin.(a^\circ - A_1)}{\lambda \sin.(a' - a^\circ)};$$

whence, making $A_1 = 36^\circ\ 39'\ 20''$,

$$\varrho^\circ = \varrho(9{\cdot}9288916) - (8{\cdot}5552427),$$
$$\varrho' = \varrho(0{\cdot}0358507) + (8{\cdot}5401948),$$

from which two equations we shall obtain the nearest approximation of which this method of solving the problem is susceptible.

Suppose $\varrho = (9{\cdot}7790000)$. On going through the same computation as before, we shall find

$r^\circ + r' + c = a = 1{\cdot}6758479$, $a^{\frac{5}{2}} = 2{\cdot}1694623$
$r^\circ + r' - c = b = 0{\cdot}9509163$, $b^{\frac{5}{2}} = 0{\cdot}9272854$

$a^{\frac{5}{2}} - b^{\frac{5}{2}} = 1{\cdot}2421769$
$6(\theta + \theta') = 1{\cdot}2422687$

Error —918

Suppose, secondly, $\varrho = (9{\cdot}7791000)$. This supposition will give

$r^\circ + r' + c = a = 1{\cdot}6758426$, $a^{\frac{5}{2}} = 2{\cdot}1694511$
$r^\circ + r' - c = b = 0{\cdot}9508021$, $b^{\frac{5}{2}} = 0{\cdot}9271186$

$a^{\frac{5}{2}} - b^{\frac{5}{2}} = 1{\cdot}2423325$
$6(\theta + \theta') = 1{\cdot}2422687$

Error + 638

From these errors, the mean to take between A and B, the two values of the same quantity in the two hypotheses, is B + (A — B) (0·41), whence the following solution:

$\varrho^\circ = (9{\cdot}6762680)$, $r^\circ = (9{\cdot}8884811) = 0{\cdot}77353695$,
$\varrho' = (9{\cdot}83738895)$, $r' = (9{\cdot}7322409) = 0{\cdot}53981000$,
$c = (9{\cdot}5593056) = 0{\cdot}3624980$.

VI. It now remains only to indicate the method of computing, from the foregoing solution, the elements of the parabolic orbit.

It was shown in § 12 that $v = \tan.\frac{1}{2}\varphi = \frac{\sqrt{r'r^\circ - sd}}{\sqrt{sd}}$,

and also that $v = \sqrt{D}\cdot\frac{\sqrt{s} - \sqrt{d}}{\sqrt{sd}}$. Comparing these

Comet. values, $\sqrt{r'r^\circ - sd} = \sqrt{D}\,(\sqrt{s} - \sqrt{d})$, and, consequently,

$$D = \frac{r'r^\circ - sd}{(\sqrt{s} - \sqrt{d})^2} = \frac{(s - r^\circ)(s - r')}{(\sqrt{s} - \sqrt{d})^2}.$$

Having obtained the perihelion distance D, the true anomaly ψ° of the point C° will be given by the equation of the parabola, namely, $r^\circ \cos.^2 \frac{1}{2}\psi^\circ = D$, from which

$$\cos.^2 \tfrac{1}{2}\psi^\circ = \frac{(s - r^\circ)(s - r')}{r^\circ (\sqrt{s} - \sqrt{d})^2}.$$

The calculation of D and ψ° is as follows:

$\frac{1}{2}(r^\circ + r' + c) = s = (9{\cdot}9232039)$
$\frac{1}{2}(r^\circ + r' - c) = d = (9{\cdot}6770815)$
$s - r^\circ = (8{\cdot}80878805)$
$s - r' = (9{\cdot}47438015)$

$(s - r^\circ)(s - r') = (8{\cdot}2831682)$

$\sqrt{d} = (9{\cdot}8385407)$ $\sqrt{s} = (9{\cdot}9616019)$

$\frac{\sqrt{d}}{\sqrt{s}} = (9{\cdot}8769388) = {\cdot}7532495$

$1 - \frac{\sqrt{d}}{\sqrt{s}} = {\cdot}2467505 = (9{\cdot}39225808)$

$\sqrt{s} = (9{\cdot}9616019)$

$\sqrt{s} - \sqrt{d} = \sqrt{s}\,(1 - \frac{\sqrt{d}}{\sqrt{s}}) = (9{\cdot}35385998)$

$(\sqrt{s} - \sqrt{d})^2 = (8{\cdot}70771996)$
$(s - r^\circ)(s - r') = (8{\cdot}2831682)$

$D = (9{\cdot}5754482)$
$r^\circ = (9{\cdot}8884811)$

$\cos.^2 \frac{1}{2}\psi^\circ = (9{\cdot}6869671)$
$\tan.^2 \frac{1}{2}\psi^\circ = (0{\cdot}0118412).$

Having thus obtained the perihelion distance and the true anomaly, we must now find the time required for describing this anomaly. For this purpose it is usual to employ a table constructed from the following property of bodies moving in a parabolic orbit, namely, if T and T′ be the times of describing the same anomaly in two parabolas whose perihelion distances are respectively D and D′, then $T : T' :: D^{\frac{3}{2}} : D'^{\frac{3}{2}}$. Hence, if a table is formed showing the time T′ in which every degree, &c. is described in a parabola whose perihelion distance is $D' = 1$, it will give the time T′ in which the same anomaly is described in the parabola whose perihelion distance is D, by simply multiplying the tabular time by $D^{\frac{3}{2}}$; for when $D' = 1$, we have $T = D^{\frac{3}{2}}T'$. The time T must be added to the epoch of the first observation, if the comet is approaching the perihelion of its orbit, but subtracted from that epoch if it has already passed the perihelion.

But instead of employing a table of parabolic motion, the time may be computed directly from the formula

$$T = \sqrt{2\,D^3}\,(\tan.\tfrac{1}{2}\psi^\circ + \tfrac{1}{3}\tan.^3\tfrac{1}{2}\psi^\circ),$$

observing to add to the logarithm of T the constant logarithm 1·7644179 (the compliment of 8·2355821), in order that T may be expressed in mean solar days.

Computing from this formula, there results in the present case,

T = 26·35895
Epoch of first observation, October.....22·68488

Passage through perihelion, November 18·04383.

To determine the position of the orbit, we must first compute the heliocentric latitudes and longitudes. Let α°, α' be the heliocentric longitudes of the points C° and C′; β°, β' their heliocentric latitudes; then, denoting for an instant by σ the comet's distance from the earth, we shall have $r \sin.\beta = \sigma \sin.b$; but $\sigma = \varrho \sec.b$, therefore

$$\sin.\beta = \frac{\varrho}{r}\tan.b, \text{ whence}$$

$$\sin.\beta^\circ = \frac{\varrho^\circ}{r^\circ}\tan.b^\circ, \quad \sin.\beta' = \frac{\varrho}{r'}\tan.b.$$

These two formulæ, which are very easily computed, give the heliocentric latitudes at the extreme observations. In the present case they become

$\sin.\beta^\circ = (9\,4155979)$, $\sin.\beta' = (9{\cdot}4341627)$.

Now, to compute the heliocentric longitudes, let us suppose K to be the projection of C on the plane of the ecliptic. In the rectilinear triangle ESK, formed by joining the positions of the earth, the sun, and the projected place of the comet, we have $EK = \varrho$; $SK = r\cos.\beta$; the angle ESK, opposite to EK, $= \alpha - A$, the difference between the heliocentric longitude of the comet and the longitude of the earth; and the angle KES, opposite to SK, $= \alpha - A$, the difference between the geocentric longitude of the comet and the longitude of the sun; therefore

$$\varrho : r\cos.\beta :: \sin.(\alpha - A) : \sin.(\alpha - A),$$

from which, since $\frac{\varrho}{r} = \frac{\sin.\beta}{\tan.b}$, we deduce for the first and third observations,

$$\sin.(\alpha^\circ - A^\circ) = \frac{\tan.\beta^\circ}{\tan.b^\circ}\sin.(\alpha^\circ - A^\circ),$$

$$\sin.(\alpha' - A') = \frac{\tan.\beta'}{\tan.b'}\sin.(\alpha' - A').$$

In the present case these formulæ become

$\sin.(\alpha^\circ - A^\circ) = (9{\cdot}6598371)$, $\sin.(\alpha' - A') = (9{\cdot}8155230)$
$\alpha^\circ - A^\circ = 27^\circ\ 11'\ 18''$, $\alpha' - A' = 40^\circ\ 50'\ 15''{\cdot}45$
$A^\circ = 29\ 19\ 50$, $A' = 41\ 22\ 26$

$\alpha^\circ = 56\ 31\ 8$ $\alpha' = 82\ 12\ 41{\cdot}45$

Let N be the ascending node, γ its longitude, and I the inclination of the orbit. In the spherical triangle NCK, the side $NK = \alpha - \gamma$, $CK = \beta$, and the angle $CNK = I$. Therefore, by Napier's analogies, $\cot.I = \cot.\beta \sin.(\alpha - \gamma)$, which, on substituting the longitudes α° and α', gives the double equation

$$\cot.I = \cot.\beta^\circ \sin.(\alpha^\circ - \gamma) = \cot.\beta' \sin.(\alpha' - \gamma);$$

from which we have

$$\frac{\sin.(\alpha^\circ - \gamma)}{\sin.(\alpha' - \gamma)} = \frac{\tan.\beta^\circ}{\tan.\beta'},$$

whence

$$\frac{\sin.(\alpha^\circ - \gamma) + \sin.(\alpha' - \gamma)}{\sin.(\alpha^\circ - \gamma) - \sin.(\alpha' - \gamma)} = \frac{\tan.\beta^\circ + \tan.\beta'}{\tan.\beta^\circ - \tan.\beta'}.$$

But if A and B represent two arcs, then, by the trigonometrical formulæ,

$$\frac{\sin.A + \sin.B}{\sin.A - \sin.B} = \frac{\tan.\frac{1}{2}(A + B)}{\tan.\frac{1}{2}(A - B)}$$

and

$$\frac{\tan.A + \tan.B}{\tan.A - \tan.B} = \frac{\sin.(A + B)}{\sin.(A - B)};$$

whence the above equation becomes

$$\frac{\tan.\{\frac{1}{2}(\alpha^\circ + \alpha') - \gamma\}}{\tan.\frac{1}{2}(\alpha' - \alpha^\circ)} = \frac{\sin.(\beta' + \beta^\circ)}{\sin.(\beta' - \beta^\circ)},$$

consequently

$$\tan.\{\tfrac{1}{2}(\alpha^\circ + \alpha') - \gamma\} = \frac{\sin.(\beta' + \beta^\circ)}{\sin.(\beta' - \beta^\circ)}\tan.\frac{\alpha' - \alpha^\circ}{2}.$$

Comines. The tangent now found belongs to two different angles; but this circumstance can occasion no ambiguity; for as the inclination I is supposed to be always less than 90°, the cotangent of I must be always positive, so that sin. $(\alpha^\circ - \gamma)$ must always have the same sign as cot. β. This consideration will enable the computer to choose between the two values of γ, which correspond to tan. $\{\frac{1}{2}(\alpha^\circ + \alpha') - \gamma\}$. With regard to the sign of β, the northern latitudes are supposed positive, and the southern negative; and the motion will be direct or retrograde, according as $\alpha' - \alpha^\circ$ is positive or negative.

On computing the above formula, there results

$$\frac{1}{2}(\alpha^\circ + \alpha') - \gamma = 84^\circ\ 14'\ 30''$$
$$\text{but}\quad \frac{1}{2}(\alpha^\circ + \alpha') = 69\ \ 21\ \ 54$$
$$\text{therefore}\quad -\gamma = 14\ \ 52\ \ 36$$
$$\text{and consequently}\quad \gamma = 345\ \ 7\ \ 24.$$

By correcting this value of γ so as to satisfy the equation cot. β° sin. $(\alpha^\circ - \gamma) =$ cot. β' sin. $(\alpha' - \gamma)$, Legendre finds

$$-\gamma = 14^\circ\ 52'\ 34''\cdot5$$
$$\gamma = 345\ \ 7\ 25\cdot5.$$

Having found the longitude of the node, the inclination I is given by the formula cot. $I =$ cot. β° sin. $(\alpha^\circ - \gamma)$, from which we deduce

$$\log.\ \cot.\ I = 0\cdot5458488,\quad I = 15^\circ\ 53'\ 0''\cdot5.$$

Lastly, let H be the angular distance of the comet from the node, and Π be the longitude of the perihelion. Then

$$\cos.\ H = \cos.\ \beta^\circ \cos.\ (\alpha^\circ - \gamma)$$
$\Pi = H + \gamma + \psi^\circ$, if the comet is advancing to the perihelion; or

$\Pi = H + \gamma - \psi^\circ$, if it has already passed the perihelion. Comines.

In the present example,

$\alpha^\circ - \gamma$	$= 71^\circ\ 23'\ 42''\cdot5$	H	$= 72^\circ\ 3'\ 32''\cdot9$
cos. $(\alpha^\circ - \gamma)$	$= 9\cdot5038445$	γ	$= 345\ \ 7\ 25\cdot5$
cos. β°	$= 9\cdot9847558$	ψ°	$= \ 91\ 33\ 43\cdot3$
cos. H	$= 9\cdot4886003$	Π	$= 148\ 44\ 41\cdot7$

The elements of the orbit of this comet, therefore, as deduced from the above solution, are as follows:

Log. Π.....9·5754481
Passage through the perihelion, November.....18·04383
Inclination.....15° 53′ 0″·5
Longitude of ascending node.....345 7 25·5
Longitude of the perihelion.....148 44 41·7
Motion direct.

The orbit determined according to the method which has here been explained, will always satisfy the first and third observations. In general it will also represent the second; but should it occur that the place of the comet at the second observation, computed from the elements thus found, differs considerably from its observed place, we may then conclude that the true orbit cannot be represented by a parabola. In this case recourse must be had to the ellipse, for computing which, the best method is that which is given by Gauss in his *Theoria Motuum Corporum Cœlestium*. (T. G.)

COMINES, Philippe de, Sieur d'Argenton, was descended from an illustrious family of Flanders, and born at the castle of Comines, near Menin, in 1445. He passed his youth at the court of Philip the Good, Duke of Burgundy, where he became attached to the Comte de Charolais; and attending him in the war of the *Public Good*, was present at the battle of Montlhéry. When the count had succeeded his father, under the name of Charles the Rash, Comines continued to enjoy his confidence and intimacy, and was in attendance on him when, irritated by the bad faith of Louis XI., the duke detained that artful monarch a prisoner at Péronne. Comines, though then young, showed his prudence and sagacity in endeavouring to calm his headstrong master, who was transported with the most violent resentment against Louis; and by his wise counsels he contributed to the conclusion of the treaty of pacification which for the moment united these princes. He was afterwards employed in various negotiations, which he conducted with equal ability and address. But the impetuous temper of the Duke of Burgundy becoming more and more exasperated by his reverses, and a species of frenzy having seized him in consequence of the failure of schemes rashly undertaken and imprudently executed, Louis took advantage of the faults of his rival to detach from the duke's service all the men of ability or consideration by whom he had been surrounded; and Comines was one of those who were thus gained over by the artful monarch. Various reasons have been assigned for this desertion, respecting which Comines himself observes the most guarded silence in his *Mémoires*. By Louis he was loaded with favours; for scarcely had he entered the service of that monarch when he received a donation of the principality of Talmont, and of the lordships of Olone, La Chaume, Curzon, Château-Gontier, Chastel-Berry, Brem, and Barndois. The king also married him to Hélène de Jambes, the heiress of a rich and noble family of Poitou, assisted him to purchase the estate of Argenton, conferred upon him the office of seneschal of Poitou, and confirmed all his grants and donations by letters patent. Comines, in fact, became one of the most confidential servants of the king; and although he was neither the friend nor the favourite of Louis, who never had any such, he was better suited to the government of that monarch than any other person of his time, and maintained his influence solely by rendering himself useful. He executed several important commissions with great ability, and preserved undiminished to the last the confidence of his jealous and suspicious master. On the death of Louis, Comines, who had plunged into a variety of intrigues against the government of Anne of Beaujeu, was at length expelled from the court by Duke René of Lorraine, and retired to Moulins, the residence of the Constable of Bourbon, to whose party he had attached himself. Nor did his misfortunes end here. The constable, having made his peace with the court, discarded Comines, who soon afterwards became involved in a new conspiracy formed by Count Dunois and the Duke of Orleans. The plot having been discovered, Comines was arrested and sent prisoner to Loches, where he passed eight months in one of those iron cages which Louis XI. had employed for the confinement of state criminals. "Plusieurs les ont maudites, et moi aussi," says he, "qui en ai tâté sous le roi d'à présent." When the Duke of Orleans had been vanquished and taken prisoner at St Aubin, and the authority of the regent had been confirmed by victory, Comines underwent his trial by the parliament, upon a charge of having maintained a treasonable intercourse with the rebels; and being found guilty, he was sentenced to banishment for ten years to his estates, and to forfeit the fourth part of his property. It does not appear, however, that this sentence was executed. In 1493 he assisted in the treaty which was concluded at Senlis between the king and the Archduke of Austria as Duke of Burgundy. He accompanied Charles VIII. to Italy; and when the expedition to Naples had been resolved upon, he was sent to Venice in order to induce that republic to observe a strict neutrality—

Comines || Comitia.

a matter of the utmost consequence to the success of the enterprise. Comines discharged this important duty with his usual ability, and delayed, though he could not prevent, the declaration of the republic in favour of the enemies of France; upon which he returned to Florence, where the king then was. Comines does not seem to have been employed in any public capacity during the last three years of Charles VIII.; but when Louis XII. ascended the throne in 1498, he appeared at court to render homage to the new sovereign. This is the last circumstance in the life of Comines of which any notice has been preserved. He died at Argenton, August 16, 1509, at the age of sixty-four. It was after his return from Italy that he commenced his *Mémoires*, at the solicitation of Angelo Cattho, Archbishop of Vienne, who, like himself, had been in the service first of the Duke of Burgundy, and afterwards in that of Louis XI.; and it is to this work that he is alone indebted for the celebrity of his name. Indeed, among modern historians, no one has been estimated more highly than Comines, who, to the charm of a natural and flexible style, which receives the direct impress of his thoughts, and to the interest which belongs to the fresh and animated recital of an eye-witness, unites a profound knowledge of men and affairs, and displays cool observation in happy alliance with sound judgment and accurate discrimination. In estimating the qualities of conduct and the shades of character, Comines is perhaps unrivalled. Taking men as he found them, and regarding them merely as the instruments of Providence, he depicts them with a cool, rigorous, yet apparently unstudied severity; and so true do his delineations appear, that he seems to have looked into their very souls, and to have discovered the real principles or motives of which their actions were the necessary result or expression. We look in vain in his *Mémoires* for noble sentiments, chivalrous feelings, or lofty aspirations. He never rises above the level of his subject, nor sacrifices that calm dignity of tone which he sustains without effort, because it seems to have been natural to his character. He speaks little of himself; and the most important circumstances of his life are omitted, probably because the recital of them might have embarrassed him. The first edition of the *Mémoires* of Comines, published at Paris in 1525, contains only the reign of Louis XI. from 1464 to 1483, and is divided into six books; but two more, containing the history of Charles VIII. till the year 1498, appeared in 1528, Paris, folio. A new edition, however, revised and corrected, was published at Paris in 1552, folio, by the Sieur du Parc, and has often since been reprinted. Of modern editions, the most complete and valuable is that of Lenglet-Dufresnoy, London, 1747, 4 vols. 4to.

COMINES, or COMMINES, a town of Belgium, province of West Flanders, on the left bank of the Lys, 10 miles S.E. of Yprès. Pop. (1850) 3443. On the opposite bank of the river, in the department of Nord, is the French town of this name, with about 3000 inhabitants. The two towns are connected by a drawbridge. The manufactures are ribbons, thread, cottons, &c.

COMITATUS, in law, a county. England was first divided into counties, the counties into hundreds, and these again into tythings, by Alfred the Great. Sometimes it is taken for a territory or jurisdiction of a particular place.

COMITIA, in *Roman Antiquity*, general assemblies of the people, convened by a magistrate for the purpose of putting any subject to their vote.

The proper comitia were of three sorts, *curiata*, *centuriata*, and *tributa*, with reference to the three grand divisions of the city and people into *curiæ*, *centuriæ*, and *tribes*: for by *comitia calata* were meant all the comitia in general, the term *calata* (from *calare*, i. e., *vocare*) being their common epithet, though it was at last restricted to assemblies for the creation of priests, and the regulation of last wills and testaments, to which the people acted as witnesses merely.

Comitia.

The *comitia curiata* owed its origin to the division which Romulus made of the people into thirty curiæ, ten being contained in every tribe. The curiæ answered in most respects to the parishes in our cities, being not only separated by proper bounds and limits, but distinguished too by the different places set apart in each for the celebration of religious service, which was performed by particular priests (called *curiones*), one to every curia.

Before the institution of the comitia centuriata, all the great concerns of the state were transacted in the assembly of the curiæ; as the election of kings and other chief officers, the making and abrogating of laws, and the judging of capital crimes. After the expulsion of the kings, when the commons had obtained the privilege of having tribunes and ædiles, they were for some time elected at these assemblies; but that ceremony being at length transferred to the comitia tributa, the curiæ were never convened to give their votes, excepting upon occasion of making some particular law, relating to adoptions, wills, and testaments, or the creation of officers for an expedition, or for electing some of the priests, as the *flamines*, and the *curio maximus*, who were themselves chosen by every particular curia. The power of calling these assemblies belonged at first only to the kings; but on the establishment of the democracy, this privilege was allowed to most of the magistrates, and sometimes to the pontifices.

The persons who had the liberty of voting were such Roman citizens as belonged to the curiæ, or actually lived in the city, and conformed to the customs and rites of their proper curiæ; and all were excluded who dwelt without the bounds of the city, or retained the ceremonies of their own country, even although they had been honoured with the *jus civitatis*. (See CITIZEN.) The place where the curiæ met was the *comitium*, a part of the forum. No fixed time was appointed for holding any of the comitia, but they were convened as business required.

The people being met together, and confirmed by the report of good omens from the augurs, which was necessary in all the assemblies, the *rogatio* or business to be proposed to them was publicly read. After this, if none of the magistrates interposed, upon the order of him who presided in the comitia the people divided into their proper curiæ, and consulted of the matter; and then the curiæ on being called out, as it happened by lot, gave their votes man by man, in ancient times *viva voce*, and afterwards by tablets; the most votes in every curia going for the voice of the whole curia, and the most curiæ for the general consent of the people.

In the time of Cicero, the comitia curiata were so much out of fashion that they were formed only by thirty lictors representing the thirty curiæ; whence, in his second oration against Rullus, he calls them *comitia adumbrata*.

The *comitia centuriata* were instituted by Servius Tullius, who had obliged every one to give a true account of what he was worth, and divided the people, according to the returns, into six ranks or classes, which he subdivided into a hundred and ninety-three centuries. The first classis, containing the equites and richest citizens, consisted of ninety-eight centuries. The second, including the tradesmen and mechanics, consisted of twenty-two centuries; the third of twenty; the fourth of twenty-two; the fifth of thirty; and the sixth, composed of the poorer sort, of only one century; but this, though it had the same name with the rest, yet was seldom regarded, and scarcely allowed any power in public matters. Hence it is common with the Roman authors, when they speak of the classes, to reckon no more than five, the sixth not being worth their notice. This last *classis* or order was divided into two parts or orders, the *proletarii* and the *capite censi*. The former, as their name implies, were designed purely to stock the republic with men, since they could supply it with so little money;

Comitia. and the latter, who paid the lowest tax of all, were rather counted and marshalled by their heads than by their estates. See CAPITE CENSI.

Persons of the first rank, by reason of their pre-eminence, had the name of *classici*; and hence the name of *classici auctores* came to signify the most approved writers. All others, of what classis soever, were said to be *infra classem*. The assembly of the people by centuries was held for the election of consuls, censors, and prætors; as also for the judging of persons accused of what was called *crimen perduellionis*, or actions by which the party had showed himself an enemy to the state, and for the confirmation of all such laws as were proposed by the chief magistrates, who had the privilege of calling these assemblies.

The place appointed for their meeting was the *Campus Martius;* because, in the primitive times of the commonwealth, when they were under continual apprehensions of enemies, the people, to prevent any sudden assault, went armed, in martial order, to hold these assemblies, and were for that reason forbidden by the laws to meet in the city, because an army was upon no account to be marshalled within the walls; yet in later ages it was thought sufficient to place a body of soldiers as a guard in the Janiculum, where an imperial standard was erected, and the taking down of which denoted the conclusion of the comitia.

Though the time of holding these comitia for other matters was undetermined, yet the magistrates, after the year of the city 601, when they began to enter upon office on the kalends of January, were constantly *designed* (*designati*) about the end of July and the beginning of August.

All the time between their election and confirmation they continued as private persons, that inquisition might be made into the election, and that the other candidates might have time to enter objections, if they thought fit to do so. Yet at the election of the censors this custom did not hold; for as soon as they were elected they were immediately invested with the honour.

By the institution of these comitia, Servius Tullius secretly conveyed the whole of the power from the commons; for the centuries of the first and richest class, who were called out first, being more numerous by three than all the rest put together, if they agreed, as they generally did, the business was already decided, and the other classes were needless and insignificant. However, the three last scarcely ever came to vote.

In the time of freedom, the commons, in order to remedy this disadvantage, obtained that, before the centuries proceeded to vote any matter at these comitia, that century should give its suffrages first upon which it fell by lot to do so, with the name of *centuria prerogativa;* while the rest were to follow according to the order of their classes. After the constitution of the thirty-five tribes into which the classes and their centuries were divided, the tribes cast lots, in the first place which should be the *prerogative tribe*, and then the centuries of the tribes also cast lots for the honour of being a prerogative century. All the other tribes and centuries had the appellation of *jure vocatæ*, because they were called out according to their proper places.

The prerogative century being chosen by lot, the chief magistrate, sitting in a tent in the middle of the Campus Martius, ordered that century to come out and give their voices; upon which they presently separated from the rest of the multitude, and came into an inclosed apartment, which they termed *septa* or *ovilia*, passing over the *pontes* or narrow boards laid there for the occasion; on which account *de pontibus dejici* signifies to be denied the privilege of voting; and persons thus dealt with were called *depontani*.

At the further end of the pontes stood the *diribitores* (a sort of under officers, so called from their marshalling the people), who delivered to every man, in the election of magistrates, as many tablets as there appeared candidates, and one of these names was written upon every tablet. A proper number of great chests were set ready in the *septa*, and every voter threw in which tablet he pleased. Comitia.

Close by the chests were stationed some of the public servants, who took out the tablets of every century, and for every tablet made a prick or a point in another tablet, which was kept for the purpose. Thus, the business being decided by most points, gave occasion to the phrase *omne tulit punctum*, and the like.

The same method was observed in the justiciary process at these comitia, and also in the confirmation of laws, except that, in both these cases, only two tablets were offered to every person, on one of which was written U. R. and on the other A. in capital letters; the two first standing for *uti rogas*, "be it as you desire," relating to the magistrate who proposed the question; and the last for *antiquo*, or "I forbid it."

It is remarkable, that though in the election of magistrates, and in the ratification of laws, the votes of that century whose tablets were equally divided signified nothing; yet in the trials of life and death, if the tablets for and against were the same in number, the person was actually acquitted.

The division of people into *tribes* was an invention of Romulus after he had admitted the Sabines into Rome; and though he constituted at that time only three, yet as the state increased in power, and the city in number of inhabitants, they rose by degrees to thirty-five. For a long time after this institution, a *tribe* signified no more than a certain space of ground with its inhabitants. But at last the matter was quite altered, and a tribe was no longer *pars urbis*, but *pars civitatis*—not a quarter of the city, but a company of citizens living wherever they pleased. This change was chiefly occasioned by the original difference between the tribes in point of honour; for Romulus having committed all mechanic arts to the care of strangers, slaves, and libertines, and reserved the labour of agriculture to the freemen and citizens, who by this active course of life might be prepared for martial service, the *tribus rusticæ* were for this reason esteemed as more honourable than the *tribus urbanæ*. And now all persons being desirous of getting into the more creditable division, and there being several ways of accomplishing their wishes, as by adoption, by the power of censors, or the like, that rustic tribe which had the most worthy names in its roll had the preference to all others, though of the same general denomination. Hence all of the same great family bringing themselves by degrees into the same tribe, gave the name of the family to the tribe which they honoured; whereas at first the generality of the tribes did not receive their names from persons but from places.

The first assembly of the tribes we meet with is about the year of Rome 263, which was convened by Sp. Sicinius, tribune of the commons, upon account of the trial of Coriolanus. Soon after the tribunes of the commons were ordered to be elected here, and at last all the inferior magistrates and the collegiate priests. The same comitia served for enacting laws relating to war and peace, and all others proposed by the tribunes and plebeian officers, though they had not properly the name of *leges*, but only that of *plebiscita*. They were generally convened by the tribunes of the commons; but the same privilege was allowed to all the chief magistrates. They were confined to no place; and therefore we sometimes find them held in the comitium, sometimes in the Campus Martius, and now and then in the capitol. The proceedings were in most respects conformable to those already described in the account of the other comitia, and therefore need not be insisted on. We may only observe further of the comitia in general,

Comitialis || Commerce.

that when any candidate was found to have most tablets for a magistracy he was declared to be *designed* or elected by the president of the assembly, and this they termed *renunciari consul, prætor*, or the like; and that the last sort of the comitia only could be held without the consent or approbation of the senate, which was necessary to the convening of the other two.

COMITIALIS MORBUS, a name given by the ancient Romans to epilepsy—for this reason, that the comitia were dissolved if any person in the assembly happened to be seized with that distemper; the comitia stood then adjourned to another day.

COMMA, in *Music*, a small interval found, in some cases, between two sounds produced under the same name by different harmonic progressions: generally in the ratio of 80 to 81.

COMMANDERY, a kind of benefice or fixed revenue attached to certain military orders, and conferred on knights of merit.

There were strict or regular commanderies, obtained by merit or in order; others of grace and favour, conferred by the grand master. There were also commanderies for the religious of the orders of St Bernard and St Anthony.

The commanderies of Malta were of different kinds, viz., for knights, chaplains, and brothers servitors. The knight to whom one of these commanderies was given was called *commander*. The commanders of Malta were rather farmers of the order than beneficiaries, since they paid a certain tribute or rent, called *responsio*, to the common treasury of the order.

Commendam || Commerce.

At the suppression of the religious houses in the time of Henry VIII., there were in England at least fifty commanderies, or preceptories as they were often called, and a few of them were possessed of considerable estates; but the greater number were only farms or granges.

COMMENDAM. See BENEFICE.

COMMENSURABLE, among geometricians, an appellation given to such quantities as are measured by one common measure.

COMMENSURABLE *Numbers*, whether integers or fractions, are such as can be measured or divided by some other number without a remainder; as 12 and 18, which may be measured by 6 and 3.

COMMENSURABLE *in Power*, is said of right lines when their squares are measured by the same space or superficies.

COMMENSURABLE *Surds*, those which, being reduced to their least terms, become true figurative quantities of their kind; and are therefore as a rational quantity to a rational one.

COMMENTARY, a comment explaining or illustrating the difficult or obscure passages of an author. It also denotes an historical narrative or memoir of particular transactions; as the *Commentaries* of Cæsar.

COMMERCE.

COMMERCE, in its most general sense, implies the exchange of articles of any kind for money or other articles. The earliest form of such exchanges is by barter, because the use of gold and silver is not adopted until society has made a certain progress. "The armour of Diomed," says Homer, "was plain, and was paid for by nine oxen; whilst the splendid armour of Glaucus cost a hundred." Barter being now disused in all improved countries, commerce is almost always understood to denote the exchange of commodities for money. In France and the south of Europe the words used to designate commerce are derived from the Latin; in Holland, Germany, and other northern countries, a vernacular word is more frequent; but all are alike in meaning, being applied equally to home and foreign trade.

We propose in the present essay to treat of,

I. The history of commerce, particularly in England and Holland;
II. The principles of commerce, and the evils of interfering with the free course of trade;
III. Commercial fluctuations in the present age—evils of an undue expenditure by government.

I. HISTORY OF COMMERCE.

Origin of Commerce.

It has been an object with many writers to ascertain in what nation of antiquity commerce was first carried to a considerable extent; but as that extent implies a previous population, the more simple inquiry would be, in what country population first acquired density, particularly in towns. The answer is, that mankind first increased their numbers in warm latitudes, especially in situations where irrigation, whether effected by the overflowing of rivers, by the descent of streams from a range of mountains, or by any other means, was so extensive as to counteract the parching effect of heat, and give to vegetation a luxuriance unknown in colder regions. It was thus that the Nile gave fertility to Egypt, the Euphrates to Chaldea, and the Ganges, in the lower part of its course, to Bengal.

The earliest written notice of commercial intercourse is in Scripture, where we read of Joseph being sold by his brethren to a company of Ishmaelites or Arabs, who were going to Egypt with spices, balm, and myrrh, conveyed on the backs of camels. These itinerant traders probably brought back corn, Egypt being, even at that remote period, an occasional granary for Syria and other adjacent countries. The conveying of goods on the backs of animals ought to be remarked as indicative of a primitive state of commercial intercourse—of that which is carried on before the forming of roads or the use of wheel-carriages. Such was the case in England two centuries ago, such at present is the case in Spanish America, and, in some degree, in Old Spain, the mountainous nature of that country making it a matter of some difficulty to form roads.

Phœnicia; Sidon and Tyre.

But whatever might be the inland traffic of the Arabians, Chaldeans, or Egyptians, they made very little progress in navigation; that was the province of the Phœnicians, who acted as naval carriers to the neighbouring nations, in the same way as the Dutch did during the sixteenth and seventeenth centuries to the rest of Europe. This almost exclusive possession of navigation may seem strange in the present age, but the cause was the same in both cases, namely, the difficulty in a rude age of finding men capable of conducting vessels in the open sea. Seamanship, now so familiar to the inhabitants of almost every port in Europe, was in those days understood by only a limited number, and was carried on with a degree of caution and slowness hardly credible to a modern reader. Thus the seamen of ancient times made it a rule to keep within sight of land, as if trusting for protection to a situation which the mariners of our days look on as attended with considerable risk. This arose from the great difference in the mode of propelling vessels, for which the moderns trust chiefly to the wind, and navigate with comparatively few hands. The small barks of the ancients were fitted out with oars; a method which required a great sacrifice of manual labour, but was attended with

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What, it may be asked, was the chief cause of the extension of the navigation of Phœnicia? The vicinity of Egypt, and the quantity of provisions and merchandise exported from that fertile country. The navigation of the Red Sea also was conducted chiefly by Phœnicians. History is not sufficiently explicit in regard to the commodities forming the object of traffic along the Red Sea, nor have we any certain knowledge of the era at which the trade with India by that channel commenced. Bonaparte, when meditating his expedition to Egypt, was led, in his sanguine estimate of its advantages, to consider the Red Sea as the fittest line of communication with India, and to ascribe the wealth of Thebes in Egypt, one of the earliest of commercial cities, to intercourse with the coast of Malabar. But whether the navigators of the Red Sea proceeded at that early date as far as the shores of India, it is evident that an extensive traffic was carried on with Cosseir, or a sea-port on the Red Sea which communicated with Thebes. The epoch at which Homer celebrated the wealth of that city, is nearly the same as that at which Phœnician mariners navigated the Red Sea on account of the Jewish government in the reign of Solomon; but no historical investigator has been able to fix with certainty the situation of Ophir and Tarshish, the ports with which these vessels traded. Some confident calculators have considered them to have been in India; but, judging from the limited skill of navigators in that early age, it seems more likely that these harbours were near the eastern or more remote parts of the Red Sea, a part from which there probably was a direct communication with India.

Such was the traffic of the Phœnicians with the south and east; it extended also to countries less peopled and in a still more primitive state in the west. The island of Crete seems to have owed to them its early civilization; and after Crete came Attica, Bœotia, the Peloponnesus, in all of which tradition recorded the early introduction of the arts by settlers arriving from Phœnicia or Egypt.

Greece. These arrivals seem to have taken place about a thousand years before the Christian era, and half of that time elapsed in the gradual attainment of that state of civilization to which Greece had arrived at the period of her political celebrity—the invasion of her territory by the Persians under Darius and Xerxes.

Extent of coast. Greece is in several respects well fitted for foreign commerce. Her coast is greatly indented by the sea, and presents a number of inlets hardly inferior to the well-known gulfs of Argos and Corinth. Hence an early familiarity with the use of shipping, and the practice of sending forth colonies at so early a date as a century after the Trojan war. These colonies proceeded in various directions, to Asia Minor in the east, to Thrace and the Euxine in the north, to Sicily and Italy in the west. The progress made by the inhabitants of these colonial settlements was rapid, particularly at Syracuse, whose capacious harbour soon acquired it extensive commerce and a numerous population. Agrigentum, Messina, Tarentum, were likewise places of considerable importance. It was the custom of these and other colonies to maintain an alliance and mercantile connection with the parent states, such as Athens, Corinth, Argos; and a number of characters eminent in literature and the arts appeared in the colonies, at a time when their establishment might have been considered as too recent to afford more than the necessaries of life. But in a newly-settled country, such as the United States of America, various circumstances concur to increase the number and improve the condition of the inhabitants; provisions are abundant, in consequence of the extent of unoccupied land; the connection with the mother country insures a certain extent of trade; while the monopolies and other abuses natural to a long-settled community are in a manner unknown. Commerce

On the other hand, the inland territory of Greece was not well fitted for commercial intercourse. It is traversed by no navigable river; and being mountainous and rugged, it could not, even in the days of its prosperity, boast of roads, merchandise being in those days, as at present, conveyed, not in carriages, but on the backs of horses and oxen. This deficiency of communication by land was one cause of the different states of Greece so long maintaining their independence, and of the limited ascendency attained by Lacedæmon, which, in extent of military means, was so superior to the other states of the Peloponnesus. Sparta and Thebes being inland towns, and Corinth comparatively a small state, Athens was the chief commercial city of Athens. ancient Greece. Her distance from the sea, five miles, was such as to afford her security against a sudden descent from an invading armament, while it was sufficiently near to her harbour, the Peiræus, for the easy transmission of merchandise. The trade and shipping of Athens, however small it might appear to a modern reader, was such as to give it an ascendency over the different islands to the eastward of Greece, and to enable it to maintain, in the Peloponnesian war, a long struggle against a strong confederacy. When overcome at last, in consequence of what may be termed an accidental cause, the capture of its fleet by Lysander, its political depression was of short duration; the activity and industry of its inhabitants revived its trade, so that Athens continued for ages the most populous and commercial place in Greece.

Tyre, though at no time a town of great extent, re- Tyre mained long in the enjoyment of considerable trade. From the reign of Solomon, when its commercial activity is described in Scripture, to its capture and destruction by Alexander the Great, there elapsed a period of seven centuries. The formidable resistance it made to the Macedonian arms impressed Alexander with a strong sense of the value of commerce, and of its effect in increasing the sources of national power. Though known to the world chiefly as a warrior, Alexander had considerable claims to the character of a politician. He adopted, and caused his followers adopt, to a certain extent, the manners of the nations they conquered; and by the expedition of Nearchus from the mouth of the Indus to the Persian Gulf, he discovered a commendable zeal for maritime discovery. Equal judg- Alexandria ment was evinced by him in founding his new city of in Egypt. Alexandria in a position such as to command an extensive range of intercourse. The Nile brought to it on one hand the valuable products of Egypt, and afforded on the other a ready inlet to the merchandise imported from Europe. To India also the route by Alexandria and the Red Sea was preferable to that of the Persian Gulf, which involved the necessity of a considerable journey by land.

Contemporary with the decline of Athens and the rise Carthage of Alexandria, but superior to either in commercial activity, was Carthage, the destruction of which forms one of the foulest blots in the history of the Romans. The situation of Carthage was well adapted for trade; its harbour was good, its range of navigation extensive, both to east and west. Founded by a colony from Tyre, it maintained a friendly intercourse with Phœnicia; while in the west of the Mediterranean, in Sicily, Spain, and the south of France, it met with no commercial rival. These countries, at that time uncivilized, and almost uncultivated, were greatly indebted to Carthage for the introduction of intelligent settlers, and derived from her the same advantages which Greece, several centuries before, had received from Phœnicia and Egypt. In Spain the fine harbours of Carthagena and Cadiz were rendered the resort of shipping

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by the Carthaginians; and without calling on our readers to believe the traditional assertions of the extent of their navigation, either to the north of Europe or the south of Africa, we may with confidence affirm, that had not this state unhappily fallen, from the jealousy of the Romans, it would have been the means of diffusing industrious habits over a great part of the west of Europe, and of advancing by several centuries the progress of the useful arts.

Rome.

The policy of Carthage, though not uniformly pacific, was far less pernicious than the perpetual tendency to aggression of a military state like Rome. In navigation the Romans were at no time remarkable. During their conflicts with the Carthaginians they sustained repeated losses, chiefly from the unskilfulness of their seamen, and their inability to cope with the fury of the elements. After they had triumphed over the Carthaginians, and extended their conquests to Macedon and Greece, the Romans were no longer under the necessity of equipping fleets, because no maritime state dared to dispute their supremacy. But the extension of the Roman power was favourable, in several respects, to commerce; piracy was suppressed, and merchant vessels had free access to almost every part of the Mediterranean. Hence a gradual increase in the length of mercantile voyages, which now extended on one hand to the north of France and Germany, on the other to the Indian Ocean, to which it became easy, from the progressive improvement of navigation, to proceed either by the Red Sea or the Persian Gulf. The mariners' compass was still unknown, but the uniform direction of the wind in certain seasons enabled the navigators to and from India to complete their voyages with little difficulty.

The middle ages.

It was towards the middle of the fifth century, about a hundred years after the removal of the seat of empire to Constantinople, that the Romans became unable to defend their frontier against the uncivilized tribes who pressed on them from the north and east. The consequence was, that the country along the Rhine, the inland provinces of Gaul, and, some time afterwards, Spain and the north of Italy, were overrun by these rude assailants. The increase in the population of towns was checked, many places being plundered, others subjected to heavy contributions, and property in general rendered unsafe. There was no longer a central or general government; the territory of the empire was divided into a number of separate states, the rulers of which had no just idea of the importance of commerce. These uneducated governors, accustomed to appeal on almost all occasions to the sword, were not sufficiently enlightened to forego the temptation of a present seizure, for the sake of the lasting advantage of mercantile intercourse.

Venice.

The apprehension engendered by the approach of barbarians from the north and east, led a number of traders and manufacturers settled in the north of Italy to fix their families in the small islands near the mouths of the Po. There the surrounding waters afforded them a degree of protection against invaders, who, however formidable by land, had no means of carrying on hostilities by sea. Such was the origin of Venice, a city situated in the midst of the waters, and destined to acquire extensive trade from the security attendant on her position, and to take a lead amidst the mercantile states of the middle ages.

Pisa.

Next to Venice in the history of modern commerce came Pisa, a town built on the banks of the Arno, at a distance of nearly three leagues from the sea. Its trade was chiefly with the western coast of Italy, with Sardinia, Corsica, and Sicily. Its commercial importance was prior by two centuries to that of Genoa, although it never equalled the latter in extent of navigation, nor in the number of distant settlements. Pisa declined from its commercial rank, in consequence of Leghorn, which was situated immediately on the coast, being better adapted to foreign intercourse.

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Genoa.

Genoa continued flourishing from the year 1000, until its ill-judged hostility with Venice in the latter half of the fourteenth century. These were injurious to both, yet both recovered from the effects, so as to hold, during several centuries, a distinguished rank in trade. They were remarkable also, particularly Venice, for a variety of the finer manufactures. Neither could boast of a supply of the raw materials of almost any manufacture in their respective territories; but their numerous merchant vessels brought a variety of products from a distance, and the amount of the population of either city was such as to render practicable that division of employment which is the soul of manufacture, and which was at that time almost unknown in other parts of Europe.

Constantinople.

Constantinople had the good fortune to remain untouched by the enemies of the empire until the middle of the fifteenth century, a time when civilization had made progress in the west of Europe, and literature was on the eve of receiving a great extension by the discovery of the art of printing. To this fortunate coincidence of the revival of the arts in the west, at the time when the east of Europe was sinking under the pressure of barbarism, we owe the preservation of much that was valuable in the ancient world; and, among other things, that of certain manufactures and branches of commerce. Constantinople had all along maintained a commercial intercourse with Venice and other ports in Italy, and, in general, with Alexandria. The same had been the case in regard to India; for when the occupancy of Egypt by the Saracens prevented the trade to India by the Red Sea, it was kept up by the Caspian and Euxine. But by far the shortest course from the east of Europe to India is by the Euphrates and the Persian Gulf. It was to the extent of intercourse carried on by this channel, some time after the Christian era, that we are to ascribe the wealth and grandeur of Palmyra, a city erected in the midst of deserts. This would have continued one of the chief routes of communication between Europe and India during the middle ages, had not the caravans been in perpetual danger from the Arabs, after the decline of the civilized governments in this part of Asia.

Trade with India

Venice: causes of its increase.

The trade between Europe and India, though of considerable value, was not extensive enough to be productive of the wealth ascribed to it by Dr Robertson and other historians, who, unacquainted practically with commerce and its limited gains, are ready to lend an ear to the sanguine statements of early writers. Thus the wealth of Venice, commonly ascribed to its trade with Alexandria and India, was the consequence of a variety of causes, no one being of particular importance, because several centuries were passed in the gradual increase of its population and capital. Venice afforded a secure resort in ages when other countries were in danger of invasion and plunder. It had also a prudent government, in times when, in most parts of Europe, there was little idea of a free constitution, or of a regular administration of justice. Venice was in this state when, in the twelfth and thirteenth centuries, the increase of traffic, arising from conveying the crusaders, with their military stores, and the readiness of those zealous combatants to extend the sway of a Christian state, enabled that commercial republic to increase her foreign territories. In general, the foreign policy of Venice was pacific, but she found it difficult to avoid hostilities with the Turks, or to escape from taking a part in the repeated contests which took place between France and Austria for the territory of the Milanese.

Commerce. Those who take an interest in tracing the gradual extension of industry, will find in Venice the origin of several important commercial institutions. In that city was established the first public bank, and there also was first introduced a funded debt transferable from hand to hand. The same thing held in regard to lesser matters connected with the details of mercantile business. Bills of exchange, if not invented by Venetian merchants, were first carried by them to a great extent; and the principles of book-keeping by double entry were there first understood and applied in practice. However familiar those principles may be to merchants of the present day, they were too refined for the rude and primitive state of most parts of Europe in the middle ages.

Spain. And here it may be well to point out the fallacy of a notion general in Spain, and not uncommon in other parts of Europe, namely, that in the middle ages Spain was a flourishing country, and possessed, in Tarragona, Tortosa, and Zaragoza, great population and wealth, each of these towns being said to have contained several hundred thousand inhabitants. This singular opinion was widely spread, in consequence of the prominent figure made by Spain in the politics of Europe, in the reigns of Charles V. and Philip II. The public did not take into account the great addition of power conferred on Spain by her possessions in Italy and the Low Countries; nor were there in these days statisticians capable of explaining the very slow manner in which either cultivation or commerce can acquire extension in a country so mountainous, and with so few means of transport, as Spain. Of roads she can boast only the few that are required for the purposes of government, the cross roads being little more than bridle paths, and the traffic of the country being in general carried on by mules. All this indicates a scanty population and a backward state of society, as has been the case in Spain in every age; for there is no truth in the traditionary opinion that her population was greatly thinned by emigration to America. The number of persons who proceeded annually from Spain to America never exceeded the tenth part of those who at present go annually from Ireland to Canada. The truth is, that the power of Charles V. and Philip II. was great only because the power of the other princes of Europe was very limited. The military establishments of that age were quite insignificant compared to those of the present times.

The Hanse Towns. One of the chief features in mercantile history during the middle ages was the association of towns in the north of Europe for the purpose of giving security to mercantile property. At that time the different countries of Europe were very imperfectly governed; there were then no regular posts and very few roads, so that the means of redressing grievances, or of making communications from one part to another, were very imperfect. Too much has been said of the political power exercised by the Hanse Towns, but the association was of great use in protecting

Lubeck. individual property. It dated from the middle of the thirteenth century, and originated at Lubeck, a sea-port, which had not in those days more population or wealth than at present, but possessed much more comparative importance, because very few places in Europe could at that time boast of 30,000 or 40,000 inhabitants. The trade between the Baltic and the west of Germany centred in the harbour of Lubeck, in ages when navigators were not sufficiently skilled to proceed to or come from the Baltic by the circuitous route of the Sound. The association of the Hanse Towns consisted first of Lubeck, Hamburg, and Brunswick, but soon extended to other places—to Amsterdam, Dordt, Cologne, on the one side, to Dantzic, Konigsberg, Riga, on the other. These and many smaller towns, to the number of sixty and upwards, became members of this protecting body, which continued in a state of union during three centuries. At the end of that time it was gradually dissolved, not by any violence or exercise of authority, but by the continued progress of civilization; the different governments in the north of Europe having by that time acquired the power of protecting their mercantile subjects. It is now about two centuries since the association of the Hanse Towns ceased to exist in a comprehensive sense, and for a considerable time the name has been confined to Hamburg, Lubeck, and Bremen. Commerce.

Hamburg took the lead of other trading towns of the north of Germany, by means chiefly of the extent of its river, and the consequent easy communication with the sea on the one hand, and the interior of Germany on the other. It gained also by the improvement of navigation in the fifteenth and sixteenth centuries, when vessels from the south of Europe found it no longer necessary to suspend their voyage at Bruges, but found it practicable, and even easy, to proceed at once as far as the Elbe.

The wealth and possession of the Netherlands belong, like the early opulence of Tyre, and the magnitude of the trade of Carthage, to the remarkable phenomena of mercantile history. To judge from the physical aspect of Holland, the general marshiness of the soil, the indifferent climate, and the total absence of mineral products, we should be inclined to consider it among the least favoured countries of Europe; but all these disadvantages were balanced, and more than balanced, by the possession of extensive water communication. No part of Europe equals Flanders and Holland in extent of inlets from the sea, in the breadth of navigable rivers, or in the ease with which canals may be excavated. To these advantages, much more than to civil institutions, we are to ascribe the early prosperity of the Netherlands; for these apparently unpromising countries took a lead in civilization, almost as remarkable as the more favoured regions of the north of Italy. That they were not so early in the career of improvement, was owing to the comparative barbarism of the countries in the north of Europe with which they held intercourse; while Italy had communication on one hand with Constantinople and the eastern empire, on the other hand with the south of France, the west of Italy, and various sea-ports which still preserved a portion of ancient civilization. The Netherlands.

The soil of Flanders, without being naturally fertile, was more easily cultivated than the comparatively marshy districts of Holland. Hence the early superiority of the Flemings in agriculture and manufactures. It was in the fourteenth century that the art of weaving the finer woollens was introduced from Flanders into England, and in the sixteenth that we derived from the same quarter many useful imports in agriculture and gardening. The progress of the Dutch in navigation was equally remarkable. The Maese and Rhine enabled them to bring down the bulky produce of the interior, such as timber, corn or cattle, to their own coast, as well as to carry up these rivers to the inland provinces, the various articles of merchandise imported from the south of Europe. Hence the increase of Dordt and Rotterdam. The rise of Amsterdam was owing to a different cause; to the extent of the Zuyder Zee; to the easy access which that expanse of water afforded to vessels from the Elbe, the Weser, and the Baltic. Flanders. Holland.

Bruges owed its increase to its adoption as an intermediate port for vessels from the north and south of Europe. A voyage from the Mediterranean to the Baltic was in those days a formidable undertaking; seafaring men accounted it too long to be performed out and home in one

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season, and gladly embraced the opportunity afforded by the warehouses of Bruges for landing their cargo from the south, and taking on board another from the north, without the delay of a passage through the Sound. This plan of dividing the voyages to the north continued during the thirteenth and fourteenth centuries; in the fifteenth it in a great measure ceased, because the improvements in seamanship made it easy for vessels to proceed direct to Hamburg, Copenhagen, and other northern parts.

Antwerp.

Antwerp succeeded Bruges as the station authorized by the Hanse Towns; but its prosperity was mainly owing to the width and depth of the Scheldt, which may be said to surpass any of the maritime inlets in the north of Europe. The time of the chief prosperity of Antwerp was in the sixteenth century; its population and wealth had attained a great height for so unimproved an age, and would have continued to increase, had not the tyranny of Philip II. provoked the inhabitants to insurrection, and exposed them to all the evils of a siege and capture by a military force. The consequence of this misfortune, and of the continued intolerance of the Spanish government, was the removal to Amsterdam of many of the inhabitants, and of a great share of the mercantile business of Antwerp. In the next century the Dutch acquired great political weight, and took advantage of it to prevent the navigation of the Scheldt, that Amsterdam and Rotterdam might possess exclusively the trade with the interior provinces. This singular prohibition, unexampled in the history of commerce, remained in force 150 years; for the Scheldt was not opened to merchant vessels until 1794, when the Netherlands fell under the dominion of France. During all that time Antwerp was deprived of the benefit of foreign trade; its population ceased to increase, and remained stationary at the number, on an average, of 50,000.

Discovery of a maritime route to India.

The great object of navigators in the fifteenth century was to reach India by the ocean, and to carry on what was accounted a lucrative traffic without interruption from the Turks or Arabs. The discoveries required for this purpose were made by the Portuguese, who, in situation, were nearer than other Europeans to the western coast of Africa, the line necessarily followed by those who aimed at reaching India by a new course. The Portuguese had in those days more than one prince of the blood disposed to patronize maritime discovery; but their seamen were very unskilful, so that in following their awkward efforts at discovery, we find season after season passed in tracing the unknown part of the coast of Africa to a distance of only fifty or sixty leagues. This inconceivable slowness marked the navigation of the Portuguese in their progress towards the equator, until, in 1484, they ventured to forsake the coast, stood out to the open ocean, and penetrated 1500 miles to the south of the line. From that time a bolder course was taken by these adventurers, and at last the discovery of the route to India by the Cape of Good Hope was accomplished in 1497.

Discovery of America.

The discovery of America was effected in a very different manner. Though accomplished by Spanish vessels, the honour of the enterprise belonged more properly to Italy; for it was only in a country accustomed to navigation, and possessing well-educated mariners, that so distant a voyage could have been accounted practicable. Many years were passed, as is well known, by Columbus in forming his plan, and soliciting the aid required to carry it into effect; but, once embarked in the attempt, the success was speedy, because the mind of the conductor was sufficiently enlightened to persevere in the voyage, instead of returning, as would probably have been done by an inferior navigator before traversing the half of the Atlantic.

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We now come to the sixteenth century, the time when the productive industry of Europe received a considerable impulse from the influx of the precious metals from America. At that time the chief trading towns of Europe were in Italy, the Netherlands, and, in a much less degree, in France, England, and Germany. In the latter countries the towns were very small, not being peopled to the extent of one third of their present numbers. Nothing shows more clearly the backwardness of manufactures in that age, the imperfect division of employment, or the limited communication between one province and another. There were in those days few lines of intercourse entitled to the name of roads, or fit for conveying corn or merchandise by wheel carriages. Even in countries comparatively level, such as the south of England, the north of France, the north of Germany, there were no carriage roads, and goods were conveyed on the backs of mules and horses, in the same manner as over the mountainous regions of the Alps. Nor were there in that time post-office establishments for the service of either governments or merchants.

An increase in town population is the best evidence of improvement in agriculture, as in commerce. In a rude state of cultivation, the labour of seventy or eighty persons is required to raise provisions for a hundred; so that three fourths of the inhabitants are obliged to live in country districts, for the mere purpose of raising subsistence. But as machinery and implements become improved, and the art of husbandry is better understood, the farmer can render more effectual the labour of himself and his assistants; there remains a greater surplus of provisions for the support of the inhabitants of towns; and somewhat more of the population are enabled to attach themselves to employments distinct from agriculture, namely, those of mechanics and manufactures. To this improved condition Europe was slowly advancing, when the discovery of the silver mines of America had the effect of materially quickening its progress. This renders it proper to make a few remarks on the supply of gold and silver in early ages.

The precious metals; effect of their increase on productive industry.

It is somewhat singular that Egypt, a country never remarkable for mines in its own territory, should have been among the first to give an example of mining on a large scale. But the Egyptians had extended their conquests to the southward, where, in the mountains of Nubia, there were extensive mining districts. In these, as in the mines of other parts of the world, masses of ore contained only particles of silver, and the task of raising the ore to the surface was very laborious. This was performed in the Nubian mines with little aid from machinery, and chiefly by manual labour, as is still the case in many parts of Spanish and Portuguese America.

The next accounts of mining in ancient history relate to Greece, where, from the mountainous nature of the country, the mines were numerous, though not particularly productive. They were wrought in Attica, Thrace, and several of the islands. The labourers were paid partly in money, partly in provisions; and the accounts handed down to us by Greek writers show that mining, like agriculture, afforded a fair return for the capital and labour employed, but no remarkable profit. Spain in those times, as at present, was remarkable for extensive mining; as were in a less degree Sardinia, Corsica, and the small island of Elba.

Such undertakings were long carried on for the public account; but towards the fifth century of the Christian era, the Roman government withdrew from most of its mining establishments, allowing individuals to carry them on for their own account. The quantity of gold and silver in circulation appears to have subsequently decreased; but we are greatly at a loss for correct information in re-

gard either to the state of mines or the prices of commodities, as represented in money, during the middle ages.

Influx of silver from America.

It is now three centuries since the importation of silver from America, in particular from Mexico and Peru, amounted at first to half a million annually, and increased to one, and afterwards to two millions. This sum was such as to affect the prices of corn, labour, and merchandise generally. It caused a gradual rise of prices, carried to the greatest length in maritime districts, in parts connected with each other by navigation. The published works of the sixteenth century contain many notices of the rise in the price of commodities, and of the inconvenience resulting to the consumers from such rise: the advantages to agriculturists and producers generally were not so clearly perceived, or the humble classes enjoying them had not equal means of stating them to the public.

The supplies of gold and silver from America continued during the seventeenth and eighteenth centuries, and on a much larger scale than during the sixteenth; yet their effect was not so great for several reasons. First, the number of persons among whom silver now circulated was far greater than formerly. Gold also had become more common, and began to form the chief, or almost the sole medium for large payments; and, lastly, the use of silver for plate, jewellery, watches, and other ornamental purposes, increased greatly in consequence of the improved circumstances of the middle and upper classes. There remained thus less silver to add to the coin in circulation.

It was in the eighteenth century, particularly after 1750, that the use of bank notes became general in England, and subsequently in the United States of America. This may be compared in its effect on prices to an additional supply of gold from the mine, because its tendency to raise prices is considerable, though not so great as is vulgarly supposed; because bank paper payable in cash on demand, of which alone we speak, can never be unduly extended.

Bank notes have as yet obtained little currency on the Continent of Europe; but in Great Britain, Ireland, and North America, their effect on prices may be said to have been similar to that of the importation of the precious metals from America. In either case, the consequence was a rise in the money price of corn, and commodities generally. To comprehend the benefit of such rise, we should consider society as divided into two great parts; the producing and the non-producing classes. The latter consist of capitalists, landholders, or fixed annuitants; the former of farmers, especially tenants on lease, manufacturers, merchants, and, in general, all persons who carry on business with borrowed capital. If a tenant on lease continue to pay during twenty-one years the same rent, while the market price of his crops experiences a progressive rise, it follows that his circumstances will improve. Thus, on the augmented importation of silver from America, which began three centuries ago, there took place a slow but steady rise in prices, the effect of which was of great advantage to agriculturists, in particular to those who held land on lease. The yeoman who was cautious and persevering thus laid the foundation of a little property, the next generation added to it, and the third rose from the condition of cottagers to that of farmers. This, or something like this, was the course of circumstances in England, during the chief part of the sixteenth, seventeenth, and eighteenth centuries. If the effect was at no time very great, it was continued and progressive; for we can trace no great or general decline in the price of agricultural produce until the general peace of 1814.[1]

Trade of England

The trade and navigation of England, unexampled as it now is in extent, did not by any means make an early figure in the commercial history of Europe. Of this the principal cause was the thinness of our population compared to that of the north of Italy or the Netherlands, and the consequent insignificance of our towns. Our slow progress in trade is also to be ascribed to political causes, to the civil troubles originating with the great barons, the frequent wars with France, and still more to the long and sanguinary contests in the fifteenth century, respecting the rival claims of the houses of York and Lancaster. It was not till the reign of Henry VII., little more than three centuries ago, that the advantages arising from our extent of coast and abundance of fuel began to be brought into active operation. During the reign of his successor, the progress of improvement received little patronage from the court, but a most efficient indirect aid from the introduction of Protestantism. The advantages resulting from that happy change, and the development of national industry, were strongly displayed during the long reign of Elizabeth, under the wise administration of Cecil. At that time, also, was felt the benefit arising to the productive classes, from the augmented import of gold and silver from America.

The navigation laws.

We pass over the very questionable, though popular opinion, that the adoption of our navigation laws had a beneficial effect on our shipping. They accelerated its increase; but that increase would probably have taken place to an equal extent, and on a surer foundation, had foreigners been allowed to frequent our harbours, until the course of circumstances gradually led to a preference of British vessels. In all the departments of productive industry which have as yet had a fair trial, interferences and exclusive privileges have been found detrimental to national prosperity; nor does there seem any reason for making an exception in the case of mercantile shipping. Thus, in no department have more efforts been made to cause increase by artificial encouragements, than in our fisheries. Government, desirous of extending these great nurseries of seamen, have granted large bounties, particularly on the vessels employed in the herring fishery; still the result has never been satisfactory, and bounties are now withdrawn from fishing vessels, in the same manner as from exported linens, and other articles of merchandise.

Our navigation laws date from the middle of the seventeenth century; and in the course of fifty years our mercantile shipping was increased to somewhat more than double its amount. But the great period of increase was during the eighteenth century, at the beginning of which the mercantile navy of England amounted to 270,000 tons; while in the middle (about 1750) it exceeded 600,000, and in the end of the century approached to 1,600,000. On the 31st December 1852, the total number of ships belonging to the British empire, including the colonies, was 31,993 sailing vessels, and 1414 steam

[1] The effect of a progressive rise of prices in stimulating the productive industry of a people was first started by Mr Hume, about a hundred years ago in his *Essay on Money*. He had seen the effect of this rise in the war of 1740, as well as in that of 1756; and a war carried on by annual loans has the effect of raising prices nearly in the same manner as an increased supply of the precious metals. Mr Hume had also the means of observing, in some degree, the effect on prices of an augmented issue of bank paper. His remarks on these subjects, though not expressed in the language of a man of business, do credit to his reasoning powers, considering his limited means of information on a subject so foreign to his pursuits. How little were such conclusions attended to by parliament in the discussions of 1819 on the resumption of cash payments, or of 1826 on the recal of small notes!

vessels, and the tonnage of these, 4,080,385, and 223,616 respectively.

Manufactures.

Of our national manufactures, woollen was long the most considerable; but it is now surpassed by cotton, the extension of which since the year 1770 has, like the increase of our population, been one of the wonders of the age. Another manufacture surprisingly extended during the last half century is that of iron and hardware. Our superiority in the latter, both as to quality and cheapness, is such as to give to our exporters a decided preference in foreign markets.

Custom-house returns.

It is now fully a century and a half since there has been kept at the custom-house in London a yearly register of our exports and imports. But such returns exhibit a very imperfect statement of the aggregate of our foreign trade; because remittances take place in bills of exchange, and in various other ways, which escape the notice of the official registrar. It has long been the practice of merchants to consider our exports as exceeding our imports; but this has arisen chiefly from the different mode of valuing the two. The truth is, that the sum of our imports is nearly as great as that of our exports; but this approach to equality is by no means a preventive of profit. Articles are worth more in one country than in another; and a gain is made by the mere exchange, in the same way that a nation augments its wealth by the interchange of commodities between its different provinces.

Commercial treaty with France in 1786.

The commercial treaty with France, concluded in 1786, was entitled to particular notice, as well for the fairness of its conditions, as for being the first commercial compact, on a comprehensive scale, between two nations so long divided by political causes. The freedom of competition opened by this treaty put to the test the ability of either country to supply the great articles of manufacture. While in silk, jewellery, and ornamental work generally, the French continued to be superior, England had the advantage in such substantial articles as hardware and pottery, as well as in the rapidly increasing manufacture of cottons. This principally arose, not from the conditions of the treaty being unfair towards France, but from our advantages on the grand points of fuel, canal communication, and amount of capital. Unfortunately the operation of this judicious compact was cut short by the war of 1793. Had the peace continued longer, there is little doubt that whatever was obnoxious in the conditions of the treaty would have been gradually removed, by the mutual accommodations which insensibly take place between nations in a state of amity and free intercourse.

Exports to North America, India, and the West Indies.

A striking feature in the trade of England, compared to that of France, Germany, and other continental countries, is the magnitude of its exports to distant parts, such as India, North America, and the West Indies. These different branches of trade employ a number of seamen, and make a conspicuous figure in the list of our yearly exports. They are considered by foreigners, as well as by the majority of our countrymen, as the pillars of our commercial prosperity; but those who estimate them so highly have no idea of the large sums of capital that have been withdrawn by each of these countries from England. The United States of America consumed our manufactures largely for nearly a century, but in no one year did they remit to this country the full value of the articles which we exported to them. The amount due from them to England has long exceeded the general estimate, and is known only to the merchants, who feel the deduction thus made from their pecuniary means. A similar drain has long been made by our West India colonies, but in a less degree, until within these fifty years, since which the capital drawn from England has amounted to many millions. With India our commercial intercourse was more limited; and the exports, confined to the East India Company and to a few mercantile houses in London, were on a comparatively small scale until the present age, during which the extension of the private trade from Liverpool, and the advance of capital on indigo plantations, made our India business assume a considerable resemblance to that with North America and the West Indies.

The real and substantial benefit arising from commerce takes place at home, and shows itself in the extension of manufactures, the increase of towns, the improvement of roads, canals, and harbours. In all these England has in the last century taken a decided lead of France, the Netherlands, and every continental state. Happily the grounds of our superiority appear likely to continue, resting as they do on our abundant capital, our formed habits of business, the general subdivision of employment, and the extent of national improvements conducive to useful purposes. These substantial advantages are, it may be hoped, so great as to enable us to overcome the burdens arising from financial mismanagement, and our too ardent interference in foreign politics.

Of the course of trade in this country during the last half century, the following is a brief summary. After the peace with the United States of America in 1783, our trade suffered for some time by the transition from war to peace, but gradually improved; and in the years 1789, 1790, 1791, 1792, was decidedly prosperous. After this came the war with France, which was at first injurious to trade, but after the abundance of money consequent on the extended circulation of bank paper in 1797, assumed a very different appearance, and seemed to bring a yearly addition to the national wealth. This ostensible increase of profits was kept up during the chief part of the war, but at the peace the state of circumstances underwent a complete change; the transition was great beyond example; prices fell in every department of business, and the year 1816 was among the most gloomy in our commercial history. A revival of trade took place in 1817 and 1818, but it was succeeded by a long depression. In 1823 trade revived once more; in 1824 it became prosperous, and 1825 afforded a striking example of the abuse of mercantile prosperity; at the end of that year a general fall of prices took place, and afterwards the heavy calls to meet the expenses of the late gigantic railway undertakings, aggravated by the failure of the potato crop of 1846, occasioned the greatest difficulty in procuring pecuniary accommodation, and led to the crisis of 1847.

Effect of war expenditure on the price of commodities and the income of individuals.

From the ease with which money was borrowed by the government of this country during the eighteenth century, the wars we carried on were both of frequent occurrence and on a scale of great expense. The result was a continued increase of debt and taxation; but the burden did not appear beyond our means, until the unprecedented length to which it was carried by the wars of 1793 and 1803. Both took place under the ministry of Mr Pitt, and the extreme to which he allowed expenditure to be carried was the more remarkable when we consider his long experience in finance, and that from the time of his coming into office his attention was given to the state of our trade and revenue. Several of his early measures, such as the commutation of the duty on tea, and the commercial treaty with France in 1786, were entitled to great commendation. A similar opinion is not now entertained of his revival of the sinking fund; and it was in an evil hour that he allowed himself to be diverted from his pacific course by the urgency of the aristocracy and his sovereign, to take up arms against the French revolutionists. Unfortunately the atrocities of these men, the endless usurpations of Bonaparte, and, above all, the facilities afforded by the unchecked issue of bank paper, carried our expenditure to an unprecedented height.

Commerce.

In the midst of this hazardous career, the death of Mr Pitt, and the removal from office of his immediate successors, transferred the management of our finances to the hands of men wholly unequal to the task; of men unconscious of the precarious nature of our paper currency, and of the danger of such measures as a stoppage of neutral navigation, or a war with the United States of America. The consequence was a depreciation of our bank paper during five years, an enormous waste of the public money, and a burden on the country of unparalleled amount.

A state of war is attended by a great demand for the service of individuals, as well in the army and navy as in the public offices. A great number of persons are thus withdrawn from productive employment, and the consequence is an increase of the wages and incomes of those who remain so employed, as well as bringing into activity a number of persons who in a season of peace would hardly have been accounted worthy of employment.

A rise in the price of corn and other produce is another consequence of a state of war; this leads to a rise of rent; a rise of rent to increased expenditure on the part of the landlord; and that to a general activity and continued employment of working classes. Such was the condition of this country during the twenty years from 1794 to 1814, while in the twenty years that followed the peace there was a corresponding decline, and then a gradual return to higher prices. The fall in the price of produce lowered rents, and greatly lessened the income of the upper classes; hence a contracted expenditure, and a want of employment for the lower orders. All this exemplifies the precarious nature of such a rise of prices as took place in the late wars, and will, more than any other argument, confirm the public in an adherence to peace.

Decrease in the supply of the precious metals.

The supply of gold and silver from America continued regularly to increase until the year 1810, since which the disorders in Spanish America, particularly in Mexico, shortened the supply from that quarter by at least one-half.

Mr Jacobs, in his work on the precious metals, calculated the reduction in the quantity of circulating coin, during the twenty years that succeeded the peace of 1814, at not less than 20 per cent. This decrease in the supply of the precious metals must have had some effect in lowering the prices of commodities, but to what extent it is not possible, with our imperfect data, to form an opinion.

But the discovery of gold in California in 1848, and in Australia in 1851, has not only made up for any deficiency in the supplies from other quarters, but from these two countries alone there has been furnished more than twice the amount of the entire annual produce of the precious metals from all parts of the world in the most productive periods of their working. The effect of this has been to raise wages and prices very largely both in this country and America, and to give a great stimulus to emigration from Britain, and especially from Ireland, and to some extent from Germany.

In 1845 Sir Robert Peel abolished the customs duties on 420 different articles. This measure was a virtual abandonment of the system of protection, which was shortly after followed by the total repeal of the corn laws.

Till recently, our shipping interest was subjected to a variety of burdens and restrictions, by which their energies were weighed down and fettered. These, however, are happily now either wholly abolished or greatly modified. In consequence of these alterations, all the building-yards and all the seamen of the world may be made subservient to the wants and purposes of our merchants and shipowners, when we add to these recent improvements the increased facilities afforded for the transport of goods by means of the increased number and power of steam-ships, and the great extent of railways. The eventual progress of trade seems decidedly favourable to this country, provided as we are with coal and iron, with canals, roads, and machinery, as well as with abundant capital, intelligent merchants, and expert workmen. Commerce.

It was feared by some that the introduction of free-trade measures and the repeal of the laws which favoured our own shipping would prove ruinous to our trade by bringing foreigners into competition with our own merchants, but the experience of the years that have passed since the adoption of a liberal mercantile policy has completely falsified all the evil forebodings of the timorous and the contracted. No doubt foreigners will derive some advantage from the freedom in which they will participate. But why should we grudge their having some share in the more abundant prosperity which has fallen to our lot: would it be wise in us to fetter ourselves in order that we might restrict others?

During the forty years of peace our trade has progressively advanced, our exports, which in 1814 amounted only to L.51,358,398, had advanced in 1852 to L.219,515,699; and if we can avoid wars and internal commotions, there is every reason to expect that our prosperity will go on increasing. Of all the important countries to which our commerce extends, the empire of Russia is one of the least profitable. Although it includes a seventh part of the globe, it only consumes British products to the amount of about a million annually, and for many years its imports from Britain have been diminishing till it has reached this amount. The small kingdom of Portugal nearly equals Russia in its consumption; and Holland takes three times the amount of British manufactures.

In this view it may appear that a war with Russia would not materially injure the commercial prosperity of this country; nevertheless, the calamitous effects of a state of warfare, not only in its immediate, but in its more remote consequences, will be seriously felt even in this case.

The trades which draw their raw materials from the Baltic and the Black Sea will suffer from short supplies; the prices of their manufactures will be enhanced, taxes will be increased, freights and insurance will be more expensive, the demand for money will be greater, and the interest raised, and in many ways the war will operate injuriously to the public.

Close of the historical view of commerce.

We shall conclude our historical sketch of commerce by a brief notice of its prominent characteristics at different periods.

The chief features of the commerce of antiquity were the early opulence of Tyre, and the great extent of the trade of Carthage, and Alexandria in Egypt. In modern times the earliest points of commercial history entitled to notice were the prosperity of Venice, Genoa, and other towns in Italy, the era of whose splendour was the fifteenth century. In the sixteenth and seventeenth the lead in commerce was taken in a remarkable degree by Holland; in the eighteenth by England. But as to the effect on commerce of an increase of circulating medium, it was felt in the sixteenth century by the influx of the precious metals from America, which caused, it is said, a great rise in prices. This rise continued during the seventeenth and eighteenth centuries with a steady but not a remarkable progress. After this came the addition to the circulating medium, arising from the use of bank paper; it became considerable only in the eighteenth century, particularly in the latter half of that period. From 1797 to 1814 the issue of bank or government paper was carried to an unexampled length in England and other countries; the sufferings of the succeeding twenty years were mainly owing to the re-action proceeding from its recal. That period is the only one in the history of modern Europe in which the circulating medium has been much contracted, or the prices of commodities and the income of individuals have experienced a long continued decline.

II. PRINCIPLES OF COMMERCE.

Having treated the historical part of our subject at considerable length, it is now fit to bestow some attention on its principles or general rules. By "principles of commerce," we understand conclusions of two kinds; those deduced from the practice of merchants, and applicable to the management of trade by individuals, and those of a more comprehensive character, which, resulting from the course of productive industry generally, are entitled to the attention of a minister, a member of Parliament, or whoever is engaged in the task of devising regulations for trade. Most of those conclusions seem so plain as to admit of little question; but it is a fact that several of them have been the result of long, and, in some cases, of dearly bought experience. As a specimen we give the following:

Mercantile axioms; example of them.

1. Short credits and quick returns, however small the commission or profit, are eventually better than long credits and a large commission or charge.

2. The greatest mercantile profit arises from intercourse with populous and long-settled countries, such as Holland, because the inhabitants are in general possessed of capital, and punctual in their payments.

3. Recently-settled countries, like the United States of America, the West Indies, Spanish and Portuguese America, are always bare of capital. There is a perpetual tendency in them to draw it from Europe; and mercantile transactions with these countries, profitable in the outset, often become otherwise, from delays of payment, and ultimate insolvency.

4. Trade should be left as much as possible to its natural course, interference being almost always hurtful. Governments ought merely to remove obstacles and grant facilities. Privileges and monopolies were formerly very general in England; but these, if necessary in an early age, when individual capital was too scanty for distant undertakings, should be withdrawn as soon as such capital becomes sufficient.

5. Division and subdivision of employment can be carried to only a limited extent in agriculture. In manufactures they may be carried very far, and are productive of the greatest advantage. They afford employment to persons of every age, and they conduce greatly to the finished execution of work. Hence the superiority of towns, in particular of the larger towns. This was the cause of our manufacturers not going abroad after the peace of 1815, when wages fell, although provisions were still high priced.

Rules or observations like these are very seldom met with, either in printed works or in personal intercourse; and the reason is, that while few departments of industry have been followed in practice to so great an extent as commerce, hardly any other has been less an object of study in regard to its principles. While the professions of law, medicine, and the church, possess in abundance printed works for the guidance of those who intend to follow them, the case is quite different in regard to trade. There are hardly any books or written compositions for the purpose of instructing the merchant in the practical management of his business, and not many containing statistical or other information connected with trade. To no profession are written precepts considered to be so little applicable; in none is proficiency thought to depend so exclusively on practice. Hence an unacquaintance with principles or general rules, and the commission of grievous errors, as well by merchants in the pursuit of business, as by members of parliament in the enactment of commercial regulations. Of the former we may take as examples the repeated glutting of foreign markets with our goods, and the injudicious extension of sugar cultivation in the West Indies; of the latter, the oppressive duties on Baltic timber, or the fetters so long imposed by act of parliament on our country banks.

The belief that it is for the advantage of a nation to manufacture almost every article it consumes, has been the cause of the most serious inconvenience and loss. It is thus that in France the making of sugar from beet-root, and the more serious error of erecting blast furnaces for making iron in districts unprovided with coal fuel, has placed a large amount of capital in a situation where it is subject to reduction year by year, and whence it cannot be withdrawn without heavy loss. In like manner, the privileges so long conferred by act of parliament on the silk manufacture in England, frequently tended to produce embarrassment, because they interfered with the natural course of trade. No branch of industry can be of permanent advantage to a nation, unless it can support itself without indirect or artificial aid. Were merchants and manufacturers left to themselves, the natural course of things would point out the branches of productive industry likely to succeed or not in a particular country; and capital would not then be advanced on an insecure foundation. Plain as this appears, it is quite at variance with the creed of our ancestors; a creed which, under the name of "mercantile system," long retained an influence over our traders, and, in some degree, over members of the legislature.

The mercantile system explained.

The basis of that system was, that "wealth consisted in the precious metals; that what is gained in trade by one nation must be lost by another; and that our great object in receiving returns for our exports should be to get money instead of merchandise." It followed from such notions, that of all possessions, a mining country, such as Mexico and Peru, was the most desirable; and hence in a great measure our rupture with Spain in 1740, which led to our unfortunate expedition to Carthagena, involved us in a contest with France, and caused us in the course of eight years an immense waste of blood and treasure. The return to a state of peace in 1748 obliged us to desist from attempts on Spanish America, but the influence of the mercantile system continued, and was singularly favoured by the annual custom-house returns. These returns exhibit an apparent excess of exports above imports, and give rise to the notion that the balance is sent to this country in the shape of money. Supposing the exports of England to the Continent of Europe to amount for any given year to L.20,000,000, and the imports to L.14,000,000; the difference, or L.6,000,000, is, according to this absurd notion, the amount of profit paid to us in money. It is clear, however, that the custom-house returns take no notice of some very important items, such as the export of public money for our foreign garrisons, the transmission of bills of exchange to foreign merchants, or the import of smuggled goods. Besides, if the quantum of our circulating medium remain, as it probably does, very nearly on a par, what becomes of the supposed importation of money? Were England in possession of all the annual balances which the advocates for this system suppose her to have received in money during the last century, our metallic stock would not be below L.400,000,000 sterling; that is, ten times its actual amount!

Fallacy of custom-house returns.

When a merchant exports goods, the sale, of course, takes place abroad, and a remittance is made, either by bill or by the return of other merchandise. It hardly ever enters into the contemplation of the exporter that he would find an advantage by obtaining a return in coin or bullion. Money owes the reputation it has acquired, as an object of national interchange, to its convenience in other respects; to its being the commodity with which we regularly go to market, and to its fitness for the smallest

Wealth supposed to consist in gold and silver.

Commerce

purchases, by the minuteness of its subdivisions. But this recommendation, however important in private business, should have no weight in the intercourse of nations; merchants can be at no loss to dispose of a remittance made in the shape of goods, nor is it any object with them to multiply the means of petty purchases.

The interest of a commercial country is not to increase the amount of its currency, but to quicken its circulation; the same sum performing double and triple duty when passed expeditiously from hand to hand. Now nothing promotes circulation so much as exemption from arbitrary interferences, were the effect nothing more than the general preservation of credit. In France, the monstrous abuse made of the paper system in the beginning of the Revolution has long prevented the use of any other circulating medium than coin; the result is an annual loss of three millions sterling to the public, such being the difference between the cost of paper and the precious metals, even after making an allowance for the retention of a portion of the latter sufficient for the purposes of banking. Some people, however, imagine that, to increase the amount of the circulating medium, is to increase the capital of a country. These persons should recollect that capital is by no means limited to money, but embraces all that mass of property which is devoted to reproductive consumption. When we wish to lend capital, or to employ it in business, we begin by selling the various articles at our disposal: the amount is then in our hand in the shape of money; but this is very transient; the money disappears as soon as we make payment for the new purchases. The public not having time to enter into all this reasoning, judge from first impressions, and take for granted that money is capital, because its agency is required to put capital in motion. Governments, however, might have saved themselves much trouble in providing supplies of metallic currency, since the natural course of business will invariably provide them for itself. The plenty or scarcity of the precious metals depends on considerations altogether different from the imagined balance of trade. Specie was so scarce in England in 1809 that government was not a little embarrassed to find L.200,000 for the Walcheren expedition; yet in that year our custom-house returns presented an apparent balance of above L.7,000,000 in our favour.[1]

Capital defined.

Losses to England from the mercantile system,

No country has suffered so much from the errors of the mercantile system as England; partly on account of the influence of traders and manufacturers in our legislature; partly from the temporizing policy of our ministers, who have seldom scrupled to buy the consent of any great body of the community to a new tax, by the grant of some injurious preference. Hence a variety of pernicious regulations in favour of the landed, the shipping, and the manufacturing interests; hence, also, a number of unfortunate measures in our foreign policy.

Our ancestors laid it down as a fundamental rule, that there could be no profit on the one hand, without a corresponding loss on the other. They considered trade as a game of mere transfer, and had no idea how a country could derive wealth by an intercourse between its own inhabitants. Charles II. entered on the war of 1672 with high hopes, imagining that, by destroying the commerce of Holland, we should not only increase our own, but in a manner absorb that of the world. Political reasons led us afterwards into close alliance with Holland, and prevented the ebullitions of our jealousy in that direction; but the aspiring power of Louis XIV. and the prospect of his acquiring the crown of Spain, led us to a closer connection with Portugal, and particularly to the well-known Methuen treaty, concluded in 1703, the object of which was to favour the consumption of port wine, in return for a similar preference to our manufactures. The result has been, that we have not scrupled, for more than a century, to punish our palates and injure our health for the sake of an imaginary political advantage; we say imaginary, because France would evidently have agreed to take our manufactures in return for her produce; and if the increase of her trade had, on one hand, the effect of augmenting, to a certain extent, her national power, it would, on the other, have increased her dependence on us, and have rendered a war with us extremely impolitic and unpopular.

In the 17th and 18th centuries.

Commerce.

Our attachment to Portugal arose, in a great measure, from her not being a manufacturing country, and likely, in the opinion of the calculators of the day, to be so much the more advantageous to us in the capacity of a customer. This notion has prevailed in our councils to a very recent period; the administration of 1808 and 1809 not scrupling to give encouragement to the export of merchandise, on a large scale, to the unproductive occupants of Brazil and Spanish America. Now, the fact is, that the means of extending our trade, and consequently our profits, with a foreign country, are to be estimated by a quite opposite rule; they depend on the productive power of that country, on its means of affording equivalents for our commodities; in other words, on its capability of paying for that which it suits us to sell to it. Now, what country was ever wealthy without industry? The mines of Mexico and Peru, the richest the world ever saw, fall, in point of annual produce, far short of the annual value of the cotton, the tobacco, the flour, and other less tempting products of the United States. In like manner, the cochineal, the cocoa, the barilla, and even the indigo of Spanish America, form a small amount when put in competition with the exchangeable commodities possessed by the industrious nations in our own neighbourhood, such as France, the Netherlands, or the north of Germany.

Mercantile policy of other countries;

If from our own favourite policy we turn our attention to that of continental states, we find Holland steering a course of impartiality, and guarded from an imitation of our trespasses, not indeed by superior knowledge, but by the characteristic moderation of her government. The northern kingdoms deserve comparatively little attention, their rulers having in general given their thoughts much more to war than to discussions of internal policy. The same thing was long true of a country where the commercial interest has at no time been very considerable; the personal will of the sovereign, and the influence of the *noblesse*, having afforded the grand *raisons determinantes* for public measures. Still the history of France is not without traces of the effects of mercantile prejudices. Among other regulations of the kind, there formerly existed several for the purpose of favouring linen manufactures instead of cotton, because flax was a home product, whilst the purchase of cotton carried money out of the country.

of France

At last it was found out by some Frenchmen of greater sagacity than the rest, that cotton might be safely admitted to entry, the money required to buy it proceeding necessarily from the employment of French industry in some shape or other. But the extent of popular prejudice was most singularly exemplified at the time when it was proposed to permit the unrestrained use of *toiles peintes*, or printed calicoes; every town that had a chamber of commerce remonstrated against it. A deputation sent from Rouen affirmed, that "the proposed measure would throw

[1] Appendix to the *Report of the Bullion Committee*, 1810.

Commerce.

its inhabitants into despair, and make a desert of the surrounding country;" Lyons, the centre of the silk manufacture, declared that "the news had spread terror into all its workshops," Tours "foresaw a commotion likely to cause a convulsion in the body politic;" Amiens asserted "that the proposed act would become the tomb of the manufacturing industry of France;" and Paris declared, "that her merchants came forward that they might bathe the throne with their tears." The government, however, stood firm, the duty on printed calico was withdrawn, and the inspector-general of manufactures ventured some time afterwards to challenge the authors of those elegant effusions to compare their predictions with the result. "Will any of you," he said, "deny that the manufacture of printed calico has been the cause of giving a vast extension to the industry of the country, by employing a number of hands in spinning, weaving, bleaching, and printing? Look only to the branch of dyeing, and say whether this change has not done more for it in a few years than other manufactures would have accomplished in a century."

In some countries government go much farther, and still act in a commercial or manufacturing capacity, notwithstanding all the admonitions of political economists, or the more home-felt lessons of experience. The Austrian government conducts the gold and silver mines of Hungary to so little account, that the profit realized from these splendid establishments does not exceed a few thousands a year. In the year 1817 the French government, desirous of laying in a stock of corn for Paris, obtained a loan of money, with which they made purchases in various markets both in and out of the kingdom. The result was most distressing; the price of corn rose from 80s. to 120s. per quarter. The people in the provincial towns became apprehensive of a scarcity, and, though in general submissive to a fault, attempted at Rouen and other places to impede the course of the market, and to prescribe a limit to the price of corn. The alarm, once given, extended through great part of Europe, and gave occasion to a sudden rise, as may be seen by reference to the corn prices at the time in London, Amsterdam, and Hamburg. Nothing is, therefore, more impolitic than the interference of the public treasury with markets, however good the motive; a truth which has been so thoroughly felt in England as to prevent any thing of the kind during the last sixty years. government having confined itself in seasons of scarcity, as 1800, 1810, 1816, to permitting the free import of corn.

Austria.

The present modified state of the mercantile system.

We are next to advert to the mercantile system in its most limited sense, in the shape which it now bears, after all the modifications of the experience of a century and a half. The predilection for the importation of "hard dollars" has disappeared among a portion of the public, particularly since making the discovery that bank paper can be made to answer the purposes of gold and silver. But even these persons are far from admitting the doctrines of political economists in all their extent, they still cling to the notion that we should discourage the import of a foreign article whenever a corresponding commodity can be raised at home; that we should impede, or even prohibit, all foreign manufactures; and that we should not scruple to encourage certain fabrics of our own by bounties. Such was formerly the creed of the majority of our merchants and manufacturers; such was, forty years ago, the creed of our ministers and presidents of the board of trade. It proceeds on the plausible idea, that we cannot provide too much employment, and that our people would be in danger of falling short of work were we to purchase finished articles at the hands of foreigners. But there is not in the natural course of things any such deficiency of labour as to make it necessary, or even expedient, for us to turn things out of their regular order for the sake of giving employment to our population. Providence has evidently ordained that industry should be at no loss for objects; the interruptions to its peaceful course arise from our own wayward policy; from our restraints, prohibitions, and, above all, from our sudden changes from war to peace, and from peace to war. These are the true causes of such scenes of embarrassment and bankruptcy as we witnessed in 1793, at the close of profound peace, and as we have unhappily witnessed since the end of the war in 1815.

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Equally erroneous is the notion, that it is more for our interest to send abroad manufactures than raw produce or money. If you grant a bounty on an export, you do nothing more or less than bribe a foreigner to make a purchase from you; you withdraw from its natural destination a portion of your capital and labour; for the sake of extending one branch of business, you weaken your means of competition in others. The money so long paid in the shape of bounties on one of our most popular exports, we mean British linen under 1s. 6d. a yard, is a public loss not only to the extent in question, but to twice or three times that extent in indirect injury; it has withheld the industry of our countrymen from other lines, which they might have prosecuted without a premium, and in which they would have no occasion to dread the rivalship of their neighbours. Mr Hume has justly remarked, that in a question of personal right, the perception of a half-educated man may be sufficiently sound; but that the case is very different in regard to matters of general policy, where the real is often different from the apparent result. Now, this state of half knowledge has been the origin of almost all our mercantile miscalculations; we have listened to first impressions, and have not scrupled to give them a practical operation by acts of parliament, without ever considering that the remote consequences would be injurious to ourselves.

Cause of false views in trade

To what fatality is it then owing, that in this great commercial country the public should still be so far behind hand in a knowledge of the principles of trade. Unfortunately these doctrines, though closely connected with the national prosperity, have never formed an object of attention at the English universities, and but indirectly and imperfectly in those to the northward of the Tweed. Add to this, that most of the works hitherto published on political economy are written in an abstract, unattractive style, fatiguing the attention of the reader by a long series of reasoning, and seldom relieving him by diversity of subject, or by the introduction of practical illustrations. The public is still in want of a work which should convey the liberal doctrines of the philosopher in the plain language of business, and support the course of reasoning by an appeal to facts familiar to the mind of the merchant. Our limits do not by any means admit of our supplying this deficiency, or of bringing forward the arguments necessary to erect a structure of conclusive reasoning; they enable us only to state some of the more important results, to which we shall now make a few additions.

The true principles of commerce.

We may safely discharge from our minds all that has been said, and all that has been written, in regard to the greater relative advantage attendant in trading in this or that particular commodity; we may feel satisfied that profits are much more on an equality than is commonly supposed; that no one would long be a dealer in that which did not afford him advantage, or remain a stranger to that which was throwing an extra gain into the pockets of his neighbour. The same rule is applicable in a national sense, the traffic in one commodity being either directly or indirectly as productive of profit as in another. Even foreign articles of luxury should not be discouraged, since the money required to pay for them must be pre-

viously raised by the employment of British industry in some useful manner. This affords a new proof of the fallacy of first impressions, and leads to the grand practical conclusion of allowing people to "buy commodities wherever they can be got cheapest, without seeking to favour home produce above colonial, or colonial above foreign."

Trade ought to be perfectly free.

Merchants should possess unrestricted freedom, not only in regard to the articles they deal in, but in respect to the time of keeping them back or bringing them to market; and this not only from the general title which every one has to the management of his own property, but from a conviction that whatever benefits the individual will be productive of corresponding benefit to the public. This is a point of the last importance, as reconciling the lower orders to a variety of unpopular employments of capital, such as buying up goods to be warehoused, and not brought to market till prices are advanced. Take, for instance, the capitalist who buys a thousand hogsheads of sugar on its arrival from the West Indies in August, for the purpose of selling it in the succeeding March or April. Such a transaction is of use to all parties, affording, in the first instance, a customer for the planter or planter's correspondent; a depository for the public during the season that the article ought in great part to be stored up; and finally a seller, at a time when, without such deposits and such forthcoming of supply, the price might have become exorbitant, and might have continued so until the arrival of the next year's crop. How applicable are these arguments to the most obnoxious of all traders, the engrosser of corn!

The more we study the natural progress of commerce, the more we shall be satisfied of the expediency of leaving all its various agents to their uncontrolled management. Business then divides itself, particularly in a large city, into a variety of separate branches, each of which may be carried on to a surprising extent by separate establishments. The commission charged by such persons is small, their dispatch extraordinary; capital does not remain locked up in their hands, and goods find their way to the market whenever prices are encouraging, that is, whenever the consumers are in want of them; they are withheld only when the market is glutted, and when to force sales would be productive of eventual injury to the buyers themselves. The doctrine of the happy medium is nowhere more applicable than in commerce: if you reduce prices for one season below what is necessary to indemnify the producer, you discourage production for the next, and you expose yourself to the hazard of a dearth.

Evil of monopolies.

Monopoly is now generally admitted to be highly impolitic. No new grants of the kind have been issued among us for many years, and every renewal of the charter of the East India Company has been marked by a diminution of its restrictive character, till in 1834 its monopoly was abolished. The public are now aware that a privileged company cannot make its purchases abroad on better terms than individuals, and that the chief operation of the privilege is to enhance the sale prices, or, in other words, to put money into the hands of a few at the expense of the nation. They are further aware that the concerns of a large corporation cannot be managed with the minute economy and vigilance of the private merchant, and that its grand advantage lies in the intelligence and dexterity acquired by the transaction of business to a large extent by one establishment; an advantage of great importance, but which has nothing to do with the possession of exclusive privileges.

Commercial treaties.

It is now about seventy years since the conclusion of Mr Pitt's well-known commercial treaty with France; a treaty which many on both sides of the channel were inclined to think particularly advantageous to us, and which certainly afforded a grand object of declamation to Bonaparte. The fact, however, is, that such treaties are good only in as far as they give general confidence to the merchants of both countries; whenever they go farther, and interfere by specific provisions, they are infallibly pernicious, and not the least so to the apparently favoured nation. It is a symptom of some promise in the present age that, though backed by all Europe, our ministers did not, in the treaties of either 1814 or 1815, go the length of imposing any restraints on the trade of France, but left things to their free course, subject only to such restrictions as might be deemed indispensable by either government for the protection of particular branches of manufacture.

Trade ought to be perfectly free.

The final conclusions to be drawn from the principles of commerce are of the most comprehensive and beneficent nature. They teach us that every nation finds its account in the prosperity of its neighbours, that it would experience a corresponding suffering from their decline, that to aim at engrossing more trade than *naturally falls to our share*, is sooner or later injurious to ourselves; and that war, even when successful, is attended with the most serious losses. War turns to waste a large portion of our productive means; it leaves us oppressed with a ruinous burden in peace; it impedes the future extension of our exports, for the injury done to our neighbours recoils on ourselves; in short, it is so replete with evil to the public and individuals, as to be justifiable only in an extreme case, such as the defence of national independence, or the overthrow of a tyrannical usurper.

Division of employment; its manifold advantages

Division and subdivision of employment forms the great distinction between a backward and an improved state of productive industry. It increases the efficiency of the mechanic or manufacturer to an extent of which no one who has not studied the subject can have an adepuate conception. Now, the degree to which employment is subdivided depends mainly on the size of a city or town; and in estimating the state of civilization in a particular country, we cannot have a better guide than the proportion of the inhabitants of towns to those of the open country. Flanders and Holland were long the most improved part of the north of Europe, and had the greatest number of towns on a given extent of territory. This they still have, with the exception of the counties (Lancashire and the West Riding of York) which are the chief seats of our manufactures. After the Netherlands in town population come the north of Italy and north-east of France, along with the western part of Germany. Prussia and Austria have each a comparatively small number of towns; Poland has still fewer, and Russia is the most deficient of any country in Europe. In England the increase of town population has been progressive during the last eighty or ninety years, and bids fair to go on in an equal or greater ratio.

The division of employment is the result of commerce and of increased population. It is of two kinds; that among individuals, by which a specific task is appropriated to each, and that among nations, by which particular kinds of products are raised to a greater extent in one country than in another. The latter is as yet only beginning to claim the attention of public men, for it has been a frequent error with government to establish, in their respective territories, a variety of manufactures, without sufficiently weighing the local obstacles or disadvantages. Of this France furnishes some striking examples, particularly in the case of iron. The abundance of coal in England, and the ease in conveying it, and other bulky goods, by canals, give to our manufactures of iron and hardware an advantage which France in vain endeavours to equal. Her true policy would be to repeal the very heavy duties on the import of our iron and hardware, and to trust to

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her means of supplying us with wine, brandy, and the other natural products of her country to an equal or greater amount.

Principles of commerce; how far understood abroad.

In point of knowledge of the great doctrines of political economy, Germany, or, to speak more properly, the Protestant part of Germany, particularly Saxony, may be said to take the lead of other countries on the Continent. The Dutch, however exemplary in their practical legislation, have little turn for speculative reasoning; the French have not patience to follow through its various links a chain of philosophical deductions; but their admiration of whatever is humane or liberal makes them wonderfully delighted with the brilliant conclusions of the science. They have the advantage of possessing, in the work of the late J. B. Say, the best arranged general treatise that has hitherto appeared on the subject; and they are by no means ill prepared for a very extensive application of political improvements, such as the abolition of privateering, the repeal of all heavy duties on foreign goods, and the substitution of inland taxes for those custom-house imposts which impede the free communication of nations. The rest of Europe is so much in the dark in regard to the great truths of political science as to see merely through the medium of local governments. Such is the case likewise in Italy, although that country can boast individuals of some note among the writers on the principles of commerce, and the reflecting turn of the people is favourable to such investigations; and even in Britain a large party is still adverse to the unrestricted application of these simple and beneficent principles, but this party is daily diminishing. The happy effects of the free-trade principles, which have been for some time in operation, as proved by the periodical returns of the Board of Trade, are facts which cannot be withstood; and we may safely calculate, that a few years will convert the remaining advocates of protection to the free-trade faith.

It is surprising that a people so quicksighted, and so keenly alive to their own interests, as the citizens of the United States of America, should cling so obstinately to the illiberal doctrines exploded in this country. If their national expenditure demanded a revenue which could only be raised with difficulty, there would be some apology for their laying on heavy import duties; but with a large surplus revenue there can be no good reason for laying on duties on imported goods merely to protect certain manufacturers, and so to interfere with the natural course of trade, and to enable these manufacturers to charge a higher price for their commodities than they could demand if the trade were left free; or, in other words, to enable a portion of the community to tax the great body of the citizens for their own benefit.

Having thus briefly stated the principles of free trade, we shall proceed to the practical topics which we proposed to discuss, beginning with the consideration of the average profit of capital employed in trade.

Limited profits of trade.

1. It was common during the war to estimate the emolument of a wholesale business in Britain, in a well established concern, at ten per cent. on the capital. Moderate calculators qualified this by calling it between eight and ten per cent.; but they who were at great pains to take everything into the account, and to enumerate a variety of petty deductions which escape the sanguine reckoner, found that, in a large concern, seven per cent. was in general the extent of the clear earnings, leaving only two per cent. above that which was the current rate of interest during the war.

Mercantile profits are subject to a variety of unforeseen deductions, originating partly in an accumulation of petty expenses; but more, at least in business of long credit, from deficient payments. The latter are technically called bad debts, and almost always exceed the anticipated amount, in consequence both of the sanguine temper of our countrymen, and of the actual capital of the buyers being much inferior to its appearance. Secrecy both as to capital and annual profit is considered as a first-rate point amongst mercantile men. To the latter there can be no objection; but the concealment of the amount of capital, and the almost invariable consequence, its exaggeration, are productive of very pernicious effects. It is founded partly on the general vanity, and more perhaps on an expectation of advantage from a command of credit. But were the practice of transacting with ready money to become general, a merchant would have no greater motive to be thought in affluence than an individual in any other line. But be this as it may, the fact is, that the clear profits of trade, whether home or foreign, whether mercantile or manufacturing, whether retail or wholesale, are greatly below what the world imagines. Many hold a contrary language with regard to trade in general; but few do so in respect to their own particular business. "Ours," say they, "is of limited emolument; but other lines are very different, inasmuch as they admit of speculation and of higher charges." Whoever takes the trouble to question men in almost any business or profession may reckon on receiving a succession of such answers; answers not suggested by a wish to deceive or to conceal the profits of the individual, but originating in the general disposition to take the *ignotum pro magnifico*.

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We have naturally a strong disposition to contemplate the past or the distant through a magnifying medium, and to believe whatever the confident assertions of others, or the love of wonder in ourselves, suggests with regard to reported wealth. Hence the allegations so confidently brought forward in regard to the riches of ancient cities, and the notion generally entertained with respect to the rapidity of fortune-making in our foreign settlements. India was long proverbial in this respect; and it requires much more than the usual stock of information to discover, that if we make allowance for deaths, and disappointments from various causes, the proportion of those who succeed in that country is not *greater than at home;* and that a fortune, when it does happen to be made, is the result of the length of time, of a habit of saving favoured by exemption from the expense of a family, of rare political contingencies, or, finally, of unusual opportunities consequent on the mortality of competitors.

The East Indies.

Another point in which delusion prevails, relates to the effects of war, particularly that of 1793; a war in which we still believe ourselves, and are believed by foreigners, to have engrossed and absorbed the commerce of the world. A reference, however, to official documents will show that the exports and imports of the most boasted years of the war in question were below those of the [illegible] years of suffering. The flag of our enemies was indeed expelled from the ocean, but the greater proportion of trade passed into the hands of neutrals; and when, in 1808, we took it out of their possession, we were taught, by dear-bought experience, that war, under any circumstances, is adverse to commerce.

These observations must be understood not as intended to depreciate the value of commerce, or to damp in the individual the hopes of eventual success. They show, indeed, that the *ratio* of profit is generally small, but they afford the consolatory assurance that mercantile concerns may be carried to a great extent, and that the amount of gain may, *in process of time*, be rendered very considerable. This leads us to advert to a matter of great interest to us as we now stand relatively to the rival countries of the Continent. It is a maxim, that commercial establishments, whether in the mercantile or manufacturing line, should be confined to a few objects, and conducted on a large scale. It is by this only that the task of individuals can be simplified, that employment can be subdivided, that work can be put quickly through hands, or that we can provide on the spot a supply of the various and indispensable requisites of

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business. A large establishment affords the means of employment to every kind of capacity; in fact, the duty is so facilitated as to become, in many cases, a mere routine; while the more intelligent and attentive workmen act as superintendents, the mass of the unambitious and unthinking are occupied with the detail. It is owing to this process of subdivision, and to the relative magnitude of the London workshops, that many articles can be supplied in our metropolis as cheaply as in the provincial towns, where labour is 40 per cent. lower. The same rule accounts for the charge on the transaction of business by merchants, accountants, attornies, notaries, and agents, being less heavy than might be apprehended from the greater expense of living in London. Similar results take place in regard to manufacture in such towns as Birmingham, Sheffield, Manchester, Leeds; and it is to this, more than to any other cause, that we owe our ability to compete with the cheaper labour of the Continent.

Speculation in trade.

2. This analysis of the profit of trade leads us to say a few words on a topic which has hitherto been very generally misunderstood, we mean the profits of speculation in trade. Among men of business this expression is applied to incurring extensive hazards in the hope of extensive emolument; in short, to whatever is foreign to the proper business of the individual, or beyond the control of common rules. It is to such undertakings that vulgar credulity ascribes extraordinary profits; and even well-informed men are apt to give way to the assertions so confidently made, of vast occasional gains in this line of business. Dr Smith himself, after remarking (*Wealth of Nations*, book i. chap. 10) that to make a fortune in a regular line commonly requires a long life of industry and frugality, adds, no doubt on the faith of repeated assurances from mercantile friends, that there are many examples of fortunes realized by speculators in the course of a few years. Now, the men who embark in speculation are, in general, very loose accountants; their estimate of profits applies to the gross, never to the net return; besides, they are almost always adventurers, and adventurers are seldom noted for the observance of truth. Their favourite season of activity is a time like that of 1808, when the sudden stoppage of ordinary intercourse caused a rapid fluctuation in the price of commodities, and when the regular merchants withdrew from the scene. Now, what sober estimate can be formed of loss or gain in such a chaos? Add to this, that these men trade almost always on credit, and are in need of all the support which flattering representations, and rumours of sudden profit, can give them. All these reasons seem to justify a deliberate inquirer in doing what is seldom done on such occasions, we mean in withholding his belief from the confident allegations of speculators, so long as they are not supported by collateral evidence.

Frequency of disappointment.

Our opinion is, that instead of the large profits commonly ascribed to this course of trade, the individuals concerned in it experience little else than disappointments, and maintain a perpetual struggle to keep up a fair appearance to the world. This opinion is founded partly on a knowledge of the actual career and circumstances of speculators, but more on the well-known fact, that almost every line of business is in the hands of established merchants, who, of course, are too vigilant to overlook the opportunity of emolument, and who have much better means of information than temporary interlopers. Still, should there remain doubts as to the accuracy of our opinion, the question may be brought to a point by reference to the account-books of any given number of celebrated speculators; their affairs end almost always in bankruptcy; their papers continue open to access for years in the hands of their solicitors or assignees; and we are much mistaken if an inspection of them would show in one case out of ten, that the parties had at any period succeeded in realizing their boasted profits.

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Pernicious effects of speculation.

We have been induced to dwell the more on the boasts of speculators, because they are productive of great mischief in unsettling persons in business, particularly young men, and in making them look on their proper line with comparative indifference. It would be endless to attempt an enumeration of the various ways in which the rage for speculation has brought misfortune on merchants and manufacturers. The opening of a new country, such as Buenos Ayres, Brazil, or Caraccas, led to the export not only of a prodigious overstock of merchandise fitted for the country, but of many articles totally unsuited to the climate and habits of the people. Again, in 1814, when the war with France was drawing to a close, goods, both colonial and manufactured, were poured into the Continent of Europe, as if the compass of the markets was unbounded, and as if the calamities of war had produced no decrease of disposable capital. In 1825, our speculations abroad were most unfortunate, while at home vast sums were lavished in buildings, in mines, in manufactories, and other establishments, which never had a fair prospect of success, and owed their origin to the sanguine imagination of one projector, and the credulity of another.

Holland, its instructive example.

The country in which trade shone forth in all its splendour, where it was cultivated without the support of arms or prohibitory regulations, where, in short, it developed its beneficial tendency in all its extent, was Holland. If we look to the early enterprises of the Dutch, we find them enabled, by the power of their productive industry, to assert their independence at home, and to assail their enemies in the remotest part of their empire. The Portuguese in the east, and the Spaniards in the west, were each found unequal to the task of resisting these republicans. A proud stand was made by them against the navy of England, and they did not fall into despair even when assailed by our forces in conjunction with those of France. Afterwards, when happily restored to our alliance, and when they cooperated with us in the great struggle against Louis XIV., it is surprising how large a proportion both of troops and subsidies was furnished by this apparently inconsiderable state. "No country," says Sir William Temple, "can be found where so vast a trade has been managed, yet the inhabitants have no native commodities towards building vessels, and hardly any that are considerable for traffic with their neighbours. Holland is grown rich by force of industry, by improvement and manufacture of foreign growths." Proceeding to specify more particularly the causes of this mercantile prosperity, Sir William enumerates "the easy communication of water, particularly by the Rhine and Maese; the security of property; the undisturbed liberty of conscience, and the progressive influx of people persecuted for their religious opinions in Flanders, England, France, and Germany." Such were the original causes: those of subsequent operation were the "general habit of industry and economy; the formation of canals; the institution of banks; the low interest of money; the appropriation of particular towns to particular branches of business; application to the fisheries, and, what he regrets much should not exist in England, the practice of keeping an official register of all purchases of land or houses;" a practice introduced into Holland and Flanders in the reign of Charles V., and which at present exists in Scotland, to the incalculable convenience and security of money transactions.

Effects of trade upon individuals.

3. We are now to say a few words on a different topic, namely, the effects of trade in forming the character of individuals; a matter of no little importance in a country like ours, where merchants both constitute so large a portion of the community, and exercise such influence on the proceedings of government. The mercantile character has a number of good points, being exempt from the vacuity and indecision so frequent in fashionable life, as well as from the various vices consequent on idleness, and which are so

exemplified in the gambling and libertinism of the French metropolis. Whatever good is produced by continued activity, and by a pointed attention to the specific objects of one's occupation, may be confidently looked for among commercial men; with the farther advantage, in large concerns, of an exemption from petty jealousies and invidious interferences. In such cities as London and Amsterdam, merchants are aware that the field is ample for all; that the prosperity of one is very far from impeding that of others; and that when disappointment and failure occur, their origin will be found in a very different cause than competition. Here, however, we must close our encomium, and, in the spirit of impartiality, proceed to exhibit the opposite side of the picture. The merchant's knowledge is particular, not general; he obtains a habit of understanding individual character, and a dexterity in managing his own affairs; but he has not, and cannot, from his course of occupation, acquire the power of reasoning comprehensively on the interests of trade. If he observe in war a tendency to raise prices, or to invigorate particular lines of trade, such as ship-owning or insurance, he will probably be led to the general inference, that to a maritime country war is advantageous. Our last contests having been attended with the undisputed command of the ocean, nothing more was required to satisfy the majority of traders that our mercantile marine was in a state of equal ascendency. They took *au pied de la lettre* the custom-house reports of our annual exports, without observing how much was to be deducted on account of the depreciation of our bank paper, or how surely we were laying the foundation of future distress, by submitting to enormous taxation. Again, when in 1807 the long continuance of war had given a serious wound to our trade and navigation, a majority of the merchants ascribed it, not to the true cause, but to the undermining competition of the Americans. Their range of reflection was not such as to enable them to perceive that, by overturning the prosperity of the latter, we should sap the foundation of our own; and that every million which we prevented our Transatlantic neighbours from adding to their capital, was so much withdrawn from a fund devoted to the increase of the productive industry of Britain. Hence our unfortunate orders in council, the main cause of the overthrow of our exchanges with the Continent, of the increase of our expenses in Spain and Germany, of our war with the United States, in short, of the long continuance of our sufferings since the peace.

Merchants unaccustomed to general views.

Open to erroneous impressions.

4. Nothing would, in our opinion, conduce more to the prosperity of trade than the adoption of the plan of doing all wholesale business for ready money, and the relinquishment of that habit of long credit which prompts to unguarded enterprise, and has for so many years been the principal cause of crowding the columns of our gazettes.

Bad effect of long credits;

To show the results of long credit, it is necessary to go at some length into practical illustration, and to apprise our readers of the real situation of the majority of our manufacturers and export merchants. A manufacturer on the present footing receives orders in the course of the year from twenty or thirty mercantile houses; the goods to be exported probably to the West Indies, the United States, the Spanish Main, or Brazil; the understood term of credit twelve months. The manufacturer does not receive the orders from abroad; he has an intermediate guarantee, that of the exporting merchant. Still the risk is considerable; but he naturally hopes for the best, and is unwilling to decline an order when it comes to him from a quarter of respectability. Now by mercantile respectability our readers are to understand integrity, and the intention of acting up to engagements; but the power of doing so, especially at a remote date, is a very different question, and is, in general, possessed in a much smaller degree than the public imagine. The trader whose capital is L.30 000 will not scruple to ship goods to the value of L 40,000, first in the hope, so general among merchants, of realizing a handsome profit, and next in the confidence that should the foreign market be dull, and should delays occur in obtaining returns within the given time, his credit will procure him indulgence for several months, at the end of which the expected remittances can hardly fail to arrive. He may, and in general does go on for several years without much embarrassment, receiving indeed less than he sends out, but informed that all has been well sold, and cannot fail to be soon realized. He thus goes on pleasing himself at every balance of his books with the seeming profit, and only regretting that hitherto that profit has not been tangible, since it exists in the shape of a debt due by his Transatlantic correspondents. He continues, however, under a favourable expectation of their making up for past deficiencies, and flatters himself that the delay has resulted from partial or temporary causes. He begins to find himself straitened for funds, but has as yet little difficulty in obtaining relief from a monied friend, or a prolonged credit from the manufacturers. His correspondents continue to write in a strain of confidence, and to call for more goods, which, if he be of a confiding character, will lead him to extend the annual amount of his shipments; but at all events he is obliged to continue a certain supply, for the sake of keeping up the assortment of stock. Still he finds that year after year a larger portion of his capital remains on the other side of the Atlantic, and that his correspondents, however desirous (for we by no means put an extreme case), are unable to prevent an accumulation of debt, because they are in like manner left unpaid by the inhabitants of the country. To go to law would be of no avail, since it is the policy of almost every government in a recently-settled country to favour the debtor, and to give him the means of retaining capital in his hands. Affairs now begin to be serious with the exporter; the manufacturers and other creditors cannot or will not give further time, and demand an explanation of his circumstances. This explanation takes place, and serves to show that their debtor is a man of honour, with more assets than debts, but the latter are certain, while the former are at a distance of 3000 miles. The consequence is a grant of time, an allowance to the debtor of two, three, or four years, to act under letter of license, in the hope of accomplishing that which, it is evident, cannot be performed sooner. This is, in general, both the wisest and most liberal course; still it is not often found to succeed, because the foreign debts can seldom be realized in climates where life is held by so uncertain a tenure, where respectable agents are so rarely found, where buyers of goods have so little capital, and, above all, where the law allows them such a length of time for payment. A few of the promised instalments are probably made good but in general the merchant recognises the impracticability of fulfilling the remainder, and finds it eventually necessary to submit to bankruptcy.

exemplified in our export business

In Holland, we find that in its better days, bargains were almost always made for ready money, or for so short a date as six weeks or two months; profits were small in their ratio, but the quickness of returns made them eventually large; failures were rare, even in so distressing an era as the occupation of their country by the French, which began in 1795, and involved, from the outset, a stoppage of maritime intercourse with all their possessions in India and America. The consequence of this stoppage was a decay of trade, a suspension of various undertakings, a scarcity of work, a miserable dulness in the sale of goods; all leading, in the first instance, to diminished income, and eventually to encroachment on capital; but, amidst this distress, the failures were surprisingly few, fewer indeed than occur in Britain in any ordinary season. Another example, equally replete with instruction, was the state of France after the double invasion of 1814 and 1815. There prevailed at

Holland a country of short credit.

that time a general discouragement among the upper ranks, and a great deal of wretchedness among the lower, trade being at a stand, and stocks of goods lying unsold in shops or warehouses for years; still bankruptcy was exceedingly rare. All this shows what a satisfactory prospect we may anticipate when we adopt the plan of transacting the greater part of our business for ready money.

Benefit from an abolition of the money laws.

Yet we are far from recommending any law or measure to enforce that object; the evident advantage of the plan will not fail to secure its adoption. One great obstacle which long stood in the way of the system of cash payments in mercantile transactions, arose from the impolitic laws which limited the interest on borrowed money to five per cent. The usury laws being now repealed, the money-holder may lend to the merchant at such a rate of interest as the state of the market entitles him to receive. Formerly, when the market rate of interest exceeded five per cent., the merchant could only borrow money for the purposes of his trade by resorting to some subterfuge, such as life policies, which had the effect of enhancing the interest to an extravagant rate.

III. COMMERCIAL FLUCTUATIONS IN THE PRESENT AGE; EVILS OF AN UNDUE EXPENDITURE BY GOVERNMENT.

The present age has been remarkable beyond all others for fluctuations in the state of trade, and in the value of property as represented in money. During the twenty years of war, from 1794 to 1814, there was a continued rise of prices; while a decline, almost equally great and long continued, has taken place since the peace. The public long flattered themselves that individual property in this country had received during the war an increase unexampled in our history; the visions inspired by high prices have disappeared, and the computation of our augmented wealth seems to have had no solid foundation.

The reaction in the money value of income and property has been productive of great embarrassment and distress. The causes of it are and have long been a subject of anxious consideration, but they have not as yet been satisfactorily explained. To this we shall devote the rest of this article, premising that the subject is rather intricate, and will call for the close attention of the reader.

The rise in the price of commodities in the late wars with France was steadily progressive, and reached eventually a great height. If we compute the degree of enhancement in provisions, wages, rents, and almost every thing except manufactures, we shall find it to have been at the close of the war sixty or seventy per cent. on the prices of 1792; in other words, in the year 1812, L.160 or L.170 were required to make the purchases which in 1792 might have been made for L.100.

This great advance is commonly ascribed to our bank paper, in particular to its increased issue and inconvertibility into cash in 1797. Admitting these to have been the main causes of the rise, it may be well to explain the mode in which they operated, and to endeavour to give a definite form to what is generally brought forward as vague allegation. This is a nice question, and will require a reference to our expenditure in former years.

It is now fully a century and a half since this country adopted the funding system, or the plan of carrying on war with borrowed money. The result was both a great increase of yearly expenditure, and a continuance of that increase for a number of years. That a state of war enhances the price of commodities is generally admitted; the point is, to define in what manner it produces that effect. It does so chiefly in three ways:

1. By increasing taxes.

2. By withdrawing capital from productive to unproductive purposes; from agriculture, manufactures, and trade, to the maintenance of fleets and armies. The manner of doing this is by public loans, and the result is a rise generally very considerable in the rate of interest.

3. By withdrawing several hundred thousand men from productive to unproductive employment; that is, from agriculture, manufactures, and the work of mechanics, to service in the army and navy, or to preparing arms, clothing, and the various naval and military stores required by government. The number of men thus withdrawn from productive employment in the late wars was on an average 600,000, or fifteen per cent. of our able-bodied population.

These causes of enhancement have operated powerfully in every war since the time of William III.; but in the military contests of the present age there were two additional causes of great importance, viz.

4. The repeated insufficiency of our crops, and the necessity of importing large quantities of corn.

5. The inconvertibility and eventual depreciation of our bank paper.

The effect of an insufficient crop in raising prices is easily understood; that of our bank paper requires some explanation. What then was the consequence of our bank paper becoming inconvertible, or no longer payable in cash? It was not so much an increase in the amount of our circulating medium, as a certainty of a continued supply. During the first years of the war, 1793, 1794, 1795, 1796, and the early part of 1797, our financial difficulties had been serious, and the expenditure of government had been repeatedly checked by remonstrances from the bank, founded on the state of foreign exchanges, and the drain, or apprehended drain, of gold from its coffers. But after the exemption of the bank from cash payments, there was an end of such apprehensions, and government possessed an uninterrupted command of money, because the checks on its supply were removed.

Again, the direct causes of rise of prices in war are increase of taxation, and the withdrawing of men and capital from productive employment. Now to these causes, which in former times were restricted both in their duration and extent, the exemption from paying bank paper in cash gave a scope almost unlimited. The uninterrupted supply of money consequent on the exemption was felt in every department; among agriculturists in the payment of rents, among merchants in the discount of bills, and in the community at large by a silent acquiescence in the rise of wages, salaries, and the price of commodities; a rise which the war rendered necessary, but which had been strongly resisted until 1797. Hence a power in the public of paying taxes and making loans to an unexampled amount. Facilities so many and so great went far to persuade the public that the successive additions to the sums of money paid for rents, wages, and the purchase of commodities, were proofs of increasing wealth. Few persons could perceive that this increase was, in a great measure, nominal; and still fewer could foresee the distressing extent of a reaction on the return of peace. Had our ministry been at all aware of that reaction, their scale of expenditure would have been very different.

Such were the causes of the rise of prices during the war; the fall has been almost as great since the peace, because circumstances have been altogether different. Government have needed less both of men and money, and have left both to be employed productively by the public. Many persons imagine that, had there been no such act as that of 1819, and had the exemption from cash payments been continued, prices would have been kept up, and the public would have been saved a great part of the distress that took place after 1819. In this, however, they go too far; their argument holds good only to a limited extent. During the war the exemption from cash payments had a most powerful effect on the prices; in peace its operation would have been temporary and partial, because the circumstances of

Commerce. the country were entirely altered. The causes of enhancement arising from war no longer existed; our men and capital were restored to productive employment; both served to augment our yearly supply of commodities, and consequently to furnish them at a cheaper rate. We were, besides, in open intercourse with the Continent, and in that case there is a continued tendency to a reduction of prices. Every year our markets felt the lowering effects of imports from countries less heavily burdened.

This was in a manner proved by experience. During no less than five years of peace, from 1814 to 1819, our bank notes were exempt from payment in cash, yet our prices progressively declined. All this shows that our prices would have decreased greatly after 1819, by the mere operation of peace, had there been no return to cash payments. It suggests also a consideration of considerable importance at the present moment, namely, that we ought to form a very moderate estimate of the effect that a return to small notes would produce on prices. That measure would tend to arrest the progress of distress, by preventing a further fall of prices; but it would be too much to expect that it could cause them to be reinstated, or to rise in any material degree.

It is a remarkable fact, that the difference in value between gold and bank paper was very slight for a length of time after the bank notes had ceased to be payable in cash. During no less than twelve years after 1797, the depreciation of our bank paper seldom reached five or six per cent., and that only at intervals when the import of foreign corn, as in 1801, or the payment of large subsidies, as in 1805, brought down our exchanges with the Continent. At last, in 1809, the fall of the exchanges, and the depreciation of bank notes, became very serious, and continued to be so during the remainder of the war. The causes were, the expense of the war in Portugal and Spain, which could not be defrayed by bills or bank notes, but required a great deal of coin; and the stoppage, by our orders in council, of the trade of America with the Continent of Europe, and of the large remittances to England arising from that trade.

These facts ought to be carefully considered, for they enable us to make a distinction of great importance in regard to bank paper when not convertible into cash. Irregular as such paper is, it may, when issued by so respectable an establishment as the Bank of England, and received and circulated freely for the purposes of sound money, such as paying taxes, making purchases, and discharging debts, maintain the value of coin for many years. It falls only when large sums are required abroad, and the payment of them must of course take place in gold and silver. It was thus that our bank paper, after so long maintaining its value, fell so suddenly and to so great an extent after 1809. From that time forward it proved a most unprofitable mode of paying on the Continent; while in this country it continued to circulate without any perceptible loss.

This difference in the local value of our notes, their depreciation abroad while their value was maintained at home, was long unperceived by the public. The want of this distinction accounts for a great part of the contradiction that prevailed on the bullion question. Of the various witnesses examined before the committee in 1810, a number insisted positively, and without qualification, that our bank paper was depreciated, and an equal number that it was not. The writers of the report maintained the former, and alleged that the depreciation arose from over-issue; but they were wholly unable to reconcile their opinion with facts, for it was contradicted by the official returns from the bank, which showed that there was no necesary connection between the amount of the notes in circulation and the degree of their depreciation. What was the result of this singular discrepancy? Each opinion had its advocates, and perhaps in equal number, until 1814, when, on the return of Bonaparte from Elba, an apprehension by the public of immediate war caused our exchanges with the Continent, and consequently our bank notes, compared with specie, to fall ten per cent. in one week. A few months afterwards, on the close of the war, the exchanges and bank paper were promptly reinstated, and all without altering the quantity of notes in circulation; for it had neither been increased at the time their value fell, nor contracted when it recovered. Commerce.

These remarkable facts were observed by the late Mr Horner, and led his candid mind to review its former impressions. He then felt that in the bullion report he had carried too far the charge of over-issue by the bank, and made an admission to that effect before his death to Mr William Blake, the author of two very able pamphlets on subjects connected with the currency.

It appears, therefore, that the depreciation of our bank paper, compared to coin, though eventually great, was local and temporary. It applied strongly to foreign parts, but at home its effect was far from being general, and affected chiefly the articles which we were in the habit of importing from the Continent. Of these, corn was by far the most important. It happened unfortunately that the crops of 1809 and 1811 were both deficient, and that large imports were indispensable: hence a rise in our corn markets to a degree which would certainly not have taken place had not our currency been greatly depreciated on the Continent.

We are thus enabled to perceive the great defect in the report of the bullion committee in 1810; a defect which was productive of very general perplexity. It consisted in making no distinction between two things which were very different; the rise of prices in consequence of the war, and the rise from the depreciation of our bank paper. The bullion report implied a belief that the two were coincident in point both of time and amount; whereas with regard to time, the rise of prices from the war had begun in 1795, before our bank paper could be depreciated; and as to amount, it (the rise of prices) had reached the height of thirty or forty per cent., compared to the prices of 1792, at a time (1805, 1806) when the inferiority of our paper to coin was not above five or six per cent. In short, the rise of prices began soon after the war, and lasted twenty years without intermission; whilst the depreciation of our bank notes was slight and temporary until 1809, and prevailed to a serious extent during little more than five or six years.

Enough has now been stated to show the importance of studying the principles of trade, leading as they do to conclusions very different from those of the multitude. How few men would have believed, half a century ago, that after the separation of the North American colonies our trade with them would be greater than ever! How few would formerly have believed that, of the French public, described as so eager for war, nine persons in ten are anxious for peace; regarding war, at least war with England, as the greatest misfortune that could befal their country! Equally unprepared were many persons to believe that, amidst all the distress of late years, amidst the general fall of prices, and the decline of wages, salaries, and incomes, the real wealth of this country, and the yearly amount of our manufacturing and agricultural produce, have been steadily on the increase. Such are a few of the results of the study of the principles of commerce; results sufficiently gratifying to repay that anxious investigation, that long-continued and pains-taking research, which are indispensable to place our conclusions on a sure basis. (J. L—E.) Conclusion.

Commercy || Commission.

COMMERCY, a town of France, capital of a cognominal arrondissement in the department of Meuse, on the left bank of the river of that name, 20 miles east of Bar-le-Duc. Pop. (1851) of town, 3735; of arrondissement, 87,664.

COMMEWINA, a river of Guiana, in South America, which rises in the mountains in the interior, and falls into the Surinam, about ten miles from its mouth. It is from two to four miles in breadth, but so shallow, and so full of quicksands, small islands, and rocks, that its navigation is very difficult. On its banks are some fine plantations of coffee and sugar.

COMMINATION (Lat. *comminatio*), a denunciation of ill; a threatening of punishment or vengeance. In the liturgy of the Church of England, an office appointed to be read on the first day of Lent, or Ash-Wednesday. It is substituted in the room of that *godly discipline in the primitive church*, by which, as the introduction to the office expresses it, "such persons as stood convicted of notorious sins were put to penance, and punished in this world, that their souls might be saved in the day of the Lord; and that others, admonished by their example, might be the more afraid to offend." This discipline, in after ages, degenerated in the Church of Rome into a formal confession of sins upon Ash-Wednesday, and the empty ceremony of sprinkling ashes upon the heads of the people. But our reformers rejected the ceremony as mere show and shadow, and substituted in its room this office, which is entitled "*A Commination or Denouncing of God's anger and judgment against sinners.*"

COMMINUTION (Lat. *comminuere*, to reduce into small parts), the crushing, or rather grinding a body into minute particles.

COMMIRE, JOHN, a learned French Jesuit, born at Ambois in 1625; died in 1702 at Paris, where he taught rhetoric and divinity. He wrote odes and fables in Latin, and also paraphrased the psalms and prophets.

COMMISSARY (one to whom any thing is committed), in the ecclesiastical law, an officer of the bishop, who exercises spiritual jurisdiction in places of a diocese so far from the episcopal see that the chancellor cannot call the people to the bishop's principal consistory court without putting them to inconvenience.

Commissary Court, in Scotland, a court originally constituted by the bishops, and anciently called the *bishop's court, curia Christianitatis*, or *consistorial court*. This court was regulated by Queen Mary at the Reformation, and continued in a certain modified form as a separate tribunal until a recent period, when the power and jurisdiction was transferred to the Court of Session. See SCOTLAND.

COMMISSION—COMMISSIONER. The word commission, from one of the many meanings of the Latin *committo*, whence it is derived, has been extensively used to express the imparting of power and authority by a superior to an inferior. The terms are used for a great variety of functionaries both in this and in other countries; and while the prime minister of Britain is generally the first commissioner of the treasury, the person whose duty it is to carry the messages for the guests at a French inn is called the commissionaire. In its older use in Britain it was generally restricted to authority proceeding directly from the Crown. In many late instances, however, persons employed by the secretary of state or any other minister to conduct investigations for the public service have been called commissioners, and more lately the term has been applied to persons employed to make special inquiries into local abuses or other matters of interest by the publishers of newspapers. In the army the old distinction is still preserved, those who from the rank of ensign upwards receive their authority to command under the sign-manual being called commissioned officers, while serjeants and corporals are called non-commissioned. There are some great offices of state which it has lately been the practice to supersede by commissions. The lord high treasurer, and the lord high admiral, whose authority was exercised by mere investment with the insignia of office, have been superseded by commissions, the head of each department being called the first lord commissioner. The great seal is sometimes placed in commission. An account of the various commissions in Great Britain would be an account of the greater part of the official administration of the country. Many of them are judicial, as the commissioners of oyer and terminer in England, the commission of teinds in Scotland, and the various commissions of the peace. Others are purely administrative, such as the poor-law commission, the board of health, and the revenue boards. Some commissioners are especially appointed by statute, as the commission of supply in Scotland; while others are elected by certain constituencies acting under statutory authority, as, for instance, police and improvement commissioners. The permanent commissions are generally of immemorial constitutional existence, or have been created by statute. Sometimes commissions of inquiry have been issued by the sovereign on a parliamentary address, or without this preliminary. It is usual in such commissions to impart authority for summoning and examining witnesses. From the general spirit of co-operation in all useful public inquiries, such powers have seldom been disputed, and in general those appointed to make inquiries under mere ministerial instruction have seldom felt any difficulty in obtaining testimony. When, however, the royal commission for inquiry into municipal corporations in England was issued, the London companies conceived themselves sufficiently powerful to resist investigation.

Commission.

The Merchant Tailors' Company, in November 1833, expressing their readiness to disclose their affairs to any competent tribunal, passed, among other resolutions, one to the effect "that this court being satisfied that any information given by their authority to the municipal corporation commissioners would be purely voluntary, feel that they cannot, consistently with the ancient and lawful oath taken by each individual on his admission to the court of assistants, disclose any matter which in their knowledge or judgment was not intended to be published." They were backed by an elaborate opinion from Sir James Scarlett (afterwards Lord Abinger), Mr Follet, and Mr Rennell. Sir James said, "I am of opinion that the Crown cannot by virtue of the prerogative alone compel any subject to make communications or disclosures upon oath or otherwise, except in a due course of the administration of justice. The Crown may issue a commission to hear and determine offences against the law; and in cases where the Crown is visitor of ecclesiastical corporations or hospitals, it may visit by special commissioners as well as by the chancellor. But even then the visitorial power must be called into action like any other judicial power by the complaint of some party grieved, to whom the ordinary means of redress have been refused, or by way of appeal from some domestic forum which has exercised its judgment upon a specific complaint. But I apprehend that a roving commission to inquire for grievances and to compel answers, even in cases where the Crown can visit by commissioners, much more in cases where it cannot, is clearly contrary to law." (J. H. B.)

Commission of Bankrupt. See BANKRUPTCY.

COMMISSION, in *Commerce*. See COMMERCE.

Commission of Lunacy issues out of the court of chancery, in order to try whether a person represented to be a lunatic be so or not. See MENTAL DISEASES.

Commission, Military, the warrant authorizing the holder to exercise the functions of his office in military affairs.

In the British army, as well as in the navy, all the commissions of officers are signed by the sovereign. The original commission, and each step in promotion, may either

Commission.

be acquired by purchase, according to the rules of the service; or the appointment and promotion may be made without purchase by the commander-in-chief; but the commissions in the navy, the artillery, the engineers, and the marines, are conferred by the ministry without purchase. Cadets who have completed a course of military education at Sandhurst are likewise appointed without purchase.

Prices of Commissions.

Rank.	Full price of Commissions	Difference in value between in succession.	Difference in
Life Guards.	L.	L. s.	L. s. d.
Lieutenant-Colonel	7250	1900 0	...
Major	5350	1850 0	...
Captain	3500	1715 0	...
Lieutenant	1785	525 0	...
Cornet	1260	.	...
Royal Regiment of Horse Guards.			
Lieutenant-Colonel	7250	1900 0	...
Major	5350	1850 0	...
Captain	3500	1900 0	...
Lieutenant	1600	400 0	...
Cornet	1200	...	...
Dragoon Guards and Dragoons.			
Lieutenant-Colonel	6175	1600 0	1533 0 0
Major	4575	1350 0	1352 0 0
Captain	3225	2035 0	1034 3 4
Lieutenant	1190	350 0	632 13 4
Cornet	840	...	300 0 0
Foot Guards.			
Lieutenant-Colonel	9000	700 0	...
Major, with rank of Colonel	8300	3500 0	...
Captain, „ Lieut.-Col.	4800	2750 0	...
Lieutenant, „ Captain	2050	850 0	...
Ensign, „ Lieutenant	1200	...	...
Regiments of the Line.			
Lieutenant-Colonel	4500	1300 0	1314 0 0
Major	3200	1400 0	949 0 0
Captain	1800	1100 0	511 0 0
Lieutenant	700	250 0	365 0 0
Ensign	450	...	150 0 0
Fusilier and Rifle Regiments.			
1st Lieutenant	700	200 0	365 0 0
2d Lieutenant	500	...	200 0 0

The commissioned officers of a battalion of infantry are as follows:—colonel, lieutenant-colonel, and major, who are called field-officers; captain, lieutenant, and ensign, who are called regimental officers; and chaplain, adjutant, quartermaster, and surgeon, who are called staff-officers.

Rate of Annual Pay of Officers.

Rank of Officer (Colonel).	First Dragoon Guards.	Other Regiments of Cavalry	Regular Infantry.
	L.	L.	L.
If appointed before 1st March 1834		1000	600
If appointed after that day	1000	900	500

The regiments of guards have not only higher pay and greater sums allowed for clothing than the other regiments, but the officers take precedence of officers of other corps. The ensigns in the guards take rank as lieutenants, lieutenants as captains, and captains as lieutenant-colonels.

Until lately, colonels of cavalry and infantry, besides their regular pay, derived a considerable addition to their emoluments from the off-reckonings of the clothing allowance. But now (1855) government are issuing the clothing of soldiers in kind, and allow a compensation of from L.450 to L.1000 per annum to the colonels, according to the strength of the various regiments, for this retrenchment of their emoluments.

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Rates of Daily Pay of Officers.

Rank of Officer.	Dragoon Guards and Dragoons.	Infantry of the Line	Staff Corps.
	L. s. d.	L. s. d.	L. s. d.
Lieutenant-Colonel	1 3 0	0 17 0	. .
Major	0 19 3	0 16 0	..
Captain	0 14 7	0 11 7	0 15 0
Do. having higher rank by brevet		0 13 7	...
Lieutenant	0 9 0	0 6 6	0 9 0
Do. after 7 years' service as a Lieutenant	...	0 7 6	...
Cornet	0 8 0	...	. .
Ensign	.	0 5 3	. .
Paymaster	0 12 6	0 12 6	...
Do. after 5 years' service in that rank on full pay	0 15 0	0 15 0	...
Do. after 15 years	0 17 6	0 17 6	...
Do. after 20 years (or 25 on full pay as a commissioned officer, including not less than 15 as a Paymaster)	1 0 0	1 0 0	...
Adjutant (in addition to the pay of Subaltern)	0 2 6	0 3 3	...
Surgeon	0 13 0	0 13 0	
Do. after 10 years' service on full pay in the army as medical officer	0 15 0	0 15 0	.
Do. after 20 years	0 19 0	0 19 0	...
Do. after 25 years	1 2 0	1 2 0	...
Assistant-Surgeon	0 8 6	0 7 6	...
Do. after 10 years' service	0 11 0	0 10 0	...
Veterinary Surgeon	0 8 0	...	...
Do. after 3 years' service as a medical officer on full pay	0 10 0	...	...
Do. after 10 years' service	0 12 0	. .	. .
Do. after 20 years' service	0 15 0	...	...
Quarter Master	0 8 6	0 6 6	0 6 6
Do. after 10 years' service	0 10 6	0 8 6	0 8 6
Do. after 15 years' service	0 12 0	0 10 0	0 10 0

A military commission was in 1854 appointed by her Majesty to report upon the several modes of promotion in the army; and the result of their deliberations has been, that promotion is in future to be bestowed on account of merit, and not altogether from seniority. This principle, which was to a certain extent a concession to the popular demands, is calculated more than anything else to raise the character of the service, and to put the British army on the same footing with regard to the people as the armies of continental Europe stand to the nations to which they respectively belong. It will, however, only obtain gradually, by the alternate promotion of senior colonels on the list with those promoted from distinguished service, until the existing establishment is reduced to 234 general officers, of whom 50 shall be generals, 70 lieutenant-generals, and 114 major-generals. We understand also that the rank of field-marshal is to be given without reference to seniority, and that periodical brevets are to be discontinued.

Commissioned officers, who have served certain periods, receive when reduced, or off duty, certain sums denominated half-pay. All officers placed upon half-pay during the late war, or reduced upon the formation of a peace establishment, or compelled for the public convenience to retire upon half-pay, or in consequence of ill health, are entitled to what is called the *new* half-pay.

Commission.

Table of Rates of Half-Pay.

Rank of Officer.	Cavalry. New Rate	Cavalry. Old Rate	Infantry. New	Infantry. Old.
	s. d	s. d.	s. d.	s. d.
Colonel (per day)	15 6	13 0	14 6	12 0
Lieutenant-Colonel	12 6	10 0	11 0	8 6
Major	10 0	8 0	9 6	7 6
Captain	7 6	5 6	7 0	5 0
Do. of infantry, having superior brevet rank, and having served 2 years as captain immediately before retirement	...	...	8 0	...
Do. of cavalry, with brevet rank, exchanging to half-pay, after 2 years' full pay service, with a captain of infantry	...	...	7 6	...
Lieutenant	4 8	3 0	4 0	2 4
Do. of infantry, if commissioned 7 years as a lieutenant in the army previous to retirement	...	...	4 6	...
Do. of cavalry, of 5 years' standing, if entitled to reckon 2 years for the battle of Waterloo	5 2	...	...	...
Cornet	3 6	2 6	...	..
Second Lieutenant and Ensign	...	...	3 0	1 10
Adjutant, if not commissioned as Lieutenant	4 0	4 0	4 0	4 0

The number of officers receiving half-pay in 1846–47 was 3722, and the sum awarded to them L.429,786; while in 1853–4 the number was 2920, at a charge of L.358,000, and in 1854–5 the number was 2853 at a charge of L.356,000. Besides this, above L.100,000 is annually voted for compassionate allowances, and gratuities to the families and relatives of deceased officers in distressed circumstances, and to officers who have sustained bodily injury in the service. Commission.

Medical officers, if placed on half-pay by reduction of establishment, are allowed the following rates:—

Rank of Medical Officer.	After a service on full full pay of: 30 years.	25 but under 30.	20 but under 25.	10 but under 20.	Less than 10.
	L. s. d	L. s. d	L. s. d.	s. d.	s. d.
Inspect. Gen. Hosp	1 10 0	1 5 0	1 0 0	..	...
Deputy Inspect. do.	1 0 0	0 17 0	0 14 0	10 6	8 0
Staff surgeon	0 17 0	0 15 0	0 12 6	10 0	7 6
Regt surg. & staff surg. 2d class	0 15 0	0 13 0	0 11 0	8 6	6 0
Assistant surgeon	0 7 6	0 7 0	0 6 0	5 0	4 0

Medical officers, placed on half-pay from any other cause than reduction, are allowed the following rates:—

Rank of Medical Officer.	After a service on full pay of: 30 years.	25 but under 30.	20 but under 25.	10 but under 20.	Less than 10.
	L. s. d.	L. s. d.	L. s. d.	s. d.	s. d.
Inspect. Gen Hosp.	1 0 0	0 15 0	0 12 0	...	...
Deputy Inspec. do.	0 18 0	0 14 0	0 10 0	8 0	7 0
Staff Surgeon	0 17 0	0 13 0	0 9 6	7 6	6 6
Regt. surg. & staff surg. 2d class	0 15 0	0 11 6	0 8 0	6 0	5 6
Assistant surgeon	0 7 0	0 6 0	0 5 0	4 0	3 0

The following is a list of pensions to widows:—

Pensions to Widows, &c., and Compassionate Allowance to the Children of General, Regimental, Medical Staff, and Garrison Officers.

Rank of the Officers.	Widows' Pension.	Special Pensions in cases of Officers killed in Action. To the Widow in lieu of the Ordinary Pension	To the Mothers or Sisters.	Compassionate Allowances to Legitimate Children. If the Officer was killed in Action.	If the Officer was not killed in Action.	Agg. amount of Allow. to the Family of any 1 Officer not to exceed. If killed in Action.	If not killed in Action.
General Officers	L.120	According to the circumstances of the case.	L.120	L.25 to L.40 each per annum.	L.16 to L.20 each per annum.	L.500	L.300
Regimental Officers.							
Colonels, not General Officers	90	L.200	90	18 to 25	14 to 16	350	Not exceeding the Annual Amount of the Half-Pay attached to the Rank of the Officer.
Lieut.-Colonels of Foot Guards							
Majors of Foot Guards							
Lieutenant-Colonels	80	200	80				
Majors	70	120	70	16 — 20	12 — 14	250	
Captains, Paymasters	50	70	50	12 — 16	9 — 12	150	
Lieutenants, Adjutants	40	60	40	8 — 14	5 — 10	100	
2d Lieutenants, Cornets, Ensigns, Quarter-Masters	36	46	36	8 — 14	5 — 10	80	
Regimental Chaplains married prior to 1796, and in the receipt of the reduced Allowance of 4s. a day at the time of their Deaths	30	...	...	... — ...	5 — 10	...	
Veterinary Surgeons	30	40	30	8 — 14	5 — 10	65	
Veterinary Surgeon dying subsequently to 7th October 1846	40	50	40	8 — 14	5 — 10	80	
Medical Officers.[1]							
Inspectors-General of Hospitals	80	200	80	16 — 20	12 — 14	350	
Deputy-Inspector-General of Hospitals	60	90	60	12 — 16	9 — 12	200	
Assistant-Inspectors of Hospitals	50	70	50	12 — 16	9 — 12	150	
Surgeon Majors of Foot-Guards							
Staff Surgeons, 1st Class							
Staff Surgeons, 2d Class	45	55	45	12 — ...	9 — 12	125	
Regimental Surgeons							
Purveyors							
Assistant Surgeons	40	50	40	8 — 14	5 — 10	100	
Deputy Purveyors	30	40	30	8 — 14	5 — 10	65	

[1] The widows of half-pay medical officers holding any commission, giving a rank not included in the above scale, if eligible, have the rates of pension specified in the scale annexed to the warrant of 13th June 1826.

The pension allowed to the widows of staff and garrison officers, such as chaplains to the forces, district paymasters, and the provost-marshal commissioned as such, is L.50. The children of these officers, if killed in action, are allowed pensions varying from L.9 to L.12. Other staff or garrison officers according to their regimental commissions when placed on half-pay.

Number of Commissioned officers in the Army on the 25th of January in the years

	1829.	1835	1840	1847.
Royal Horse Guards and Life Guards	104	99	96	96
Foot Guards	221	218	220	218
Cavalry	545	525	493	494
Infantry	3325	3297	3226	3210
	4195	4139	4035	4018
REGIMENTS IN INDIA.				
Cavalry, including recruiting companies	188	188	236	236
Infantry, including recruiting companies	1121	1020	1122	1352
Colonial Corps	185	266	316	467
	5689	5613	5709	6073
Add supernumerary officers, to fall into vacancies as they occur—				
In the Royal Horse Guards	2	2	1	0
Foot Guards	19	21	21	22
	5710	5636	5731	6095

COMMISSION of Teinds, a court at Edinburgh, instituted in room of a committee of the Scottish parliament, for erecting new parishes, and valuing teinds for the support of the clergy. It is vested in the Lords of Session. See SCOTLAND.

COMMISSURE (Lat. *commissura*, a joining together), a joint or seam; the place where two bodies or parts of a body meet and unite, as the bones of the skull; an interstice between particles or parts, as between plates or lamellæ.

COMMITMENT, in criminal law, is the sending to prison a person who has been guilty of any crime, or charged with any offence. This takes place where the offence is not bailable, or the party cannot find bail. It must be done by proper warrant, containing the cause of the commitment; and it continues till put an end to by the course of law, imprisonment being intended only for safe custody, and not for punishment.

COMMITTEE, one or more persons to whom any matter or business is referred, either by some court, or by consent of parties whom it concerns.

COMMODORE, a general officer in the British marine, invested with the command of a detachment of ships of war destined on any particular enterprise, during which time he bears the rank of brigadier-general in the army, and his ship is distinguished from the rest of his squadron by a broad red pendant tapering towards the outer end, and sometimes forked. The word is corrupted from the Spanish *comendador*, which signifies both the superior of a monastery, and a knight who holds a commandery.

COMMODORE is also a name given to the convoy or leading ship in a fleet of merchantmen, which carries a light in her top to guide the other ships. See CONVOY.

COMMODUS, L. AURELIUS, emperor of Rome from A.D. 180 to 192, was the son of M. Aurelius and the younger Faustina, and was born at Lanuvium A.D. 161. At an early period he was provided by his guardians with the best teachers that the most enticing offers could allure to Rome, and under their care his progress in every branch of philosophy and the sciences was such as to buoy up his friends with the brightest prospects of happiness and prosperity as soon as the time should come for him to assume the purple. Before he reached manhood, titles and honours were lavished on him by his countrymen and the senate, which his conduct till that time amply warranted. On the death of his father, whom he accompanied in his German wars, he concluded a peace with the barbarians, and hastened to the capital, where he was warmly received by the senate and people, and where he began his reign under the most favourable auspices. His lavish expenditure of the public money first awakened the suspicions of his subjects, but did not materially shake their confidence in the new emperor, till a conspiracy formed against him by his sister roused the dormant blood-thirstiness and ferocity of his nature, and urged him to excesses of cruelty unparalleled even in Roman history. His cruelty was only equalled by his sensuality, in the gratification of which he lavished the resources of the empire. In his thirst for public applause he did not scruple to exhibit himself in the arena as a charioteer, a dancer, or a buffoon, and especially delighted to display his skill as a gladiator, in which character he fought publicly seven hundred times, and slew many thousands of wild beasts in the circus. When the people at length grew tired of his atrocities, many plots were formed against his life, which, however, he always contrived to elude, till, in A.D. 192, he was slain by his mistress Marcia, with the assistance of a celebrated athlete, by name Narcissus. See ROMAN HISTORY.

COMMON (Lat. *communis*), belonging equally to more than one, or to many indefinitely. Also usual, ordinary, &c.

COMMON, *in Grammar*, is applied to the gender of such nouns as are both masculine and feminine; as *parens*, a parent.

COMMON Divisor, a quantity or number which divides two or more other quantities or numbers without a remainder.

COMMON, *Communia* (*quod ad omnes pertinet*), in law, signifies that soil, the use of which is common to a particular town or lordship; or it is a profit that a man has in the land of another person, usually in common with others; or a right which a person has to put his cattle to pasture in ground that is not his own. And there is not only common of pasture, but also common of piscary, common of estovers, common of turbary, &c. In all cases of common, the law respects the custom of the place; for the rule is, *consuetudo loci est observanda*.

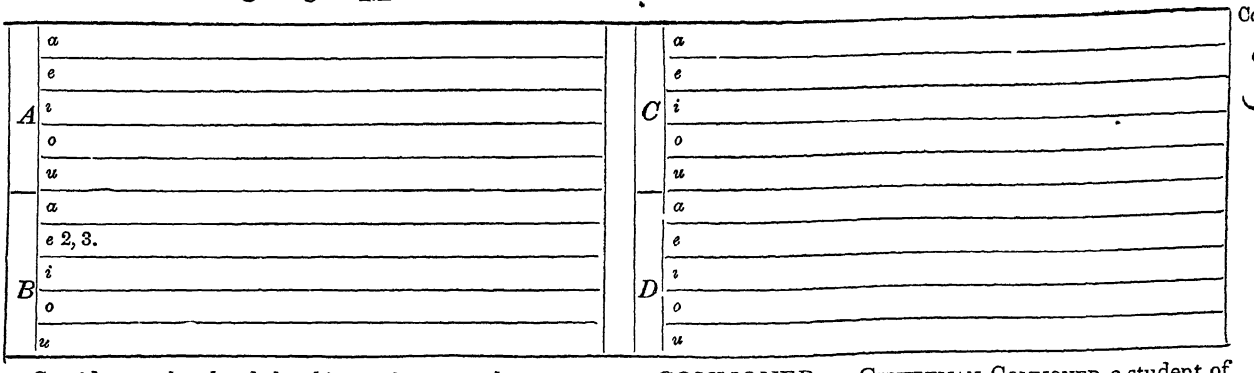
COMMON-Place Book, a book in which things to be remembered are recorded, and arranged under general heads. The advantages of a common-place book are manifold. It not only makes a man read with accuracy and attention, but induces him insensibly to think for himself, provided he considers it not so much a register of sentiments which strike him in the course of reading, as a register of his own thoughts upon various subjects. Many valuable thoughts occur even to men of no extraordinary genius; but these, without the assistance of a common-place book, are generally lost both to himself and others. There are various methods of arranging common-place books: that of Mr Locke is as good as any that has hitherto been contrived.

The first page of the book serves as a kind of index to the whole, and contains references to every place or matter in it; and in the convenient arrangement of this index, so as to admit of a sufficient variety of materials without any confusion, the whole method consists.

In order to this, the first page, as already mentioned, or, for more room, the first two pages that front each other, are to be divided by parallel lines into twenty-five equal parts, of which every fifth line is to be distinguished by its colour or other circumstance. These lines are to be cut perpendicularly by others, drawn from top to bottom; and in the several spaces the several letters of the alphabet, both capital and minuscular, are to be written.

The form of the lines and divisions, both horizontal and perpendicular, with the manner of writing the letters therein, will be conceived from the following specimen; in which, what is to be done in the book for all the letters of the alphabet is here shown in the first four, *A, B, C, D*.

Common Pleas || Commonalty.



Commoner || Communion.

Consider to what head the thing to be entered may most naturally be referred, and under which one would be led to look for such a thing: in this head or word regard is had to the initial letter, and the first vowel that follows it, which are the characteristic letters on which all the use of the index depends.

Suppose, for instance, we would enter down a passage that refers to the head *beauty*. *B* is the initial letter, and *e* the first vowel; then looking upon the index for the partition *B*, and the line *e*, which is the place for all words whose first letter is *b*, and the first vowel *e*, as *beauty*, *beneficence*, *bread*, *breeding*, *blemishes*, and finding no numbers already down to direct us to any page of the book where words of this characteristic have been entered, we turn forward to the first blank page we find, which, in a fresh book, as this is supposed to be, will be page second, and there write what we have occasion for on the head *beauty*; beginning the head in the margin, and indenting all the other subservient lines, that the head may stand out and show itself. This done, we enter the page in which it is written, viz., 2, in the index in the space *B e*; from which time the class *b e* becomes wholly in possession of the second and third pages, which are consigned to letters of this characteristic.

Had we found any page or number already entered in the space *B e*, we must have turned to the page, and have written our matter in whatever space was left therein. Thus, if after entering the passage on beauty, we should have occasion for *benevolence*, or the like, finding the number 2 already possessed of the space of this characteristic, we would begin the passage on benevolence in the remainder of the page; but this not containing the whole, we would carry it on to page third, which is also for *b e*, and add the number 3 in the index.

Common Pleas is one of the queen's courts, now held constantly in Westminster Hall; but in former times it was moveable.

All civil causes, as well real as personal, are or were formerly tried in this court, according to the strict law of the land. In personal and mixed actions it has a concurrent jurisdiction with the king's bench, but has no cognizance of the pleas of the Crown. The actions belonging to the court of common pleas come thither by original, as arrests and outlawries; or by privilege, or attachment for or against privileged persons; or out of inferior courts, not of record, by *pone*, *recordari*, *accedas ad curiam*, writ of false judgment, and so forth. The chief judge of this court, called *lord chief justice of the common pleas*, is assisted by three other judges, called puisne judges.

Common *Prayer*. See Liturgy.

COMMONALTY, the lower of the two divisions of the civil state. See Civil State. The commonalty, like the nobility, are divided into several degrees; but although some commoners are greatly superior to others, all in law are commonalty in respect of their want of nobility. These several degrees are noticed under their respective heads.

COMMONER, or Gentleman Commoner, a student of the second rank in the universities of Oxford and Cambridge.

COMMONS, House of. See Parliament.

COMMONTY, in *Scotch Law*, sometimes signifies lands belonging to two or more common proprietors; sometimes a heath or muir, though it should belong in property to one, if there has been a promiscuous possession of it by means of pasturage; and the act 1695 mentions commonties belonging in property to the king and to royal burghs.

COMMONWEALTH. See Republic and Britain, vol. v., p. 412.

COMMOTE, an ancient term in Wales, denoting half a cantred, or hundred, containing fifty villages. Wales was anciently divided into three provinces, each of which was subdivided into cantreds, and every cantred into two commotes or hundreds. Giraldus, however, in his *Itinerary*, says that a commote is but a quarter of a hundred.

COMMUNE, the name given in France to a subordinate territorial division of the country, which in area may be considered as corresponding to the English parish. In other respects, however, they differ considerably—the commune being a division for civil and military purposes, and governed by a mayor, with one or more assistants and a certain number of councillors. Also, that our larger cities and towns comprehend several parishes, whereas those of France, with the exception of Paris, constitute only one commune.

COMMUNIS, the name of a class in Linnæus's *Methodus Calycina*, consisting of two plants which, like teazel and dandelion, have a calyx or flower-cup common to many flowers or florets. These are the aggregate or compound flowers of other systems.

COMMUNIBUS Locis, a Latin term, in frequent use among philosophical and other writers, implying some medium or mean relation between several places. Dr Keil supposes the ocean to be one-quarter of a mile deep, *communibus locis*, that is, at a medium, or taking one place with another.

Communibus Annis has the same import with regard to years that *communibus locis* has with regard to places.

COMMUNICATING, in *Theology*, the act of receiving the sacrament of the eucharist. Those of the Reformed and of the Greek Churches communicate under both kinds; those of the Roman Catholic Church under only one. The oriental communicants receive the wine by a spoon; and anciently they sucked it through a pipe, as observed in Rheanus upon Tertullian. See Supper of the Lord.

COMMUNICATION, in a general sense, the act of imparting something to another. It is also used for the connection of one thing with another, or the passage from one place to another.

COMMUNION (Lat. *communio*, mutual participation), in matters of religion, the being united in doctrine and discipline; in which sense different churches are said to hold communion with each other. In the primitive Christian church, every bishop was obliged, after his ordination, to send circular letters to foreign churches, to signify that he was in communion with them.

Communion ‖ Communism.

COMMUNION is also used for the act of communicating at the sacrament of the eucharist, or the Lord's supper.

The fourth council of Lateran decrees that believers shall at least receive the communion at Easter, which seems to import a tacit desire that they should do it oftener; as, in fact, they did in the primitive days. Gratian and the master of the sentences prescribe it as a rule for the laity to communicate three times a-year, at Easter, at Whitsuntide, and at Christmas. But in the thirteenth century the practice was adopted never to approach the eucharist except at Easter; and the council thought fit to enjoin it by a law, lest coldness and remissness should go farther still. The council of Trent renewed the same injunction, and recommended frequent communion, without enforcing it by an express decree.

In the ninth century the communion was still received by the laity in both kinds; or rather the species of bread was dipped in the wine, as is admitted by the Roman Catholics themselves. See *Acta SS. Benedict. Sæc. III.* M. de Marca observes, that the people received it at first in their hands (*Hist. de Bearn*), and believes the communion under one kind alone to have had its rise in the West under Pope Urban II. in 1096, at the time of the conquest of the Holy Land. But it was more solemnly enjoined by the council of Constance in 1414. The twenty-eighth canon of the council of Clermont distinctly enjoins the communion to be received under both kinds; adding, however, two exceptions; the one of necessity, the other of caution, *nisi per necessitatem et cautelam*; the first in favour of the sick, and the second in favour of the abstemious, or those who had an aversion to wine.

Communion Service ‖ Communism.

It was formerly a kind of canonical punishment for clerks guilty of any crime, to be reduced to *lay communion*, that is, only to receive it as the laity did, under one kind.

There was another punishment of the same nature, though under a different name, called *foreign communion*, to which the canons frequently condemned bishops and other clerks. This punishment was not any excommunication or deposition, but a kind of suspension from the function of the order, and a degradation from the rank they held in the church. It had its name because the communion was only granted to the criminal on the footing of a foreign clerk; that is, being reduced to the lowest of his order, he took place after all those of his own rank, as all clerks and others did in the churches to which they did not belong. The second council of Agda orders every clerk who absents himself from the church to be reduced to foreign communion.

COMMUNION Service, in the liturgy of the Church of England, the office for the administration of the holy sacrament, extracted from several ancient liturgies, as those of St Basil, St Ambrose, &c.

COMMUNISM

Is one of the terms which have been applied to the various classes of projects for re-organizing society, and subjecting men to a more or less strict system of regulations calculated, as their framers maintain, to promote human welfare. It is impossible to give a scientific definition of the word Communism, any more than of Socialism or other miscellaneous terms, in which groups of varying theories and projects are colloquially referred to. The influence which these projects have from time to time exercised upon mankind, and their late tragic connection with European history, render it necessary that some notice of them should be found in a work of general reference. It will be seen presently that it is convenient to bring them all under one head; and the word Communism presents itself as preferable to any other, because it applies generally to the highest developments which artificial systems have aimed at. It thus includes the minor within the greater projects, and admits of the general review of the whole question between artificial systems and the natural laws of society. Under the head of Communism it is usual to class those organizations which propose to adjust the whole conduct of the human being, and not only to regulate property, industry, and the sources of livelihood, but also to revolutionize the domestic relations and the social morals of mankind. The less unpopular term of Socialism is generally applied to a revolution in the laws of property and the organization of labour. But no such distinction is fully established, and all the views and projects of the re-organizers run more or less into each other. Investigation lays open an indefinite series of schemes, from the vast projects for taking possession of the new-born infant, and subjecting him to a strict daily and hourly discipline through life, down through an indefinite gradation of organizing schemes, until we reach projects of pauper management or of joint-stock partnership, which may be merely spoken of as carrying in their nature a tinge of socialism. To give under the head of each separate artificial system—as, for instance, under Phalanstery, St-Simonianism, Fourierism, or Owenism—a specific account of the minutiæ of each system thus propounded, after the manner in which an account is given of the several sciences and philosophical systems, is the course which would naturally give most satisfaction to the supporters of each scheme; for, as there has been little good understanding among the several projectors, and each has generally attacked the others, an inquiry in which their systems are mixed up with each other would be received as a confusion of truth with falsehood, and of sagacity with quackery. But if it were desirable to describe each system to the satisfaction of its supporters, it would be scarcely practicable. Fourier's alone might occupy years of study; and he himself maintained to the last that none, even of his most ardent disciples, rightly understood his system in all its complexity; there was always something or other overlooked in its intricate machinery, which, like the absence of some essential wheel in a complex piece of clock-work, disorganized the whole.

Even, however, if each system could be satisfactorily pursued through all its ramifications and laid distinctly before the reader, it does not appear that the result would justify the labour and space necessary for the object. A question antecedent to any question as to the merits of the details of each system is, whether a case is made out for artificial intervention at all—whether nature has not established laws which accomplish the object in view better than any projects which human ingenuity can devise.

It is to the social laws developed by the domestic relations, and to those wider and less rigid principles of action which are indicated by the science of political economy, that we go to find the system on which it has pleased the Deity to provide that mankind should live. It is true that, in investigating the true principles which rule the domestic relations, inquirers may, as in scientific investigations of any kind, make mistakes; and they are perhaps still more liable to err when they investigate the laws of political economy, and endeavour to distinguish what they are sufficient from what they are insufficient to accomplish. But both systems proceed upon the belief that there are laws of social and economic development, as there are laws of mineral crystallization, or of animal and vegetable physiology; and to find out these laws is the constant endeavour of all social and political economists.

The propounders of communistic or socialistic projects, on the other hand, deny the existence of the whole or of a

Communism.

great part of such a system—maintain that man is living in chaos, and offer to regulate him and put him into shape as so much inorganic matter. As a simple example, social economy says that in the general case parents ought to have the adjustment of their childrens' destiny left in their hands, because a law of nature makes them love their offspring and desire its welfare; and though there may be exceptional cases, yet the law of family affection is so general that a reliance on it affords a better chance of accomplishing the desired object than any artificial arrangement. On the other hand, a communist will maintain that children ought to be immediately removed from their parents and brought up by a committee of management, because, to use the words of Robert Owen, "the affections of parents for their own children are too strong for their judgments ever to do justice to themselves, their children, or the public, in the education of their own children, even if private families possessed the machinery—which they never do—to well manufacture character from birth."

To take another simple example from political economy. This science teaches us that the best means of supplying mankind with the material objects of their desire is to leave the function to the spirit of commercial competition, and to secure an absolute property in the fruits of industry to those who bring them into existence. On the other hand, Louis Blanc says that commercial competition is a source of misery and degradation, while Prudhon says property is robbery, and each desires to adjust the whole matter according to an organization of his own.

Those therefore who believe in the truth of political economy cannot admit that there is any need for the projects of the socialists and communists, and consequently cannot admit that there is any necessity for studying and developing the ramifications of each system, and showing precisely where they differ and agree, or wherein one is preferable to the other. Hence it is that, proceeding upon the basis that the principles of political economy express with more or less accuracy certain natural laws which it is unnecessary to supersede, it is not considered necessary to investigate the ultimate arrangements of each projector's system; and so it has been deemed expedient to treat here merely of the primary question between the natural system and the artificial systems.

For the whole matter receiving attention to this extent in a work like the present, there are various reasons. In the first place, late European events have made the projects of the socialists and communists a part of the history of the world. But further still, at the point where the plans of the artificial projectors depart from the received doctrines of political economy, they are an important means of testing the accuracy of these doctrines by the application of a sort of *experimentum crucis*. Hence the readers of socialist works often say that the system, as a system, is unsound, yet there is some truth in its foundation; while what they really mean is, that there is some mistake or defect in the received doctrines of political economy for which the inventor is offering an artificial remedy. Wherever opinions in favour of these artificial systems prevail—and in later times they have occasionally prevailed to a sufficiently alarming extent—there must be something wrong in the condition of the people. There is some error in the political economy which rules their actions, and either they are improperly interfered with, or they are so neglected that the true laws of nature have not freedom to develop themselves. One organic defect developed in nearly all the instances where such projects become popular, is an extent of popular ignorance, rendering the laws of political economy nugatory among a people who cannot understand even their simplest rudiments. From such causes, the social and communistic movements with which the world has been occasionally visited are, taken collectively, an interesting and valuable object of inquiry.

The literature of this department of inquiry is indefinite, since it blends itself with theology, ethics, politics, political economy, and history. Every one who proposes anything for the improvement of mankind is liable to come within this category, if, instead of aiding nature, his project should propose to supersede her laws. Hence communistic literature covers all the range from such vast plans of reconstruction as Fourier's or St Simon's, down to the pamphlet on Pauper Management, which may become liable to the suspicion of communism. The great conceptions or plans of government which have from time to time appeared, generally mix up an artificial organization with that which is in actual operation; and sometimes the former character so entirely preponderates, and carries the whole project so far out of the course of actual practice and probability, that it is set down as a fanciful dream, of which the author never anticipated the realization. Such is the Utopia of Sir Thomas More, which has afforded a term for characterizing impossible or preposterous schemes. Some of the French writers are proud of saying, that the great dispute between socialism and political economy—between the world as it should be made, and the world as it is—began when Plato wrote his *Republic*, and Aristotle in his *Politics* bent his powerful practical mind to the examination of the actual condition and political organization of mankind. The *Republic* of Cicero, from which the world expected important views on government, supplied from the practice of Rome, embodied the platonic vagueness; and the same spirit has pervaded the works of a multitude of writers on political philosophy. It has to be observed, that before it can give expression to a distinct theory of communism, the press must be free, or in a state of defiance, because in proposing a new plan of organization, it proposes to supersede the government of the day. Hence it was in the midst of the great contest in England in the seventeenth century, that the boldest practical opinions were expressed in such works as the *Leviathan* of Hobbes and the *Oceana* of Harrington. When works like Rousseau's *Social Contract* were popular, it may be said that the French press was in a state of licensed rebellion, since under despotic rule, opinions of the most anarchical and revolutionary character were promulgated with such systematic calmness, as if the possibility of their being adopted and carried into practice were not to be entertained. In France, since the first revolution, while the press has sometimes been controlled, yet opportunities have been afforded from time to time for issuing such works as have to be presently noticed. In 1848, not only in France, but throughout Germany, a current of socialistic literature broke out. It has now been forced back again, and there is no freedom on the Continent to publish communistic doctrines. In Britain the whole question has been left freely to develop itself, with what effect we shall presently see.

Communistic arrangements have been from time to time in partial practical operation among isolated bodies of men, and the character of this partiality of operation is peculiarly instructive. The most illustrious example is that of the Spartan discipline. From his cradle to his grave, the Lacedæmonian citizen was regulated in all his movements by the state. He had no home or family. When the state permitted him to marry, it adjusted his conjugal intercourse, and might temporarily or permanently transfer his rights to another person. Everything was adjusted to the production and training of healthy and strong men fit for the warlike service of the state. The men living in separate barracks were, if possible, not to be acquainted with their children by sight, lest, according to the view resuscitated by Mr Owen, paternal weakness might interfere with the rigid character of public discipline. At the sysitia or public mess, there was a meal renowned for its frugality distributed with impartial uniformity to rich and poor. Competition in trade was rendered impossible, since no commercial or productive

Communism.

pursuits could be followed by free citizens; and, in reality, there was no money or circulating medium, the celebrated iron coin being rather a practical sarcasm on the gold and silver of other states, than a substitute for them. With all their elaborate and stern enforcement of equality, Spartan citizens had however in some way the command of wealth, and they were divided like the rest of mankind into the rich and the poor. But their great inequality which carried off all the social difficulties of their complicated organization was their vast system of slavery. As not only servile drudgery, but productive commerce, and, it might be said, all the arts of peace, were committed to the helot class, their numbers and capacity made them powerful, and only a ceaseless watchfulness and severity interspersed with some acts of ferocious cruelty kept them from reversing the social order. In fact, this instance goes with others of minor moment, to show that to the extent to which there is artificial organization, there must be a corresponding amount of slavery or coercion, since men must be forced to do that which it is not lawful to bribe them by competitive pecuniary recompense to do. The philosophy of the Spartan example was in the mind of a Scottish workman, who, when a brilliant communist lecturer had finished his description of the uniformity and happiness of his parallelogram, stood up and said, "but whae's to dee the durty wark." The lecturer ingeniously pointed to the number of primarily disagreeable occupations which men may be induced to undertake without payment—as when the anatomist handles macerating garbage, and the sportsman pursues the chase of the unprofitable wild beast through cold and heat, wet and hunger. But whatever speculators may anticipate as to the future of human nature, it is a fact as to the past and present visible every day, that there are services, and these important to human happiness, that nothing but coercion or pecuniary inducement will extract.

Among the practical instances of artificial organization in later times, we may cite the guilds and other associations of traders and artificers whose peculiar privileges have scarcely yet entirely disappeared, while they are in some measure virtually revived by trade-unions and combinations. Their object was to suppress competition and freedom of action; but it was so far different from such views as those of Owen and Louis Blanc, that, instead of providing some substitute for competition of which all were to reap the advantage, the object was to confine all the benefits of trade or productive industry to a chosen few, exclusive of the rest of the world. Thus, so long as they were sufficiently powerful to retain their privileges and suppress external competition, they possessed a compactness which enabled them to enforce their internal restrictions and obligations as the price paid for the possession of lucrative privileges. In other words, as it was more profitable for a man to belong to a corporation, though it restricted him from competing with its other members, than it would be for him to compete with the world at large, he assented to restrictions; and submission to them in these instances does not show that the world at large will ever consent to accept and obey them.

The power of religion has in many instances acted as that force which will keep men in associative action on principles contrary to the natural laws of society. It is not difficult to imagine the early Christians in small clusters, with the firmest reliance in each other and in the continual fear of persecution, enjoying all things in common. The monastic establishments were communistic institutions, and they infused a tinge of their character into the early universities. Relics of its tone may still be found even lingering in such uncongenial ground as Cambridge and Oxford. The monastic communities, however, attempted by their organization to supply only a portion of that which nature does by social laws. They cut off entirely those relations of husband and wife, and of parent and child, which, as they are in themselves the most complex and powerful portion of the natural organization, are of course the least easily accomplished by the artificial. There are some small communities at present in America, such as the Shakers, who, exacting the same observance of celibacy, manage, through a system of communism, to supply within the limited sphere of operation left to it the natural laws of society. Their orderly habits, and the success with which their agricultural operations have been pursued, have often been cited in support of communistic principles. It was chiefly by religious influence that the Jesuits established their empire in Paraguay, where their authority was not merely that of a government, but extended over the social direction and organization of the peculiar people among whom they established their mission. The classes of religious societies scattered through central Europe, and known as Moravians, Bohemian Brethren, or Herrnhuters, in a similar manner derive the power of social organization, so effectively exercised by them, from a religious source. The pressure of persecution has imparted to them a species of social compactness often exemplified in isolated religious bodies. The Huguenots of France, for instance, the Vendeans of the revolution, the Waldenses of the seventeenth century, and the Covenanters of Scotland, submitted to an amount of moral discipline from their proscribed and hunted priesthood, to which the followers of an established or protected clergy will rarely submit; for there are none to whom censure or the deprivation of privileges is so formidable as to those who brave persecution for the sake of belonging to a religious communion. A very remarkable instance of the organizing power of religious authority, especially when strengthened by persecution, has been exhibited in the late history of the American Mormons; and, to make it the more emphatic, its potency has exhibited itself in direct and immediate contrast with the feebleness of pure communism as an artificial system of temporal organization. Through the spiritual power which they had established, the leaders of the sect, Joseph Smith and Brigham Young, exacted so ready and implicit an obedience, that they were really able to accomplish that distribution of functions which the social organizers strive after in vain. The man whose assigned function it was to dig this drain, or plough yonder field, or weed, or make a fence, went to his duty unresisting, and did it with all his heart. It was thus that, when they set their foot on the desert, they surrounded themselves with the fruits of skilled industry, and assumed the character of an old and permanently organized community with almost miraculous celerity. But when they were driven from their possessions in Nauvoo, and a body of French communists took their place, these, far from rivalling the industrial organization of their predecessors, had not even enough of that quality to preserve the fruit of their predecessors' labours; and, in the hands of the new-comers, the cultivated fields of the Mormons lapsed again into a wilderness.

The communists, whose failure proved so signal a contrast to the practical ability of the most preposterous fanatics of the day, were led to form a settlement in America by the bold persuasions of M. Cabet, who was afterwards tried and punished for the sufferings he had occasioned to them. Icaria, the place selected for the great experiment, was on the Red River, a tributary of the Mississippi, dividing Arkansas from the newly annexed state of Texas. He professed to have there purchased a million of acres of land; and the most alluring descriptions were given of its beauty and fertility, and its capability not only of providing for all the sordid wants of ordinary mankind, but of ministering affluently to the enjoyment both of the senses and of the intellect. The classes who are usually attracted by emigration schemes, as offering them a life in contrast with their uneasy struggle at home, were charmed with the prospect. Soon after a small body had put themselves into M. Cabet's hands, the colony was represented as in active existence,

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and in the full enjoyment of all the promised elements of subsistence and luxury. It had its organ called *La Populaire*, and was trumpeted both in France and by the socialist organs in Britain. While the scheme had as yet a scarcely defined existence, the revolution of February 1848 swept past. The hurricane would have obliterated any ordinary social scheme in the hands of ordinary social reformers, but the Icarians seized the tide of socialism, and made their project so prominent that 500 eligible emigrants were obtained. The first condition of adoption into the new republic was a startling one—the emigrant required to give up all his property into the hands of M. Cabet the president. Some entertained misgivings as to their position, but did not act on them until it was too late to retreat, for the author of the scheme had furnished himself with the means for compulsory enforcement. After a miserable voyage, the emigrants, in extreme wretchedness, arrived at New Orleans, where they expected to find their promised land. Instead of it, they met with a few of their wretched fellow-countrymen, portions of the advanced party, who could find no Icaria, or any other place where they were permitted to occupy land without paying a high price for it. A portion of the 500 proceeded on the voyage up the Mississippi with their president. They had a land journey of between two and three hundred miles, which but a small portion of them accomplished, several dying by the way, while others made their escape to France. Those who reached Icaria found only a desert, with a few ruined huts, and an abundance of graves.

Finding that the land, such as it was, did not belong to M. Cabet, and that its owners demanded for it a price far beyond their means, the unhappy remnant of the expedition adopted the idea of taking possession of the still warm nest whence the Mormons had been driven by the wrath of their neighbours; but at Nauvoo their failure was so immediate that they scarcely left behind them a trace of their occupancy, and the fields on which the Mormons were becoming rich reverted almost to a state of nature in their hands.

From the incidental communism to be found scattered throughout general literature, or exemplified here and there in the manner in which we have just seen it on a small and isolated scale, it is a great step to go to the consideration of those vast systems which have been designed in our own day for the complete reconstruction of society. France is, as the world has had too much reason to know, their great productive emporium. The two patriarchs of these systems are Fourier and St Simon, two men of whom each entertained towards the other and his opinions that unmitigated contempt which it is the peculiar character of social organizers to entertain for the works of each other. They were men of totally different habits and character, and though at a distance their systems might appear to be so much alike that they would naturally have blended with each other, they took their separate courses with their respective clusters of disciples, as distinctly as two rivers from the same mountain chain pursue their courses to opposite coasts.

Of Fourier and his system it is difficult to speak, since, as already has been observed, it is so complex that he never admitted that even his most ardent disciples understood it, and to the last he would sanction nothing as an announcement of his views which he had not himself written. It may suffice to say, that those who have glanced at his writings have been astonished to find how far they have differed from all anticipation of their contents, and from all other systems of artificial human organization. Instead of the dry details of industrial training and household economy, the reader finds himself in a gorgeous imaginative world, overloaded with an exuberance of sensual and intellectual joys, such as an oriental sage might picture in his opium dreams. His theories were almost in wider contrast with the realities of his own life than with the writings of the other communists. He spent the greater part of his days as a humble drudge in a commercial office, living frugally on a small income, and writing books which startled the few who could be prevailed on to read them, by their vast theories and the rich and ingenious imagination which peopled them with wonderful and captivating analogies. They were of the kind of writing which, once admitted at all, is accepted implicitly like a revelation; and though those who gave ear to him were but few, yet among these few were some zealous and fanatical believers.

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Fourier was born in the year 1772, and it was about the year 1825, when he was upwards of fifty years old, that he appears to have enrolled his earliest disciples. The revolution of 1830 afforded a hearing in France for all who had startling social novelties to proclaim; and Fourier then began to gather a popular audience. Out of comparative obscurity he thus rose to an extent of popularity and power which astonished men more conversant with the ordinary world, and induced them to look to theories of social organization as a more promising field of enterprise, than it had seemed to be in a country so entirely under the subjection of immediate practical influence as France. Fourier found, however, that there were rivals to his popularity, and his system, founded on calculations which he maintained to be the counterpart of Newton's physical system, was in his eyes the true science which admitted of no contradiction or divergence. Hence he thought it necessary to warn the world against the efforts of fools and impostors, by the publication in 1831 of his *Pièges et Charlatanisme des deux sectes, St Simon et Owen*. He received soon afterwards more effective opposition in an attempt to put his theories into practice. Nothing, indeed, could be better fitted to dispel the gorgeous visions which he created in his studious retirement, than the vulgar exigencies of a set of people brought together to struggle with the difficulties of a new method of living; and thus, when his friends collected a considerable sum of money to begin the system of phalanges with which he promised to celestialize the human race, his instinct made him deprecate the attempt, and discountenance it as premature. The experiment of a practical embodiment of Fourierism failed according to the universal expectation of those not engaged in it; Fourier himself expecting that it would fail from deficiency of Fourierism, and the rest of the world anticipating its fall from a superfluity of that quality. The experiment was made in the neighbourhood of the small town of Rambouillet, easily approached from Paris. The sum expended on it has been calculated at L.20,000. Fourier was pretty far advanced in life when the attempt was made, and he died soon afterwards, in the autumn of 1837.

If his writings had been less elaborate and diffuse than they were found to be, the socialist impulse connected with the French revolution of 1848 might have made them very popular. Many interpretations and digests of them were then published, a few of them finding their way into British periodical literature. It is understood, however, that the greater part of his works still remain in manuscript, as they were deposited in the Phalansterian Academy at Paris.

Fourier professed to be a believer in revelation; but he practically dispensed with another world, since his system accomplished the perfection of happiness in this. When it was fully developed it was to be the third dispensation—counting the establishment of Christianity as the second. In one of his own expressive analogies, mankind was when he wrote (and would be still held by him to be) in the first or chrysalis state, which he expresses by the term *civilizée;* but when the system of harmony is accomplished, his development will be perfected with a metempsychosis as striking and beautiful as the metamorphosis of the caterpillar into the butterfly. He had a peculiar method of bringing out his

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To accomplish this consummation, the rapid perfectibility of mankind was to be accomplished by cosmical developments, of such a startling kind as we would expect to have excited an incredulous smile in the most devoted follower. His system of full enjoyment seems to have required the creation of new natural elements, and especially the existence of animals capable of conveying mankind with increased fleetness from place to place—and here his followers have given him credit for having anticipated results, though he was not quite precise as to the means, since rapid transit has been accomplished by railways and steamships, instead of the new animals of the lion and the whale kind, who were in "Harmony" to be subjected to the will of man. Some of his other cosmical views are so extraordinary, that we shall only venture to give them in a quotation from the curious introductory essay of his chief English exponent, who speaks rather as an admirer than a believer.

"The planets procreate their own species, but their functions of creative industry consist in furnishing each other with the various types of animal and vegetable life, which live and grow upon the surface of each globe respectively. Thus all the moons and planets of our solar system have contributed to the creations of our globe, in the mineral, the vegetable, and the animal kingdoms. The elephant, the oak, and the diamond, were created by the sun; the horse, the lily, and the ruby, were created by Saturn; the cow, the jonquil, and the topaz, were created by Jupiter; the dog, the violet, and opal stones, were created by our earth itself; and all the moons and planets have created special series, classes, orders, and varieties of animals, vegetables, and minerals upon our globe, and also on each moon and planet of our solar system." (Doherty's Introduction to *The Passions of the Human Soul*, by Charles Fourier, p. 14.) The system of phalanges or phalansteries formed, as it were, the Jacob's ladder which connected such cloudy speculations with the sublunary earth. Reserving these as esoteric revelations to the initiated, he plied the ordinary public of France with seductive descriptions of the economic influence of his primary organization—an organization which would, he maintained, if once begun, prove itself so beneficent that it could never lose its hold on mankind, but must be carried out indefinitely until the great system of "Harmony" was completed over the earth.

Each phalange or phalanstery was to consist of 400 families, or 1800 persons; this estimate rested on minute and certain calculations, which, like Newton's, were incapable of deceiving. Each was to be held in 1128 shares—a number derived from equally certain calculations. Of these, five-twelfths were to go to labour, four-twelfths to capital, and three-twelfths to skill or talent. The phalange was to include everything in structure and character which could gratify the highest taste and sense of enjoyment. In the meantime, however, before the whole earth was covered with phalanges, each multiplying the enjoyment-creating potency of the others, the efficacy of the system was to be established by its subsidation of the human passions to its service. The pursuits and functions of the members of the phalange were to be infallibly adjusted through a distribution, by which each person was to be set precisely to that function in life to which his passions and propensities directed him. Life at the phalange was thus to be perpetual enjoyment, and everything tending to supply the comforts, luxuries, and felicities of life was to be ceaselessly produced by men who, instead of labouring with the sweat of the brow, were to be all the time as fully indulging their own passions and pleasures as the hunter when he hears the view halloo, or the gambler when he is gaining a fortune, or the philosopher when he is achieving some great discovery. Communism.

When the principles of an existence of supreme and inexhaustible enjoyment were applied to the intercourse of the sexes, and "the condition of woman in Harmony," they naturally assumed a character calculated to create astonishment and indignation. The vindication put forth by the pupils of the system was, that in harmony man is to be divested of the vice and grossness which attend on the unlimited indulgence of his passions in his present state, and that then the same wretched precautions by which our imperfect morality is now fenced round will no longer be necessary. In attestation of his sincerity they refer to his opinion that some three or four generations would require to live under something like the existing restraints, until mankind had acquired the proper development for full and at the same time pure enjoyment.

Persons taking a glance at the great French schemers at a distance, and without any prejudice in favour of one over the other, will find a rival to Fourier in one whom his disciples would have hooted from any claim to equality as loudly as the St-Simonians would have scorned the Fourierists.

St Simon, born in the year 1760, was descended of one of the most illustrious houses of the old noblesse of France, and his system was pervaded by the aristocratic tendencies of his birth and education. His family claimed descent from Charlemagne, and he said that the emperor had appeared to him in a dream, and told him that his race having produced a *grand monarque*, was also to produce a *grand philosophe*. When a young cavalry officer, his servant was instructed to awaken him in the morning with the injunction, "Arise, Sir Count, you have great things to do—Levez vous, Monsieur Le Comte, vous avez de grandes choses à faire." Napoleon's celebrated demand from the Institute, of an estimate of the progress of science, seems to have fired his ambition to be the lord of the intellectual, as his master desired to be lord of the physical world. He established at his house assemblages of scientific men, and of the leaders in every department of intellectual exertion, assuming the position of the great philosophic generalizer, who employed them as his workers in the several details, and reserved for himself the higher task of bringing together in systematic array the results of their several labours. By his profuse hospitality he reduced himself to penury. But this change did not seem to give him much concern, as it was part of his project to experimentalize in his own person on all the conditions of humanity. For this purpose he practised all the vices, alternating them in proper scientific rotation with all the virtues, and his experience of poverty came at the right time to afford a contrast with the luxury and profusion in which he had been indulging. Among his other eccentricities, he attempted on one occasion to commit suicide, but only succeeded in blowing out one of his eyes. It was immediately after this that, as if the shock had electrified him, his social system discovered itself to him in a single intuition, and enabled him to announce himself as the divine man, saying, "Moses has promised to men universal fraternity, Jesus Christ has prepared it, St Simon has realized it." It presented itself to his view as the completion of that circle of the sciences which he considered that he had been employed in systematizing. In this respect it in some measure anticipated, and no doubt it suggested, the

system of Positivism developed by Comte. They have the common features that, beginning with what are termed the exact sciences, they try to prove that each of the other sciences is made certain by the discovery and application of its laws, and to carry up this certainty gradually to the more complex and in popular belief dubious, sciences, until it reaches sociology, when the rules by which men must be organized can be set forth with abstract certainty. But the two philosophers differed greatly in this—that while Comte felt his way with a rigorous scrutiny, and was obliged to stop on the borders of the sciences into which he could carry strict laws, rather indicating how certainty was, as the result of man's progressive labours, to characterize the whole, St Simon at once found his way to a certain or positive system of social organization, paying little heed to the steps necessary for reaching this congenial ground through the less inviting medium of the other sciences. His plan was thoroughly hierarchical. It was a religion to which all things were to be subservient, and of which he, and after him the ablest of his disciples, was to be the head. Property and all other conflicting institutions were to be abolished, and nothing was to interfere with the leadership of the Father or supreme leader, whose authority was thus purely absolute. The abolition of competition, and the organization of labour on such a more fitting and effective scale as the superior wisdom of the St-Simonian priesthood would naturally suggest, was a portion of the system; but the condition of the mass of the people had by no means that alluring prominence afterwards given to it, and the matter was all along viewed more from the right of their superiors to organize and govern them, than from the right of the working classes to privileges not possessed by them. The unholy bond of matrimony was to be abolished, and there was substituted for its restraints obedience to the sacred instincts of inclination, as directed by the unerring wisdom of the Supreme Father. The difficulties felt in giving any intelligible account of artificial projects in general, accumulate and thicken in a contemplation of the mystic ramifications of St-Simonianism, and perhaps the most satisfactory and clear explanation of it may be given in the words of Louis Blanc, who, as a rival projector, may be supposed to speak with the scientific precision of the craft. He thus epitomizes the chief elements of St-Simonianism, "that industry should be regulated in obedience to an authority self-constituted, and the judge of its own legitimacy; that production should be concentrated to excess, and its advantages portioned out in the ratio of merit; that the transmission of property should be abolished, as well as that of offices; that marriage, the legalization of adultery, should give place to the sovereignty of inclination and to the emancipation of pleasure; that the empire of society should be substituted for that of the family.[1]

It happens, not unfortunately, that no men are more clear-sighted to the anomalies of such projects than rival projectors; and the literature of communism may be said to supply its own confutation by embodying a system in which each man demolishes what his neighbour has set up. Hence, to form an accurate notion of the transcendent absurdities of the St-Simonians we must read the lively narrative of the author of the *Organization of Labour*, who, while the St-Simonians held that rewards should be distributed according to ability and merit, maintained the fundamentally opposite doctrine that people should be supplied not according to their abilities, but their needs. In his narrative it will be seen how Father Enfantin took the chief command, to which he was called by the commanding beauty of his person, his persuasive abilities, and his incomparable impudence. It will be seen how, as supreme judge of the world in matters both spiritual and temporal, he summoned Louis Philippe the king of the French to appear before him, and answer for his usurpation of the authority of the "supreme father," and other misdeeds. Though restricted in extent, however, it would appear that among his own followers, called "the Family," the sway of the supreme father was as despotic as that of any eastern potentate; and the power of compulsion possessed and wielded by him, is another instance of that capacity of enforcement for temporal purposes which religious adhesion so signally affords. Like all human authority, however, even Enfantin's was subject to rebellious antagonism, and within the college, or the cabinet as it might be termed, of the supreme father, there was a formidable conflict in the autumn of 1831. Though this high matter of state was kept secret from the family at large, yet we are told that "from the wearied step of the members of the college, from their worn and pallid faces which gave manifest evidence of sleepless and anxious nights, from their white lips, from the wild disorder of their remarks, from the mystery with which they carefully surrounded their proceedings, the members of the second degree saw that some terrible drama was going forward.[2]

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The insurrection was headed by Bazard, chief of the dogma department of the college, who not only was united to a wife, over whom he wished to continue exclusive possession, but also desired to have his daughter married according to the usual formalities of French law and custom. As the supreme father was inexorable both on this and other points, there was a considerable secession from the Family. The next great incident in their history is the dispersal of their college of Menilmontant, and the trial and condemnation of their chiefs, as propagators of immorality and irreligion. They marched to the tribunal in procession, clothed in the solemn costume of their order—a blue robe with a leathern girdle, white trousers, a red cap, the neck bare, and a flowing beard. The picturesqueness of the whole scene, and the reverential awe and passive obedience enjoyed by the supreme father, naturally created much sensation in the Parisian world; but even the French toleration of the bombast was outraged, when Enfantin stood gazing at the court, calling attention to his own handsome face and commanding figure, and demanding for them the homage due to such advantages. The supreme father, and his disciples Duverier and Michael Chevalier, were each subjected to a year's imprisonment, and a fine of 100 francs. Two others, Rodriguez and Barault, were fined fifty francs each. The Family were dispersed to diffuse their system in a modified shape, and mystic St-Simonianism gradually yielded to the more attractive views of its historian.

The three great living representatives of French projects of organization are Auguste Comte, C. J. Prudhon, and Louis Blanc. Both in his works, and in his personal history, each of them has marked individual characteristics, which give them a dissimilarity to each other, more immediately and prominently obvious than the differences in the views of their predecessors. The first is laborious, repulsive, and calm, pursuing his system of inquiry to startling and offensive conclusions, such as the non-existence of a deity, with the most arid deliberativeness. The other two are impulsive and passionate; but Louis Blanc seizes a popular key note, and goes right to the feelings and interests of the humbler and uneducated classes with a sort of sympathetic respect for all that men venerate in the shape of religion or the domestic affections, leaving to them all these undiminished, while he offers them other substantial blessings; while Prudhon lifts his voice with savage ferocity against every object of human veneration, and endeavours to break every bond tending to the preservation of order and morality.

Perhaps it is scarcely just to rank Comte as one of the artificial organizers, since his system rather pointed to a future organization as the result of the growth of Positivism; and in reality the vast progress in the development of

[1] *History of Ten Years*, i., 387.

[2] *Ib.* i., 568.

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mankind which he represents as the necessary preliminary to the acquisition of socialistic science, is a practical censure on the crude and ephemeral designs which propose an immediate decomposition and reconstruction of society. The aim of his positive system is to show that mankind possess the means of gradually acquiring as certain a command over the whole field of thought and action as they at present possess over the exact sciences. In these, so far as the human intellect has worked, there is an absolute and satisfying certainty, which leaves no room for difference of opinion or for intellectual anarchy. To astronomy, comprehending the grandest operations of the physical world, the same certainty has been applied, and the motions, distances, and sizes of the heavenly bodies have been adjusted with an absoluteness which leaves for opposition or scepticism no possible foundation. Passing through the other sciences with extraordinary labour and ingenious acuteness, he endeavours to show that they possess the elements of the same sort of certain laws, and that these will in time be developed, the development being much aided and accelerated by his own discovery of the positive system of philosophy. In the physical system his chief difficulty lies in biology, or the laws of animal and vegetable life; and after seeing and admiring the fragments as it were of certainty which he brings out of mechanics and even chemistry, the contrast of struggling difficulty exhibited in this department tells its own tale of caution to human presumption. The last of all the sciences to be subjected to supreme human intellect by the discovery and development of its absolute laws is sociology. This is to be the science whereby men are to be governed and directed in all their conduct and relations, with an assured conformity to the laws of their nature; a conformity as assured, for instance, as that by which man already regulates any of the portions of physical nature, such as steam, over which the progress of science has already given him control. We have thus an imperfect type of the certainty with which man may be governed, in the regulation of a steam-engine and its machinery by a highly competent engineer.

The prospect which this certainty held out to the mass of the people, supposing them possessed of patience to follow Comte's long deductions, was not flattering. It annihilates freedom of action and opinion. The world will be under the absolute despotism of the intellects which can grasp the greatest quantity of the positive science of sociology, as the pupils of a mathematical class are, in the matter of mathematics, entirely subjected to the teacher who knows so much more than they do. But it is to be a despotism to which people will willingly submit, because it is certain and irremediable as fate. The man destined for the humbler duties of life will never struggle against his destiny, for he will feel that he occupies the inferior position, by a law as fixed and immutable as that which makes the fern smaller than the oak, and the sheep less powerful than the tiger. It must at least be conceded to Comte that he does not appeal to vulgar prejudices. His atheism is reiterated so pertinaciously and prominently, and is so closely connected with his denial of the possible exercise of a will in the organization of the world, that it must necessarily be mentioned by every one who notices his system. But some of his admirers have thought that a more legitimate result of his system is the secondary argument for the existence of a deity, from the perfection with which he shows the world to be governed.

Hitherto we have found in the framers of artificial systems, either abstract philosophers whose works are unsuited to popular taste, or inventors of vast plans in which the people at large did not see any distinct and immediate prospect of participating. To Louis Blanc has fallen the lot of striking the key note of popular enthusiasm. He avoided the features on which his predecessors had offensively dwelt, —the necessity of subjection to the true laws of social organization, and the duty of those destined to the humbler grades of the human hierarchy to occupy them without repining. With the instinct of the genuine demagogue, he told them solely of the wealth they were to gain, not of the liberty they were to lose. The fervid eloquence of his *Organisation du Travail* luxuriated in a theme which can never fail to be attractive—the spoliation of the poor by the affluent, and the right of restitution which the humbler classes possess against their more fortunate neighbours. His views are expressed with a pleasing eloquence and a touching earnestness, which make the perusal of the book agreeable even to those who see from the beginning the monstrous and almost incredible paradoxes on which the reasonings are founded. That competition is ruinous to the working classes, and not even propitious to their employers, may be called his fundamental principle. He attacks it in various ways; it is selfish and demoralizing, rendering men sordid and jealous—it produces unfair inequalities in the distribution of the produce of industry—it has several other grave defects, but its grand offence is its potency for the destruction of the working classes. The following brief extract will perhaps show as distinctly as a fuller exposition, the extreme nature of his views. "A contractor requires a workman—three present themselves for his selection. 'How much wages do you want?' he says to one. 'Three francs—I have a wife and children.' 'So, so—and you?' 'Two francs and a half—I have no children, but I have a wife.' 'Very well—and you?' 'Two francs will do with me—I am a bachelor.' 'Then you get the job.' It is done—the bargain is made; and what is to become of the two excluded workmen?—it is to be hoped that they will permit themselves to die of famine. But what if they should become robbers? Don't be afraid—we have a police. Or assassins? Why we have the hangman."[1] In this country the answer which would at once be made to this, both by theoretic reasoning and by facts, is, that competition induces the man who requires three francs to work up to their value: and it is at the same time very certain to all who know the general proportion which the profit of capital bears to the wages of labour, that if the unburdened workman's labour is only worth two francs there is no possible fund out of which three francs can be paid to the burdened fellow-workman who requires them. It is competition that creates the fund out of which high wages are paid, and those who would abolish it because it makes an unequal distribution of the realized fund, would not have that fund at all to distribute.

He endeavours to show that competition is injurious to trade, since it must necessarily bring things into existence which are supernumerary. The process is the same as that which leads to the starvation of the workmen. A man wants a commodity—three manufacturers competing with each other make triplicates of it—he selects that which is offered at the lowest price, and the other two are lost. It is almost needless to say that, though the supply sometimes does outrun the demand, yet the general object of producers collectively is to produce no more of any commodity than what will find a market; and though they may not be

[1] "Un entrepreneur a besoin d'un ouvrier: trois se présentent. 'Combien pour votre travail?' 'Trois francs—j'ai une femme et des enfants.' 'Bien. Et vous?' 'Deux francs et demi—je n'ai pas d'enfants, mais j'ai une femme.' 'A merveille. Et vous?' 'Deux francs me suffiront—je suis seul.' 'A vous donc la préférence.' C'en est fait: le marché est conclu! Que deviendront les deux prolétaires exclus? Ils se laisseront mourir de faim, il faut l'espérer. Mais s'ils allaient se faire voleurs? Ne craignez rien, nous avons des gens d'armes. Et assassins? Nous avons le bourreau."—*Organisation du Travail*, p. 43. Bruxelles, 1843.

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perfect judges of the quantity, they are undoubtedly rendered by self-interest the best that can be found. But the whole large branch of competition which operates through tender and acceptance is overlooked in Louis Blanc's argument. His statement of facts would be exemplified if, when a man wants a house of a peculiar shape, two or three architects build according to his plan, in the hope that one will be accepted; or when a new judge takes his seat, all the tailors of London set to making robes, one only of which can have the good fortune to be of use. But when individual commodities are required, either there is a reliance on the prices adjusted by ordinary competition, or there is a special competition by previous tender. The service of the post-office is often referred to by Louis Blanc as an instance of organized labour from which competition is excluded; but it is far otherwise. There are contracts for carrying the letters from place to place; there is competition for the construction of the vehicles and other facilities for locomotion, whether under the direct control of the post-office authorities or in the hands of those who contract with them; and finally, among the various persons employed there is the usual competition to obtain as much remuneration as possible, while the government, relying on the same spirit, endeavours to obtain the greatest amount of service for its outlay. The army is another department loudly appealed to as an instance of the accomplishment of the greatest objects through organization without competition. But it is for destruction alone that organization here suffices. The productive part of the army service—the supply of food, apparel, barracks, and weapons—is the object of ordinary competition.

His ultimate project was to substitute a perfect system of state organization for the imperfect and pernicious system of employment and competition. At the time when his work was published, however, the state was a monarchy, of whose abuses he had himself made many a bitter exposure. Having therefore considered that state management had, in the experience of the world, always tended to abuse and inequality, he admitted that his system could not be committed to any state such as had existed among mankind. The first step must be the establishment of a perfectly pure democracy, which would have the interests of all impartially at heart. This once done, the organization of labour might be carried out. To make the change adjust itself to existing interests, he proposed to make the competitive efforts of the state, in the first place, absorb all other competition.

The state was to begin by raising a loan to establish a limited number of workshops in each department of industry. In these establishments government should regulate the functions and gradations of the men; but after a time, when they became acquainted with each other, and with the principle of co-operation, they would adjust their own social hierarchy on the elective system. From the commencement the men would be allowed wages or subsistence money. The profits being struck at the end of the year, would be divided into four parts. One would be a sinking fund for the repayment of the capital,—though it is difficult to see how, when the system fully developed itself, there should be any person in a position to receive payment of capital; another fourth would be divided among the men; the third would go to fund an hospital for the sick and infirm; and the last would be retained as a reserve for special purposes.

By the perfection of their management, their extensive capital, and their general popularity, these national workshops would gradually drive private establishments out of the field, and, enlarging themselves, fill the place occupied by them. But, as this competition would be worked by a perfectly benevolent, pure, and conscientious government, it would be deformed by none of the exterminating defects of the ordinary competitive system, and one of its principles should be, that its pressure be as gentle as may be consistent with its effectiveness. In a short time all private competition would be vanquished, and the organization of every department of labour would be vested in the state, to be regulated with that perfect wisdom and justice of which the state, as formed by Louis Blanc, would be certainly possessed. Communism.

It is the policy of Louis Blanc to find fault with nothing in the existing social and moral condition of things beyond that portion of them which must be superseded to admit of his own favourite plan for the organization of labour. Hence, in his endeavours to engraft his novel projects on the ordinary institutions of society, and to prove their superiority over what they displace by arguments founded on mere ordinary utility and profit, he renders his fallacies much more palpable than those of his contemporary Prudhon, who, proposing to demolish every existing institution and belief, sets arguments of a merely utilitarian character at defiance, and challenges a contest on a wider and more fundamental ground. But of the two, the paradoxes stated with so much deference to received opinions, and with so much amiable benevolence proved far more calamitous than the vast revolutions of Prudhon, which, suggested by a relentless hatred of all that men have been accustomed to love and revere, have carried with them their own practical confutation to the greater portion of those who have read them. Without examining more minutely Prudhon's system, it is appropriate to the point immediately under consideration to show that his practical conclusions are directly the reverse of those of Louis Blanc, whom, after the usual method of organic social reformers when speaking of each other's plans, he lashes with condign ridicule. Gathering up all the physical and moral wealth of which the rights of property and other human institutions have robbed mankind, Prudhon seems to advocate a distribution according to each human being's contributions as a productive worker to the riches of the world. With his usual felicity of illustration, he compares the man who obtains, by property, office, or in any other shape, more than the proportion corresponding with his exertions, to a reaper who receives a loaf for cutting an ear of corn.

On the other hand, Louis Blanc's principle of distribution is, that men should receive not according to their capacities or exertions, but their needs; and the whole object of his organization of labour, both in its theoretic form, and when afterwards, as one of the provisional government of 1848, he endeavoured to put it in practice, was to carry out this result. In his national workshops, all competition, all rivalry, all selfishness, were to be dead. Each man on a principle of honour was to perform his assigned duty—the distribution of the proceeds was to be a separate operation, proceeding on grounds totally distinct from the comparative services of the producers.

A suspicion is suggested by the tone of some parts of the *Organisation du Travail*—which will be confirmed by a perusal of its author's clever history of ten years of the reign of Louis Philippe—that his strong hatred of competition rests on opinions, or more properly speaking impulses, totally different from those economical arguments on which he professes to found them. In treating of the working classes, he always speaks of them as mere mute instruments who must take, collectively, the position which the capitalists, or—when they are superseded—the predominant party in the state, assign to them; and he never makes allowance for energy or activity promoting an improvement in their condition. In his history he complains of their becoming selfish and sordid, and accumulating money in the savings-banks during the early prosperous years of Louis Philippe's reign. These indications of a feeling that the working classes are a mere inanimate mass at the command of organizers, are accompanied by unmistakeable references to the time of conquest, aggression, and tyranny, as that of the true glory of France, and bitter allusions to the sordid spirit of peace-

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ful productive industry, which has been the source of British greatness. He refers repeatedly to the admitted prosperity and influence which Britain has achieved by the spirit of commercial competition, pointing out what France must accomplish to excel us in such a race, and pointing it out in a tone of deprecatory despondency. It is clear that the predominating influence which has produced his mischievous books is, that in a struggle with Britain for national superiority, the chance for his own country is not in directing her people to industrial productiveness, but in abandoning competition and peaceful wealth, and assuming an organization which, as in the days of Napoleon's greatest achievements, will place all France in array against any nation competing with her for the supremacy of the world. That, in short, the best chance for France being great and formidable is not by producing wealth, but by destroying the wealth created by others.

The opinions of the *Organisation du Travail* spread rapidly among the Parisian workmen, and those of the larger provincial towns. Many other works promulgating views of the same kind were eagerly devoured, and even the more abstruse and forbidding treatises of previous organizers were received into favour, as being so far on the side of the abolitionists, that they were against property and other existing institutions. Thus a large body of men radiated from central Paris through all the populous portions of France, whose opinions on government were not merely republican as against monarchy, but were communistic or socialistic as against property and other social institutions.

It belongs rather to the history of France than to the immediate object of this paper to describe the influence of these far-spread opinions on the eventful history of the year 1848. Among those who had obtained a popular position in the common arena of politics, the provisional government of France included Louis Blanc, and others for whom power was demanded, rather on account of their anti-economic than their anti-regal opinions. Between the merely political republicans on the one hand, and the communists and socialists on the other, there was a long conflict which it required a stronger party than either to put down. The miseries of the period of conflict, and the subsequent subjugation of France, were the legitimate fruit of the doctrines which Louis Blanc, Prudhon, and other writers had been promulgating. Strongly represented as they were in the provisional government, they could not obtain a direct practical adoption of their principles as the universal law of France. They obtained, however, general resolutions from the provisional government, importing that an end must be put to the sufferings of the labouring classes, and that they ought to be guaranteed the legitimate fruits of their labour. The committee of the Luxembourg was at the same time appointed, with Louis Blanc at its head, to consider the condition of the workmen. The object of the majority of the provisional government was in this shape to get rid of the whole question by making it a mere matter of inquiry. The object of M. Blanc and his friends was to make the committee a means of action rather than of mere investigation. They succeeded, at least, so far as to induce a vast body of workmen to look to them for a regeneration of their lot, and abandon all projects of honest industry. A portion of these were employed, neither to their own satisfaction nor to the benefit of the community, in national workshops where all were paid alike. The idle, who constituted the majority, admired the system. In the hotel Clichy a special experiment was tried on a government order for the uniforms of the Garde Mobile. Fifteen hundred tailors were assembled, with an establishment of foremen, clerks, and cutters. The sum at which an army contractor would during the monarchy have furnished the dresses having been set down as their proper price, the men were allowed two francs a-day as subsistence money while they worked, and were in the end to obtain the balance equally divided among them. But when the day of reckoning came, it was found that not only was there no balance of gain, but that there was loss, and that the two francs a-day of subsistence money—the lowest rate of wages paid by master tailors—had overpaid the men for the work actually done by them under the mere impulse of "liberty, equality, and fraternity." Their energies, unexcited by the spirit of competition, relaxed when each man found that the proceeds of his increased exertions were not to be received by himself alone, but to be distributed over the whole body of 1500 fellow-workmen.

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It is the peculiarity of all great systems of social organization, that when they are put in practice and fail, the failure is attributed to the imperfect character of the experiment. Louis Blanc and his friends have ever maintained that the reason why the efforts to put his projects in force in 1848 failed, was because they were imperfectly and not completely tried. The circumstances under which he fled from France, and his contributions to the socialist press of England, indicate that he purposed to carry out his system by force, when it was seen that the majority of the suffrages of the people were against it. A true fanatic to his views, he held that the popular mind had been impregnated with false principles by the corrupt system of employment and competition; and that, to afford a fair field for the true system, it was necessary in the first place to use the power possessed by the wielders of supreme authority in France to carry it out by force. He readily—like all protesters against tyranny who are going to commit a flagrant act of coercion—found an excuse for his conduct in the necessity soundly to indoctrinate the people, and enable them to appreciate the truth.

The manner in which the communist and socialist doctrines spread through Europe, and were suppressed in France as well as elsewhere, forms one of the most memorable chapters in late European history. It has only to be noticed that, while the public organs of these opinions have been suddenly silenced on the Continent, no one can at this moment say how far the opinions themselves may be undermining the governments which appear to keep them down, and the whole order of society. In our own country we know with fortunate distinctness how the matter stands, and, as the following explanation will show, we have to thank the freedom of the press for a feeling of security of which other nations are lamentably deficient.

Socialistic and communistic notions, though they have sometimes been very prevalent in Britain, have never enlisted any great amount of intellect, either in devising or promulgating them. The few stray writers who have gone beyond a sentimental and hesitating sympathy with the views of the continental communists have belonged to a totally different class in the intellectual hierarchy from those men who have by their genius and fervid eloquence from time to time convulsed the public mind of France. The name of Robert Owen stands supreme as the prophet and champion of British communism. But, though his position is thus lofty with relation to his peculiar department, he is a man of very moderate literary abilities. A continued perseverance in one tone, an undying sanguineness which made him speak with the assurance of success at the time when the prospects of his cause were at the extremity of hopelessness, and an entire reliance on his own infallibility, have been the qualities which, more than once in the course of his long life, have procured him an attentive hearing from a considerable portion of the public.

The conditions under which he first appealed to public sympathy were favourable to his demands, since he advocated the cause of a portion of society to which the social institutions of the age failed to communicate their organizing influence. The inventions of Hargreaves and Arkwright had just given their impulse to the manufacturing system. By

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the creation of cotton mills in districts which had been but thinly peopled, a portion of the people were dragged out of the bosom of ordinary society and all the organizing principles which had arisen with its slow growth, and were chaotically massed together in large groups, without the application of any sanction to replace those influences which they had left behind them, in the shape of ecclesiastical membership, corporate or parochial supervisance, the genial control of hereditary neighbours, and the family ties. In Scotland the social revolution was signally conspicuous and disastrous. The cheapness of labour in that part of the empire, and the geological facilities for obtaining water power, attracted English manufacturing capital northwards, and often in some solitary glen several hundreds of persons were at once set down as mere producing machines, without any consideration for their moral condition or any effort to supply for them those elements of social organization which, naturally of slow growth, cannot be voted and adopted at once by a working population even had they knowledge enough to be aware of their necessity.

Owen was himself practically engaged in manufactures, and the first revelations of his system came to the English public with all that authority which disinterested benevolence, supported by practical sagacity, is sure to command. So in the year 1815, in a tract called "Observations on the Effect of the Manufacturing System, with Hints for the Improvement of those parts of it which are most injurious to Health and Morals," we may read the following excellent remarks:—

"In the manufacturing districts it is common for parents to send their children of both sexes, at seven or eight years of age, in winter as well as summer, at six o'clock in the morning, sometimes of course in the dark, and occasionally amidst frost and snow, to enter the manufactories, which are often heated to a high temperature, and contain an atmosphere far from being the most favourable to human life, and in which all those employed in them very frequently continue until twelve o'clock at noon, when an hour is allowed for dinner, after which they return to remain, in a majority of cases, till eight o'clock at night.

"The children now find they must labour incessantly for their bare subsistence; they have not been used to innocent, healthy, and rational amusements; they are not permitted the requisite time if they had been previously accustomed to enjoy them. They know not what relaxation means, except by the actual cessation from labour. They are surrounded by others similarly circumstanced with themselves; and thus passing on from childhood to youth, they become gradually initiated, the young men in particular, but often the young females also, in the seductive pleasures of the pot-house and inebriation, for which their daily hard labour, want of better habits, and the general vacuity of their minds tend to prepare them.

"Such a system of training cannot be expected to produce any other than a population weak in bodily and mental faculties, and with habits generally destructive of their own comforts and the well-being of those around them, and strongly calculated to subdue all the social affections. Man so circumstanced sees all around him hurrying forward at a mail-coach speed to acquire individual wealth, regardless of him, his comforts, his wants, or even his sufferings, except by way of a degrading parish charity, fitted only to steel the heart of man against his fellows, or to form the tyrant and the slave. To-day he labours for one master, to-morrow for a second, then for a third, and a fourth, until all ties between employers and employed are frittered down to the consideration of what immediate gain each can derive from the other. The employer regards the employed as mere instruments of gain, while these acquire a gross ferocity of character, which, if legislative measures shall not be judiciously devised to prevent its increase, and ameliorate the condition of this class, will sooner or later plunge the country into a formidable and perhaps inextricable state of danger."

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This was new to the world in the year 1815, and the best testimony that it was not only new but true and valuable, is to be found in the too frequent repetition of the same causes of complaint down to the present day, uttered with a general similarity of tone which makes these sentences scarcely seem obsolete or antiquated after the lapse of forty years.

But when a few such apt elucidations are culled from Owen's earlier works, it is easily perceived that their merits are exhausted; and through the tremendous voluminousness of his writings during the ensuing forty years, we may wade in vain, finding nothing at the utmost better than an exhausted repetition, after many years, of some judicious sentiment to be found in his early pamphlets. That Owen was connected with a manufactory, the organization in which contrasted with such descriptions, was a very well known fact, which gave much emphasis to his writings. But it must be questioned whether any great portion of either the practical or theoretical wisdom of which he has obtained the merit was his own. The New Lanark cotton mill, with which Owen's name has long been associated, was founded in the year 1784 by Mr David Dale. Owen married his daughter, and thus succeeded to a patrimonial interest in the establishment. In the multifarious works in which he has proclaimed his own merits, he occasionally, but very rarely, mentions the organizing efforts of Mr Dale as a sort of introduction to his own. It is known, however, that Mr Dale was the author of at least a very large proportion of the practical arrangements in the New Lanark mill; and when it is mentioned that he is not known to have ever solicited public attention to his exertions, while Mr Owen has been an incessant prater about himself, his services, and his projects, for half a century, it may be conjectured that his practical footing in a well-organized manufactory was made for him. In fact, though he professes to have found his predecessor struggling by imperfect remedies with social difficulties which he himself afterwards overcame through means of his peculiar solvent, there is no doubt that all that was beneficently and judiciously effected at New Lanark was the doing of Mr Dale. Owen had at least sense enough to see the usefulness of his arrangements, and to improve on them. Whether by his own talent, or from the instructions of his father-in-law, he could generalize on the lesson taught by the defects of the ordinary manufactory system in the manner of the passage quoted above; and thus, being a vain good humoured man, frivolous and fond of popularity, it fell to his lot to acquire a very high reputation, as a social philosopher who had accomplished the unwonted feat of putting his theories into practice. The New Lanark mills were for some years deemed one of the wonders of the world, and no member of a royal house, or illustrious stranger travelling in Scotland, failed to visit them. Owen when he went to London delivered addresses in Exeter Hall, at which members of the royal family thought they were doing a public duty by attending; and it was at one time rumoured that the Duke of Kent intended to give the princess who is now the queen of the British empire the benefit of instructions, in social science, by Robert Owen. Among the many foreign tributes to his popularity, was the offer of a province in Texas where he might carry out his system much more freely than he could in the New Lanark mills, but he declined the banishment involved in such an arrangement.

As time passed, however, the practical base on which Owen appeared to found his system was seen to slip from beneath him. His partners in the New Lanark mill found it necessary to buy him off. He was continually writing papers explaining how the human race had heretofore been left in ignorance, darkness, and misery, which he possessed, by the establishment of his "Rational System of Society," the means of immediately correcting. He indicated his

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opinion that the New Lanark works had reached successfully two points out of twenty which were necessary to perfectibility; and some of his partners who appeared to be well contented with the pecuniary results of the undertaking, afraid that Owen might defeat them by attempts to carry out a portion of the remaining eighteen points, resolved if possible to be rid of him.

With the capital which he drew out of the concern—a considerable sum—Owen immediately projected an establishment in more entire conformity with his now matured system. The place selected was Orbiston in Lanarkshire, where a great parallelogram was to be erected, that being the only form of edifice in which the perfect uniformity of organization which was to reign throughout the administration would have its proper development. The edifice was commenced in 1825, and Owen's own funds were sufficient to build a portion of it. Of the whole sum necessary, however, which he fixed at L.96,000, so small a proportion was available that only one angle of the parallelogram was completed. In this mutilated shape it was of course impossible that the social organization dependent on the parallelogram form could be developed. Nearly two hundred inmates occupied it for some time, but they lived with so little of the promised harmony of The New Moral World, that the country people called the place Babel.

It was treated as a great moral nuisance, and the society soon breaking up, the building was levelled with the ground, much to the satisfaction of the neighbourhood. By this time, indeed, Owen had turned the tide of popular feeling against him by views calculated to be extremely offensive. Among his observations on the habits of the manufacturing population, he had laid it down that in their moral constitution vice and superstition alternated. To a person coming, as he did, from England, into close contact with the most unrestrained section of the Scottish population, the rigidness of the Calvinistic principles of the people would naturally appear in startling and unpleasing contrast with their deep vices. To fathom the depths of such a social system, and adjust the proper remedies, required a stronger judgment than Owen's, and a less presumptuous will. He immediately began an unequal theological contest, in which he omitted nothing that could rouse the jealousy and indignation of the clergy, or shock the prejudices of the people. He was not only to be the lawgiver, but the prophet of his system, establishing in it a new rational religion of his own; and though he did not require a communion of wives as well as a communion of goods, yet he made the marriage tie dissolvable with alarming facility.

On the other hand, the supporters of free political institutions were alarmed by the complex official hierarchy which was to rule with absolute power. It is true that there was in the eyes of its constructor a perfectly efficient check on tyranny, injustice, and rapacity, but it was not sufficient to convince the rest of the world. It arose from the perfection of nature which men would obtain under the rational system of society—their entire divestiture of all human passions and prejudices. These expectations, along with assurances that every human being would possess under the new system an abundance of everything desirable to an inhabitant of the world, were conveyed in unceasing streams of such mellifluent prophecies as the following:—

"In these separate societies there will be no contest or competition between the members; nor yet will there be any between the societies, however near or distant or numerous they may be . . . all will be trained and educated to acquire the greatest amount of useful and valuable knowledge; and then possessing the spirit of charity, kindness, and love for all their fellows, which spirit will be given to them by their new mode of instruction from birth,—all will of necessity feel the greatest desire to aid and assist each other to the full extent of their powers, and their greatest pleasure will arise from being thus occupied. There will also be in *each* of these societies the due proportion of manufactures, trades, and commerce, for the number of members and their wants; but manufactures, trades, and commerce will be established and conducted on principles very different to those prevalent throughout present society. . . . In this manner will these societies, being always supplied with the latest and best machinery for performing whatever it can be made to well execute, produce the greatest amount of the most valuable wealth in the shortest time and in the best manner, so as to produce health and enjoyment to all while engaged in the department of production."[1]

Owen appeared to have obtained another and a still more satisfactory opportunity of attesting his principles in the year 1843. The communists and socialists, acting under the impulses to be presently mentioned, had collected a considerable sum of money, and resolved to centralize their societies under the authority of a congress, which was to meet in Harmony Hall, an edifice built by them in Hampshire, to serve both as a central office for socialist organization, and a model for other quadrangular establishments. Here, on the 10th of May, Mr Owen was solemnly chosen President of the Congress. From that time, in the official organs of his sect, we find him making progresses among the provincial establishments, like a sovereign inspecting the several local institutions of his realm; and it would be recorded that he visited the Concordium, and after having inspected the premises, was presented with an address by the Pater and Elder, and was entertained by the whole family at dinner.

But it soon turned out that a total difference of view lay between Owen and his supporters. He, ever looking to the broad measures of universal human regeneration over which he had been now for several years a theoretic dreamer, contemplated only the blessings which the world was to reap from an entire social regeneration, while his disciples were bent on obtaining personal advantages from the immediate application of its principles. These they did not find at Harmony Hall, and they consequently deposed their chief. The history of the new race of communists and socialists, who had thus lost all respect for the patriarch of their sect, must be briefly given.

While the policy of protection to native agriculture and other interests prevailed, and the Apprentice Act, with various corporate restrictions on labour, was in full observance, the workman, far from being taught that he must depend on his own industry and prudence, was led to expect that the state would take care of him. It professed to protect the landed and farming interest, the shipping interest, and various other separate interests. It did not entirely neglect the workman. By acts for restraining the introduction of foreign silk and cotton goods, and by various other legislative efforts, he was professedly protected. Still, while the landowner, the farmer, the shipowner, and the master-manufacturer were rich, he was poor and miserable. He maintained, therefore, that what the state had done for them it had not done for him, and he hailed the doctrines of the communists and socialists as affording him a more entire and effective protection. Hence those principles had spread so widely from the passing of the Reform Bill downwards as to create much alarm. While some wisely considered that free discussion, and the remedy of admitted evils, would be the best cure for this social disease; others proposed a resort to coercion. On the 20th of January 1840, the Bishop of Exeter asked in the House of Lords if the government had taken any steps to repress the progress of socialism, and

[1] *The Book of the New Moral World, explanatory of the Elements of the Science of Society*, by Robert Owen, I., t. xi., p. 19.

was answered by Lord Normanby, the home secretary, that no such steps had been taken; but that, if the persons referred to were guilty of any offence, the proper proceedings would be adopted. On the 24th the bishop resumed the discussion, on the presentation of a petition by 40,000 of the clergy, magistrates, merchants, and traders of Birmingham, praying their Lordships to interpose for the suppression of socialism. He stated that "Great Britain was divided into fourteen principal districts. A congress met annually, which assumed to itself legislative power for directing the whole proceedings of the general body. That congress assembled, he believed, at different points in different years. Two delegates were sent from all the places where there were charter branches of the society, not amounting to less than 61. There was besides an executive body, the Central Court. He did not know how often that met; but he believed it was in a constant state of capacity for meeting. That body superintended the formation of associations throughout the land, and appointed missionaries to each of the fourteen districts into which the United Kingdom was divided by the society. There were no fewer than 350 towns regularly visited by these missionaries."—Hansard's *Debates*.

The vehement and intolerant terms in which the bishop demanded the suppression of the offensive doctrines created an immediate reaction in their favour. Whatever amount of adhesion they had obtained was speedily increased, and several able periodicals for some time represented the opinions of various clusters of communists and socialists. Free discussion, however, and the known failure of the partial experiments which had occurred, accompanied by the abolition of the protective system, soon undermined any position which such doctrines had obtained in the public mind. The revolution of 1848 was followed by an expiring flash. The communistic periodicals, after a brief period of excitement and success, dropped one by one out of existence. There is at the present moment no known public organ of these systems in Britain; and while this has been the happy result of entire freedom of discussion, there can be little doubt that, in those nations where opinion has been coerced, a communistic spirit of the most dangerous kind still [illegible] session offers itself, to burst forth in a consuming flame. (J.H.B.)

COMMUNITY, a society of people living in the same place, under the same laws, regulations, and customs. It also signifies common possession or enjoyment; as *community of goods*.

COMNENA. See Anna Comnena.

COMO, Lake of, *Lago di Como*, the *Lacus Larius* of the ancients, in the province of Como, Lombardy, is, from the beauty of its situation and the delightful mildness of its climate, the most celebrated lake of northern Italy. It is formed by the Adda and numerous streams and rivulets which empty themselves into it. The lake is of a very irregular form, about 35 miles in length; its greatest breadth three miles, but its general breadth is only between one and two. The southern portion is divided by the promontory of Bellagio into two branches, the one extending S.W. to the city of Como and retaining the name of Lago di Como, and the other, by which the Adda makes its exit, extending S.E. to Lecco, and hence called the Lago di Lecco. Steamers ply between its principal towns, but its navigation is frequently rendered hazardous by sudden squalls. The banks are formed of precipitous mountains from 2000 to 3000 feet in height, in some places overhanging the water, in others partially covered with wood and studded with hamlets, cottages, villas, chapels, and convents. The most beautiful point of view is undoubtedly at Bellagio. The upper waters are there seen winding up to the very foot of the higher chain of the Alps, and terminating within a short distance of the terrific pass of the Splugen. The loftier hills bordering the lake of Lecco rise on one side, while on the other the wider expanse of the lower lake retires behind the beautiful foreground rocks and hanging woods that form the promontory of Bellagio. Numbers of trading boats are seen gliding under the broad reflection of the gigantic mountains, their white sails occasionally gleaming in the sunshine; while several little villages lie scattered along the shores.—*Sketches of Italy*.

Como, a province in the Austrian kingdom of Venetian Lombardy, bounded on the N. by Switzerland and Valteline, on the E. by Bergamo, on the S. by Milan, and on the W. by the kingdom of Sardinia. Being towards the foot of the Alps, the northern part is mountainous, and the southern undulating. Between the spurs of the mountains are some beautiful and fertile valleys. It extends over 1000 square miles, and in 1851 had 423,206 inhabitants. The chief productions are, corn, wine, fruit, and fish. The manufactures are silk and linen articles; but the inhabitants of many of the districts subsist by making looking-glasses, spectacles, and mathematical, surgical, and physical instruments. The purity of the atmosphere attracts many of the richer families of Italy to the district, where they have built numerous rural villas.

Como, city of. See Comum.

COMORES, or Comoro Islands, a group of 4 volcanic islands in the Mozambique Channel, between Madagascar and the east coast of Africa. The group consists of Angaziya or Great Comoro, Anzuan or Johanna, Mohilla, and Mayotta. The islands are mountainous and fertile, affording pasturage to large herds of cattle. The Great Comoro contains 12,000 inhabitants, who are chiefly Arabs, and almost all Mohammedans.

COMORIN, Cape, the southern extremity of the continent of India, situated in the native state of Travancore. According to Captain Horsburgh, it is formed of a circular low sandy point, not discernible above the distance of about four leagues from sea. The land is bold, and may be approached within about a mile and a half or two miles; beyond which it is dangerous for ships to proceed in consequence of the rocky character of the coast. An elevated summit, some distance north of the cape, has by navigators sailing at a distance been sometimes mistaken for the cape itself. Long. 77. 35. Lat. 8. 5.

COMPACT (Lat. *compactus, compingo*), in *Philosophy*, is said of bodies which are of a close, dense, and heavy texture.

Compact (Lat. *compactum*), in a legal sense, an agreement or contract between parties.

COMPANY, a collective term, understood of several persons assembled together. The word is derived from the French *compagnie*, and that from *companio* or *companies*, which, Chifflet observes, are found in the Salic law, tit. 66, and are properly military words, being understood of soldiers who, in modern phrase, are comrades or messmates, that is, lodge together and eat together. The real etymology of the word would therefore seem to be the Latin *cum*, with, and *panis*, bread. Another etymon also has been proposed —namely, that it is a compound of *cum* and *pannus*, cloth (Spanish *paño*, cloth, Teutonic *fahne* or *vaan*, a flag); hence "company" would signify a body of soldiers under one standard. It may be added, that in some Greek authors under the Western Empire the word κουμπανία occurs in the sense of *society*. In modern military phrase, company denotes a subdivision of a regiment of infantry, under the command of a captain, and consisting of from 60 to 100 men.

Company also denotes a number of persons united for the same purpose in any joint concern; as a company of merchants, of mechanics, or of players. The word is applicable to private partnerships, or to incorporated bodies.

The mechanics of all corporations, or towns incorporated, are thus erected into companies, with privileges and immu-

Company. nities bestowed on them by royal charter. The original object of these associations was the protection and advancement of trade; and they might have answered some useful purposes in the rude age in which they were established. But they have long ceased to be useful; and, so far from promoting, they tend to obstruct the progress of industry. The privilege which they possessed of enacting bye-laws for the regulation of their own members, enabled them to pass rules for the purpose of maintaining a strict monopoly of their trade. No one was at liberty within the city over which their authority extended to exercise his calling without becoming a freeman of the corporation, and paying the necessary dues, which were often so high as to prevent a workman from ever prosecuting his business as a master. The restraints imposed by these corporations are now, however, happily either antiquated or abolished.

The term company seems more particularly appropriated to large commercial associations vested by charter with peculiar privileges.

"There are some branches of industry which must be carried on in some degree in common, but with respect to the prosecution of which the views and interests of individuals are so very various, that government is obliged to interfere to regulate their respective pretensions. The salmon fishery is an instance of this sort. Government has not only to fix when the fishery shall begin and terminate, but it has also to decide how far the proprietors near the mouths of rivers shall be entitled to carry weirs and other fishing machinery into their channels.

"Undertakings in which the hazard is considerable, or that require, in order to their successful prosecution, a larger amount of capital than can be conveniently furnished by individuals, are usually carried on by companies, which frequently require the sanction of the legislature to their formation. And when these bodies claim no peculiar privileges, but are formed on the principle of coming into fair and open competition with each other and with individuals, there does not seem, in ordinary cases, to be any good reason for opposing their incorporation. But in the event of their claiming any peculiar privileges, or if the purpose for which they seek to be incorporated would necessarily give them such privileges, the fair presumption being that they will employ them to promote their own private interests in preference to those of the public, they should not be incorporated without the maturest deliberation. Still, however, there are many cases in which it is for the public advantage that companies with such privileges should be established, under proper regulations. A city is ill supplied with water; there is a copious spring ten or twenty miles distant, and a company offer to bring this water into the city, on their getting an act authorizing them to appropriate the spring, and to lay pipes or to construct an aqueduct for the conveyance of the water. In this case the object in view is most desirable; but it is plain that, were the authority they require given unconditionally to the company, it would be in their power to raise the price of water to the highest level, and perhaps to make an enormous profit, to the great injury of the inhabitants. The same is the case with railways and canals. It is of the greatest importance that the best means of communication should be established between all great towns; and every facility should be given for the formation of companies for their construction. But then it is to be borne in mind, that there is always some one line between any two places decidedly better fitted for a railway or canal than any other line; and if a company get an act of parliament authorizing them to appropriate this line, they get, in fact, a substantial monopoly of the traffic between the places connected by the railway or canal, and may, in consequence, supply the public with inferior accommodation, and add proportionally to their charges. And hence, in authorizing the establishment of companies for such purposes, such conditions should be inserted in the acts as may be adequate for the protection of the public interests. This important consideration has, however, been far too little attended to. In this country, we have in most cases contented ourselves with endeavouring to provide against overcharges, by fixing maximum rates of profit on the company's stock, and maximum rates of charge for the services to be performed by them. But overcharges are not the only evils to be guarded against; and if they were, experience has shown that the restrictions referred to are ill fitted to attain their object. A limitation of the rate of dividend tempts a prosperous company to engage in subsidiary undertakings, though of doubtful utility and profit; and it farther tempts them to countenance an extravagant system of management; to give by underhand methods unfair advantages to their proprietors; and, in short, to adopt every device by which they may retain the highest (or unnecessarily high) rates of charge, without apparently raising their revenue above the sum required to defray the maximum rate of dividend. A limitation of the rates of charge is equally ineffectual. The rates are uniformly such as it is supposed will yield, when the railway or other public work is about to be constructed, an adequate remuneration for the capital to be vested in it. But the fair presumption is, that the country will continue to increase in wealth and population for an indefinite period, with the same rapidity that she has increased since the close of the American war; and if so, these rates will, in a few years, yield a profit or interest far beyond any that was in the contemplation of the parties when the work was entered upon. Now, it is plain that in such cases there will be no way of abating the company's profits, or, which is the same thing, its charges against the public, except by the formation, at a vast expense, of a new, and otherwise, perhaps, a perfectly unnecessary road. Hence the obvious expediency, in passing acts for the formation of railways, canals, docks, water and gas companies, and other public works, of reserving power to government to make periodical revisions of the tolls or rates of charge for the services to be performed; to control their management, in the view of providing for the greater security and convenience of the public; and, if needs be, to purchase up the works on reasonable terms."—(*M'Culloch's Principles of Political Economy.*)

Comparative Anatomy || Comparison.

COMPARATIVE ANATOMY. See ANATOMY, vol. iii., p. 74.

COMPARATIVE Degree, in *Grammar*, that between the positive and superlative degrees, expressive of any particular quality as above or below the level of another. See GRAMMAR.

COMPARISON, in a general sense, the consideration of the relation between persons or things, with a view to discover their agreement or difference.

COMPARISON, in *Rhetoric*, a figure by which two things are considered with regard to a third that is common to both.

Instruction is the principal, but not the only end of comparison. It may be employed with success in putting a subject in a strong point of view. A lively idea is formed of a man's courage by likening it to that of a lion; and eloquence is exalted in our imagination by comparing it to a river which overflows its banks, involving all in its impetuous course. The same effect is produced by contrast. A man in prosperity becomes more sensible of his happiness by comparing his condition with that of a person in want of bread. Thus comparison is subservient to poetry as well as to philosophy.

Comparisons serve two purposes; when addressed to the understanding, their purpose is to instruct; when to the heart, their purpose is to please. The means which contribute to the latter are various; as, first, the suggesting of some unusual resemblance or contrast; secondly, the set-

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ting of an object in the strongest light; thirdly, the associating of an object with others which are agreeable; fourthly, the elevating of an object; and, lastly, the depressing of it. And that comparisons may thus afford pleasure, will be made evident by examples, after premising some general observations.

Objects of different senses cannot properly be compared together; for such objects are totally separated from one another, and have no circumstance in common to admit either resemblance or contrast. Objects of hearing may be compared together, as also of taste, of smell, and of touch; but the chief fund of comparison consists of objects of sight; because, in writing or speaking, things can only be compared in idea, and the ideas of sight are more distinct and lively than those of any other sense.

It has no good effect to compare things by way of simile that are of the same kind, nor to contrast things of different kinds. The following is a comparison built upon a resemblance so obvious as to make little or no impression. Speaking of the fallen angels searching for mines of gold, Milton says,

A numerous brigade hasten'd: as when bands
Of pioneers, with spade and pickaxe arm'd,
Forerun the royal camp, to trench a field
Or cast a rampart.

In the following passage, again, we have things contrasted which are of different kinds.

Queen. What! is my Richard both in shape and mind
Transform'd and weak? Hath Bolingbroke depos'd
Thine intellect? Hath he been in thy heart?
The lion, dying, thrusteth forth his paw,
And wounds the earth, if nothing else, with rage
To be o'erpower'd: and wilt thou, pupil-like,
Take thy correction mildly, kiss the rod,
And fawn on rage with base humility?

This comparison has scarcely any force. A man and a lion are of different species, and therefore are proper subjects for a simile; but there is no such resemblance between them in general as to produce any strong effect by contrasting particular attributes or circumstances.

A third general observation is, that abstract terms can never be the subject of comparison, otherwise than by being personified. Shakspeare compares adversity to a toad, and slander to the bite of a crocodile; but in such comparisons these abstract terms must be imagined to be impersonations, not entities.

To have a just notion of comparisons, they must be distinguished into two kinds; one common and familiar, as where a man is compared to a lion in courage, or to a horse in speed; and another more distant and refined, as where two things which have in themselves no resemblance or opposition are compared with respect to their effects. Thus there is no resemblance between a flower and a song; and yet they may be compared with respect to their effects, because the emotions they produce in the mind are felt or imagined to be similar.

We now proceed to illustrate, by particular instances, the different means by which comparisons, whether of the one kind or the other, can afford pleasure; and, in the order above established, we shall begin with such instances as are agreeable, by suggesting some unusual resemblance or contrast. Thus:

Sweet are the uses of Adversity,
Which, like the toad ugly and venomous,
Wears yet a precious jewel in her head.

Again:

See how the morning opes her golden gates,
And takes her farewell of the glorious sun;
How well resembles it the prime of youth,
Trimm'd like a younker prancing to his love.

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Once more:

Thus they their doubtful consultations dark
Ended, rejoicing in their matchless chief:
As when from mountain tops the dusky clouds
Ascending, while the north wind sleeps, o'erspread
Heaven's cheerful face, the lowering element
Scowls o'er the darken'd landscape snow, and shower;
If chance the radiant sun [illegible] sweet
Extends his ev'ning beam, the fields revive,
The birds their notes renew, and bleating herds
Attest their joy, that hill and valley rings.

None of the foregoing similes tends to illustrate the principal subject, and therefore the chief pleasure they afford must arise from suggesting resemblances which are not obvious; for undoubtedly a beautiful subject introduced to form the simile affords a separate pleasure, which is felt in the similes mentioned, particularly in that cited from Milton.

Following the order above mentioned, the next effect of a comparison is to place an object in a strong point of view; which effect is remarkable in the following example:

As when two scales are charg'd with doubtful loads,
From side to side the trembling balance nods
(While some laborious matron, just and poor,
With nice exactness weighs her woolly store),
Till pois'd aloft, the resting beam suspends
Each equal weight, nor this nor that descends;
So stood the war, till Hector's matchless might,
With fates prevailing, turn'd the scale of fight.
Fierce as a whirlwind up the wall he flies,
And fires his host with loud repeated cries.

As words convey but a faint and obscure notion of great numbers, a poet, to give a lively notion of the object he describes, with regard to number, does well to compare it to what is familiar and commonly known. Thus Homer, in one passage, compares the Grecian army in point of number to a swarm of bees; and in another to that profusion of leaves and flowers which appear in the spring, or of insects in a summer's evening. Thus also Milton,

——— As when the potent rod
Of Amram's son in Egypt's evil day
Wav'd round the coast, up call'd a pitchy cloud
Of locusts, warping on the eastern wind,
That o'er the realm of impious Pharaoh hung
Like night, and darken'd all the land of Nile;
So numberless were those bad angels seen,
Hov'ring on wing under the cope of hell,
'Twixt upper, nether, and surrounding fires.

Comparisons like these have, by some writers, been condemned for the lowness of the images introduced, but without reason; for, in regard to number, they place the principal subject in a strong light.

The foregoing comparisons operate by resemblance; others have the same effect by contrast. Thus:

York. I am the last of noble Edward's sons,
Of whom thy father, prince of Wales, was first.
In war was never lion rag'd more fierce,
In peace was never gentle lamb more mild,
Than was that young and princely gentleman.
His face thou hast, for even so look'd he,
Accomplish'd with the number of thy hours;
But when he frown'd, it was against the French,
And not against his friends. His noble hand
Did win what he did spend; and spent not that
Which his triumphant father's hand had won.
His hands were guilty of no kindred's blood,
But bloody with the enemies of his kin.
Oh, Richard, York is too far gone with grief,
Or else he never would compare between.

Milton has a peculiar talent for embellishing the principal subject by associating it with others that are agreeable; which is the third end of a comparison. Similes of this kind have besides another effect: they diversify the narration, by new images which are not strictly necessary to the comparison, and are short episodes, which, without drawing us from the principal subject, afford great delight by their beauty and variety. Thus, in Milton:

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He scarce had ceas'd, when the superior fiend
Was moving toward the shore, his pond'rous shield,
Ethereal temper, massy, large, and round,
Behind him cast: the broad circumference
Hung on his shoulders like the moon, whose orb
Through optic glass the Tuscan artist views
At evening from the top of Fesole,
Or in Valdarno, to descry new lands,
Rivers, or mountains, in her spotty globe.

Next, with regard to comparisons which aggrandize or elevate, these affect us more than any other species of similes, as will be evident from the following instance:—

As when a flame the winding valley fills,
And runs on crackling shrubs between the hills,
Then o'er the stubble up the mountain flies,
Fires the high woods, and blazes to the skies,
This way and that the spreading torrent roars;
So sweeps the hero through the wasted shores
Around him wide, immense destruction pours,
And earth is deluged with the sanguine show'rs.

The last article mentioned is that of lessening or depressing a hated or disagreeable object; which is effectually done by comparing it to anything low or despicable. Thus Milton, in his description of the rout of the rebel angels, happily expresses their terror and dismay in the following simile:—

——————— As a herd
Of goats or timorous flock together throng'd,
Drove them before him thunder-struck, pursu'd
With terrors and with furies to the bounds
And crystal wall of heav'n, which opening wide,
Roll'd inward, and a spacious gap disclos'd
Into the wasteful deep, the monstrous sight
Struck them with horror backward, but far worse
Urg'd them behind; headlong themselves they threw
Down from the verge of heav'n.

The different purposes of comparison, and the various impressions it makes on the mind, may easily be understood from these familiar examples. But it is more difficult to lay down rules concerning the propriety or impropriety of comparisons; in what circumstances they may be introduced, and in what circumstances they are out of place. It is evident that a comparison is not proper upon every occasion: a man in his cool and sedate moments is not disposed to poetical flights, nor to sacrifice truth and reality to the delusive phantasies of the imagination; far less is he so disposed when oppressed with care, or interested in some important transaction which occupies his whole mind. On the other hand, it is observed, that a person, when elevated or animated by any passion, is disposed to elevate or animate all his subjects; he avoids familiar names, exalts objects by circumlocution and metaphor, and gives even life and voluntary action to inanimate beings. In this ardour of mind, the highest poetical flights are indulged in, and the boldest similes and metaphors relished. But without soaring so high, the mind is frequently in a tone to relish chaste and moderate ornament; such as comparisons which place the principal object in a strong point of view, or embellish and diversify the narration. In general, when by any animating passion, whether pleasant or painful, an impulse is given to the imagination, we are in that condition which predisposes to every sort of figurative expression, and in particular to comparisons. This is in a great measure evident from the comparisons already mentioned, and shall be further illustrated by other instances. Love, for example, in its infancy rousing the imagination, prompts the heart to display itself in figurative language, and in similes. Thus:—

Come, gentle night; come, loving black-brow'd night!
Give me my Romeo: and when he shall die,
Take him and cut him out in little stars,
And he will make the face of heav'n so fine
That all the world shall be in love with night,
And pay no worship to the garish sun.

Comparison.

But it will better illustrate the present head, if we give examples where comparisons are improperly introduced. Similes are not the language of a man in his ordinary state of mind, despatching his daily and usual work; for which reason the following speech of a gardener to his servant is extremely improper:

Go, bind thou up yon dangling apricots,
Which, like unruly children, make their sire
Stoop with oppression of their prodigal weight:
Give some supportance to the bending twigs.
Go thou, and, like an executioner,
Cut off the heads of two fast growing sprays,
That look too lofty in our commonwealth:
All must be even in our government

Rooted grief, deep anguish, terror, remorse, despair, and all the severe dispiriting passions, are declared enemies, perhaps not to figurative language in general, but undoubtedly to the pomp and solemnity of comparison. Upon this account the simile pronounced by young Rutland, under terror of death from an inveterate enemy, and praying for mercy, is unnatural:

So looks the pent-up lion o'er the wretch
That trembles under his devouring paws;
And so he walks insulting o'er his prey,
And so he comes to rend his limbs asunder.
Ah, gentle Clifford, kill me with thy sword,
And not with such a cruel threat'ning look.

A man exhausted and dispirited after losing a battle is not disposed to heighten or illustrate his discourse by similes.

York. With this we charg'd again; but out! alas,
We bodg'd again, as I have seen a swan
With bootless labour swim against the tide,
And spend her strength with over-matching waves.
Ah! hark, the fatal followers do pursue,
And I am faint and cannot fly their fury
The sands are number'd that make up my life;
Here must I stay, and here my life must end.

Similes thus unseasonably introduced are finely ridiculed in the *Rehearsal.*

Bayes. Now here she must make a simile.
Smith. Where's the necessity of that, Mr Bayes?
Bayes. Because she's surprised; that's a general rule. You must ever make a simile when you are surprised; 'tis a new way of writing.

A comparison is not always faultless even where it is properly introduced; for, like other human productions, it may fall short of its end. Of this defect instances are not rare even among good writers; and to complete the present subject, it will be necessary to make some observations upon such faulty comparisons. Nothing can be more erroneous than to institute a comparison too faintly; a distant resemblance or contrast fatigues the mind with its obscurity, instead of amusing it, and tends not to fulfil any one end of a comparison. The following similes seem to labour under this defect:—

K. Rich. Give me the crown. Here, cousin, seize the crown.
Here on this side, my hand; on that side, thine.
Now is this golden crown like a deep well,
That owes two buckets, filling one another;
The emptier ever dancing in the air,
The other down, unseen, and full of water;
That bucket down, and full of tears, am I,
Drinking my griefs, whilst you mount up on high.

York. My uncles both are slain in rescuing me:
And all my followers to the eager foe
Turn back, and fly like ships before the wind,
Or lambs pursued by hunger-starved wolves.

The last of these two similes is good; the first, because of the faintness of the resemblance, produces no effect, and crowds the narration with an useless image.

In an epic poem, or in any elevated subject, a writer ought to avoid raising a simile upon a low image, which never fails to lower the principal subject. In general, it is

Compass ‖ Compasses.

a rule, that a grand object ought never to be resembled to one that is diminutive, however delicate the resemblance may be; for it is the peculiar character of a grand object to fix the attention and dilate the mind; in which state, it is disagreeable to contract the mind to a minute object, however elegant. The comparing an object to one that is greater, has, on the contrary, a good effect, by raising or exalting the mind; for one passes with satisfaction from a small to a great object, but cannot be drawn down, without reluctance, from great to small. Hence the following simile is faulty:

So burns the vengeful hornet (soul all o'er),
Repulsed in vain, and thirsty still of gore;
(Bold son of air and heat) on angry wings
Untamed, untired, he turns, attacks, and stings.
Fired with like ardour, fierce Atrides flew,
And sent his soul with every lance he threw.

An error opposite to the former is the introducing of a resembling image, so elevated or great as to bear no proportion to the principal subject. The remarkable disparity of the things compared being the most striking circumstance, seizes the mind, and never fails to depress the principal subject by contrast, instead of raising it by resemblance. And if the disparity be exceedingly great, the simile assumes an air of burlesque; nothing being more ridiculous than to force an object out of its proper rank in nature, by assimilating it to one greatly superior or greatly inferior. This will be evident from the following comparison:—

Loud as a bull makes hill and valley ring,
So roar'd the lock when it released the spring.

Such a simile regarding the simplest of acts, that of opening a lock, is absurd from its inaptitude, and burlesque from its extravagant disproportion.

COMPASS, or *Mariner's Steering Compass*. See Navigation, § *Mariner's Compass*.

Compass-Dials, small horizontal dials, fitted in brass or silver boxes, for the pocket, to show the hour of the day, by the direction of a needle that indicates how to place them right, by turning the dial about till the cock or style stands directly over the needle. An objection to this instrument is, that it can never be very exact, because of the variation of the needle itself. See Dialling.

COMPASSES, or *Pair of Compasses*, a mathematical instrument for describing circles, measuring figures, &c.

The common compasses consist of two sharp-pointed branches or legs of metal, joined together at the top by a rivet, on which they move as on a centre. One of the legs is sometimes so contrived as to admit of the substitution of a point with a pen or a pencil for the convenience of describing figures more visibly.

Compasses of Three Legs, or *Triangular Compasses*, are, setting aside the excess of a leg, of the same structure with the common ones. Their use is to take three points at once, so as to form triangles, and for similar purposes.

Beam-Compasses consist of a long branch, or beam, of brass or wood, carrying two brass cursors, the one fixed at one end, the other sliding along the beam, with a screw to fasten it occasionally. To the cursors may be screwed steel or pencil points. Beam-compasses are used to draw large circles, to take great extents, &c. To the fixed cursor is sometimes applied an adjusting or micrometer screw, by which an extent is obtained to extreme nicety.

Clockmakers' Compasses are joined like the common compasses, with a quadrant or bow to keep the instrument firm at any opening. They are made very strong, with the points of their legs of well-tempered steel, being used to draw lines on pasteboard or copper.

Cylindrical and Spherical Compasses consist of four branches, joined in a centre, two of which are circular and two flat, being a little bent on the ends. Their use is to take the diameter, thickness, or calibre of round or cylindric bodies, such as cannons, pipes, &c.

Elliptic Compasses are used to draw ellipses or ovals. They consist of a beam about a foot long, bearing three cursors, to one of which may be screwed points of any kind. To the bottom of the other two are rivetted two sliding dovetails, adjusted in grooves made in the cross branches of the beam. As the dovetails have a motion every way, by turning about the long branch, they go backwards and forwards along the cross; so that when the beam has gone half way about, one of these will have moved the whole length of one of the branches; and when the beam has got quite round, the same dovetail will have got back the whole length of the branch. The use of this compass is easy; by turning round the long branch, the ink, pencil, or other point, will draw the ellipsis required. Compasses.

German Compasses have their legs a little bent outwards towards the top; so that when shut the points only meet.

Hair Compasses are so contrived inside, by a small adjusting screw to one of the legs, as to take an extent to a hair's breadth.

Lapidaries' Compasses, a piece of wood in form of the shaft of a plane, cleft at top, as far as half its length; and with this the angles, &c., of jewels and precious stones are measured. There is in the cleft a little brass rule, fastened at one end by a pin, but so that it may be moved in the manner of a brass level. With this kind of square lapidaries take the angles of the stones, laying these on the shaft as they cut them.

Proportional Compasses are those whose joint lies between the points terminating each leg. They are either simple or compound. In the former the centre is fixed, so that one pair of these serves only for one proportion. The latter consist of two parts or sides of brass, which lie upon each other so nicely as to appear but one when they are shut. The sides open easily, and move about a centre, which is itself moveable in a hollow canal cut through the greater part of their length. To this centre, on each side, is affixed a sliding piece, of a small length, with a fine line drawn on it, serving as an index, to be set against other lines or divisions placed upon the compasses on both sides. These lines are, 1. a line of lines; 2. a line of superficies, areas, or planes; 3. a line of solids; 4. a line of circles, or rather of polygons to be inscribed in circles. These lines are all unequally divided; the three first from one to twenty, the last from six to twenty.

The use of the first is to divide a line into any number of equal parts; by the second and third are found the sides of like planes or solids in any given proportions; and by the fourth, circles are divided into any number of equal parts, or any polygons inscribed in them.

Spring Compasses, or dividers, those with an arched head, which by its spring opens the legs; the opening being directed by a circular screw fastened to one of the legs and let through the other, worked with a nut.

Trisecting Compasses consist of two central rules, and an arch of circles of 120 degrees, immoveable, with its radius, which is fastened with one of the central rules, like the two legs of a sector, in order that the central rule may be carried through all the points of the circumference or the arch. The radius and rule should be as thin as possible; the rule fastened to the radius should be hammered cold, to attain the greater elasticity; and the breadth of the central rule should be triple that of the radius. There must also be a groove in this rule, with a dovetail fastened on it for its motion, and a hole in the centre of each rule. The use of this instrument is to facilitate the trisection of angles geometrically.

Turn-up-Compasses. The body of this instrument is like the common compasses; but towards the bottom of the legs, outside, are added two other points besides the usual ones, the one of which carries a drawing pen point, and the

Compiegne ‖ Complement.

other a port-cravon, both adjusted so as to turn round, and be in the way of use, or out of it, as occasion requires.

COMPIEGNE, a town of France, department of Oise, and capital of a cognominal arrondissement stands on the left bank of the Oise, he crossed by a handsome bridge of 3 arches, and on the Paris and St Quentin railway, 36 miles E. by S. of Beauvais. The town is ancient and ill built, but contains some fine edifices, among which may be mentioned the town-house, new theatre, several of the churches, and the royal palace. This last is for extent and magnificence one of the first of the kind in France. It was built under Louis XV. and XVI., and renovated by Napoleon; and is surrounded by extensive gardens, adjoining which is a forest covering 37,000 acres. Compiegne was formerly strongly fortified; and it was at the siege of this place in 1430 that Joan of Arc was taken prisoner by the English. There is a communal college, a tribunal of primary instance, and a public library of 28,000 volumes. It has manufactures of hosiery, muslins, and ropes; and a considerable trade in corn and wood. Pop. (1851) of town 8986; of arrondissement, 98,190.

COMPITALIA, or Ludi Compitalitii, in *Antiquity*, a moveable feast celebrated annually at Rome in honour of the Lares. It was so called from *compita, i. e.*, a place where several roads meet, in which it was held. (Macrob. *Saturn.* i. 7.) The Compitalia were more ancient than Rome itself; though by some writers the institution is ascribed to Tarquinius Priscus, in commemoration of a miraculous circumstance attending the birth of Servius Tullius, which induced the belief that he was the son of a Lar Familiaris. The story is related by Pliny (xxxvi. 27). Dionysius Halicarnasseus (iv. 14.) ascribes the institution to Servius Tullius; and in describing the Compitalia as celebrated in his time, he observes, that the rites were performed by slaves, who were permitted during these ministrations to lay aside every badge of servitude. He further adds, that this festival was celebrated a few days after the Saturnalia. Macrobius observes (*loc. cit.*) that the Compitalia were re-established by Tarquin the Proud, on occasion of a response of the oracle that they should sacrifice *capita pro capitibus; i. e.*, that for the health and prosperity of each family a child was to be sacrificed to Mania (madness) the mother of the Lares. This abominable practice was abolished by the consul Junius Brutus, after the expulsion of the Tarquins; and, in order to satisfy the oracle, garlic and heads of poppies were offered in place of human victims. During the civil wars the Compitalia fell into disuse, but were restored by Augustus, whose Lares were substituted for those of the state. At the same time, for the purpose of superintending their worship, he instituted an order of priests, who were chosen from the Libertini, and were designated Augustales. These must not be confounded with the Augustales appointed to attend to the worship of that emperor after his decease. (See Zumpt, *De Augustalibus*, &c.) The Compitalia were celebrated always during winter, and usually about the beginning of January. The words in which the festival was announced are preserved in Macrobius (*Saturn.* i. 4), and by Aulus Gellius (x. 24). During its celebration, each family placed at the door of their house the statue of the goddess Mania, and also hung up at their doors figures of wool, representing men and women; accompanying them with supplications that the Lares and Mania would be contented with those figures, and spare the people of the house.

COMPLEMENT (Lat. *complementum*, from *compleo*, to fill up), the full number or quantity requisite to completeness: that which is wanted to complete some quantity or thing. Thus the complement of an angle is the difference between the given angle and a quadrant, or 90°. To find the complement of any given angle expressed in degrees, minutes, and seconds, subtract it from 90° if acute; or if obtuse, subtract 90° from it. The complements of a parallelogram are the two spaces which, together with the parallelograms about the diagonal, make up the whole figure.

Complex ‖ Complexion.

COMPLEX (Lat. *complex*, from *complico*, to fold together), composed of two or more parts; composite; as a complex being, a complex term, a complex idea.

COMPLEXION, the temperament, habitude, and natural disposition of the body; but it is more particularly used to signify the colour of the face and skin.

Few questions in philosophy have engaged the attention of naturalists more than the diversities among the human species, among which that of colour is the most remarkable. The great differences in this respect have given occasion to several authors to assert that the whole human race have not sprung from one original, but that as many different species of men were at first created as there are now different colours to be found among them. It is certainly a matter of no small difficulty to account for the remarkable variations of colour that are to be found among different nations. On this subject Dr Hunter published a thesis, in which he considers the matter more accurately than has commonly been done, and determines absolutely against any specific difference among mankind. He introduces his subject by observing, that when the question has been agitated, whether all the human race constituted only one species or not, much confusion has arisen from the sense in which the term *species* has been adopted. He therefore thinks it necessary to set out with a definition of the term. He includes under the same species all those animals which produce issue capable of propagating others resembling the original stock from whence they sprung. This definition he illustrates, by having recourse to the human species as an example; and, in this sense of the term, he concludes that all of them are to be considered as belonging to the same species. And as, in the case of plants, one species comprehends several varieties depending upon climate, soil, culture, and similar accidents; so he considers the diversities of the human race to be merely varieties of the same species, produced by natural causes. Of the different colours observable among mankind, he gives the following view:—

Black.	Africans under the line. Inhabitants of New Guinea. Inhabitants of New Holland.
Swarthy.	The Moors in the northern parts of Africa. The Hottentots in the southern parts of it.
Copper coloured.	The East Indians.
Red coloured.	The American Indians.
Brown coloured.	Tartars. Persians. Arabs. Africans on the coast of the Mediterranean. Chinese.
Brownish.	The inhabitants of the southern parts of Europe; as Sicilians and Spaniards, as well as the Abyssinians in Africa. Turks, and likewise the Samoiedes and Laplanders.
White.	Most of the European nations; as, Swedes. Danes. English. Germans. Poles, &c. Kabardinski. Georgians. Inhabitants of the islands in the Pacific Ocean.

In attempting to investigate the causes of these differences, Dr Hunter observes, that there can be no dispute of the seat of colour being placed in the skin; that it is not

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even extended over the whole of this, but confined to that part named the cuticle, consisting of the epidermis and reticulum; and that it chiefly occupies the latter of these. The cuticle is much thicker and harder in black than in white people; the reticulum in the latter being a thin mucus, in the former a thick membrane. He concludes that this seat of colour in the whites is transparent, and either totally deprived of vessels, or only furnished with very few; as the yellow colour appearing in jaundice vanishes on the cause of the disease being removed, which is not the case with stains in the cuticle from gunpowder or similar causes. He next points out three causes destroying the pellucidity of the cuticle, giving it a brown colour, and rendering it thicker. These are, access of air, nastiness, and the heat of the sun. The influence of each of these he proves by many examples and from them he is inclined to consider the last as by much the most powerful. If, however, it be admitted that these causes have this effect, he thinks that all the diversity of colour which is to be observed among mankind may be thus accounted for. He remarks that all the inhabitants of the torrid zone incline more or less to a black colour. When we observe the differences which occur among them, we must at the same time remember that a black colour is not referred to heat alone, but to the other causes also; and when we attend to the diversity of temperature that occurs even in the torrid zone, the existence of a white nation there would by no means destroy the argument. He is further of opinion that the existence of a brown colour, and of considerable varieties from white, in the northern and coldest parts of Europe, may very easily be explained. This he accounts for from the manner of life of the inhabitants, by which they are either exposed to the inclemency of the air, or to constant nastiness from smoky houses.

Having thus attempted to account, from natural causes, for the varieties which occur among mankind with respect to colour, Dr Hunter observes that, to all this reasoning an objection will naturally be made from considering that infants bring these marks into the world along with them, before they can be exposed to any such causes. He imagines, however, that this may readily be explained upon the supposition that many peculiarities acquired by parents are transmitted to their posterity; and of this he thinks no one can entertain the least doubt who attends to hereditary diseases. Thus gout, scrofula, mania, and many other affections, although at first induced by particular accidents, will continue to affect families for many generations. In the same manner a parent exposed to causes destroying the natural whiteness of his complexion will beget swarthy children; and the same causes continuing to operate upon the son, the blackness will be increased. Thus all the different shades may have been at first induced, and afterwards continued.

The subject of complexion has been very well illustrated by Mr Clarkson, in a dissertation introduced in his essay on the commerce and slavery of the human species. The first point that occurs to be ascertained is, what part of the skin is the seat of colour? The old anatomists usually divide the skin into two parts or laminæ; the exterior and thinnest, called by the Greeks *epiderms*, by the Romans *cuticula*, and hence by us *cuticle*; and the interior, called by the former *derma*, and by the latter *cutis*, or *true skin*. Hence they must necessarily have supposed that, as the true skin was in every respect the same in all human subjects, however various their external hue, so the seat of colour must have existed in the cuticle or upper surface.

Malpighi, an eminent Italian physician of the seventeenth century, was the first person who discovered that the skin was divided into three laminæ or parts, the cuticle, the true skin, and a certain coagulated substance situated between both, which he distinguished by the title of *rete mucosum*; which coagulated substance adhered so firmly to the cuticle as, in all former anatomical preparations, to have come off with it, and from this circumstance to have led the ancient anatomists to believe that there were but two laminæ or divisible portions in the human skin.

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This discovery was sufficient to ascertain the point in question; for it appeared afterwards that the cuticle, when divided according to this discovery from the other lamina, was semitransparent; that the cuticle of the blackest negro was of the same transparency and colour as that of the purest white; and hence, the true skins of both being invariably the same, that the rete mucosum was the seat of colour.

This has been further confirmed by all subsequent anatomical experiments, by which it appears that, whatever is the colour of this intermediate coagulated substance, nearly the same is the apparent colour of the upper surface of the skin. Neither can it be otherwise, for the cuticle, from its transparency, must necessarily transmit the colour of the substance beneath it, in the same manner, though not in the same degree, as the cornea transmits the colour of the iris of the eye. This transparency is a matter of ocular demonstration in white people. It is conspicuous in every blush; for no one can imagine that the cuticle becomes red as often as this happens: nor is it less discoverable in the veins, which are so easy to be discerned, for no one can suppose that the blue streaks which he constantly sees in the fairest complexions are painted, as it were, on the surface of the upper skin. From these, and a variety of other observations, no maxim is more true in physiology than that on the rete mucosum depends the colour of the human body; or, in other words, that the rete mucosum being of a different colour in different inhabitants of the globe, and appearing through the cuticle or upper surface of the skin, gives them that various appearance which strikes us so forcibly in contemplating the human race.

As this can be incontrovertibly ascertained, it is evident that, whatever causes co-operate in producing this different appearance, they produce it by acting on the rete mucosum, which, from the almost incredible manner in which the cuticle is perforated, is as accessible as the cuticle itself. These causes are probably those various qualities of things which, combined with the influence of the sun, contribute to form what we call *climate*. For when any person considers that the mucous substance before mentioned is found to vary in its colour, as the climates vary from the equator to the poles, his mind must be instantly struck with the hypothesis, and he must adopt it without any hesitation as the genuine cause of the phenomenon.

This fact of the variation of the mucous substance, according to the situation of the place, has been clearly ascertained in the numerous anatomical experiments that have been made, in which subjects of all nations have come under consideration. The natives of many of the kingdoms and isles of Asia are found to have their rete mucosum black: those of Africa, situated near the line, of the same colour; those of the maritime parts of the same continent of a dusky brown, nearly approaching to it; and the colour becomes lighter or darker in proportion as the distance from the equator is either greater or less. The Europeans are the fairest inhabitants of the world. Those situated in the most southern regions of Europe have in their rete mucosum a tinge of the dark hue of their African neighbours; hence the epidemic complexion prevalent

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among them is nearly of the colour of the pickled Spanish olive; while in this country, and those situated nearer the north pole, it appears to be nearly, if not absolutely, white.

These are facts which anatomy has established; and we acknowledge them to be such that we cannot divest ourselves of the idea that climate has a considerable share in producing a difference of colour.

The only objection of any consequence that has ever been made to the hypothesis of climate is this, that people under the same parallels are not exactly of the same colour. But this is no objection in fact; for it does not follow that those countries which are at an equal distance from the equator should have their climates the same. Indeed nothing is more contrary to experience than this. Climate depends upon a variety of accidents. High mountains in the neighbourhood of a place make it cooler, by chilling the air that is carried over them by the winds. Large spreading succulent plants, if among the productions of the soil, have the same effect; they afford agreeable cooling shades and a moist atmosphere from their continual exhalations, by which the ardour of the sun is considerably abated. While the soil, on the other hand, if of a sandy nature, retains the heat in an uncommon degree, and makes the summers considerably hotter than those which are found to exist in the same latitude where the soil is different. To this proximity of what may be termed *burning sands*, and to the sulphureous and metallic particles which are continually exhaling from the bowels of the earth, are ascribed the different degrees of blackness by which some African nations are distinguished from each other, though under the same parallels. To these observations we may add, that though the inhabitants of the same parallel are not exactly of the same hue, yet they differ only by shades of the same colour; or, to speak with more precision, that there are no two people in such a situation, one of whom is white and the other black To sum up the whole, suppose we were to take a common globe, to begin at the equator, to paint every country along the meridian line in succession from thence to the poles, and to paint them with the same colour which prevails in the respective inhabitants of each, we should see the black, with which we had been obliged to begin, insensibly changing to an olive, and the olive, through as many intermediate colours, to a white; and if, on the other hand, we should complete any one of the parallels according to the same plan, we should see a difference perhaps in the appearance of some of the countries through which it ran, though the difference would consist wholly in shades of the same colour.

The argument, therefore, which is brought against the hypothesis is so far from being an objection, that it may be considered as one of the first arguments in its favour; for if the climate has really an influence on the mucous substance of the body, it is evident that we must not only expect to see a gradation of colour in the inhabitants from the equator to the poles, but also different shades of the same colour in the inhabitants of the same parallel.

To this argument may be added one that is incontrovertible, which is, that when the black inhabitants of Africa are transplanted to colder, or the white inhabitants of Europe to hotter climates, their children born there are of a different colour from themselves; that is, lighter in the first, and darker in the second instance. As a proof of the first, we shall give the words of the Abbé Raynal. "The children," says he, "which they (the Africans) procreate in America, are not so black as their parents were. After each generation the difference becomes more palpable. It is possible, that after a numerous succession of generations, the men come from Africa would not be distinguished from those of the country into which they may have been transplanted." The accuracy of this statement has been confirmed by a variety of persons who have been witnesses of the fact; but particularly by many intelligent Africans, who have been parents themselves in America, and who have declared that the difference is so palpable in the northern provinces, that not only they themselves have constantly observed it, but that they have heard it observed by others.

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Neither is this variation in the children from the colour of the parents improbable. The children of the blackest Africans are born white. In this state they continue for about a month, when they change to a pale yellow. In process of time they become brown. Their skin still continues to increase in darkness with their age, till it becomes of a dirty sallow black; and at length, after a certain period of years, glossy and shining. Now, if climate has any influence on the mucous substance of the body, this variation in the children from the colour of their parents is an event which must be reasonably expected; for being born white, and not having equally powerful causes to act upon them in colder, as their parents had in the hotter climes which they left, it must necessarily follow that the same effect cannot possibly be produced.

Hence also, if the hypothesis be admitted, may be deduced the reason why even those children who have been brought from their country at an early age into colder regions, have been observed to be of a lighter colour than those who have remained at home till they arrived at a state of manhood. For having undergone some of the changes which we mentioned to have attended their countrymen from infancy to a certain age, and having been taken away before the rest could be completed, these farther changes, which would have taken place had they remained at home, seem either to have been checked in their progress, or weakened in their degree, by a colder climate.

We come now to the second and opposite case; for a proof of which we shall appeal to the words of Dr Mitchell, in the *Philosophical Transactions*, No. 476, sect. 4: "The Spaniards who have inhabited America under the torrid zone for any time, are become as dark coloured as our native Indians of Virginia, of which I myself have been a witness; and were they not to intermarry with the Europeans, but lead the same rude and barbarous lives with the Indians, it is very probable that, in a succession of many generations, they would become as dark in complexion."

To this instance may be added one mentioned by an African traveller, who, in describing the coast of that country, and the European settlements there, has the following passage. "There are several other small Portuguese settlements, and one of some note at Mitomba, a river in Sierra Leone. The people here called *Portuguese* are principally persons bred from a mixture of the first Portuguese discoverers with the natives, and now become, in their complexion, and woolly quality of their hair, perfect negroes, retaining, however, a smattering of the Portuguese language."

These facts with respect to the colonists of the Europeans are of the highest importance in the present case, and deserve a serious attention. For when we know to a certainty from whom they are descended; when we know that they were, at the time of their transplantation, of the same colour as those from whom they severally sprung; and when, on the other hand, we are credibly informed that they changed it for the native colour of the place which they now inhabit; the evidence in support of these facts is as great as if a person, on the removal of two or three families into another climate, had determined to ascertain the circumstance; as if he had gone with them and watched their children; as if he had communicated

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his observations at his death to a successor; as if his successor had prosecuted the plan; and thus an uninterrupted chain of evidence had been kept up from their first removal to any determined period of succeeding time.

But though these facts seem sufficient of themselves to confirm our opinion, they are not the only facts which can be adduced in its support. It can be shown, that the members of the very same family, when divided from each other, and removed into different countries, have not only changed their family complexion, but that they have changed it to as many different colours as they have gone into different regions of the world. We cannot have, perhaps, a more striking instance of this than in the Jews. These people are scattered over the face of the whole earth. They have preserved themselves distinct from the rest of the world by their religion; and as they almost never intermarry but with those of their own sect, so they have no mixture of blood in their veins that they should differ from each other; and yet nothing is more true, than that the English Jew is white, the Portuguese swarthy, the Armenian olive, and the Arabian copper: in short, that there appear to be as many different species of complexion among Jews as there are countries in which they reside.

The same principles with the above we find adopted and further illustrated by Professor Zimmerman in his *Geographical History of Man*. He there proves in the most satisfactory manner that the complexion of the human species is uniformly correspondent with the degree of heat or cold to which they are habitually exposed. In maintaining this position, he makes a very proper distinction with regard to climate. By *climates* we are to understand, not simply or solely those distinguished by the geographical divisions of the globe, to the exclusion of what he terms *physical* climate, or that which depends on the changes produced in any given latitude by such adventitious circumstances as the lower or more elevated situations of a country, its being encompassed by water or large tracts of land, overspread or surrounded with forests, placed in an extensive plain, or environed by lofty mountains. Peculiarities of the like kind, as has been already noticed, frequently prevent the *physical* climate from corresponding entirely with the *geographical*, as a country influenced by them is often much warmer or colder than other regions placed under the same degree of latitude. The influence of these secondary or modifying circumstances has been already adverted to. At Senegal, and in the adjacent lands, the thermometer is often at 112 or 110 degrees in the shade; and here we find the inhabitants jet black, with woolly hair. The heat is equally great in Congo and Loango, and these countries are inhabited by negroes only; whereas in Morocco, to the north of these regions, and at the Cape of Good Hope, to the south, the heat is not so intense, nor are the inhabitants of so deep a hue. If it be asked why are not the Abyssinians and the inhabitants of Zahara of as dark a complexion as the Moors on the coast of Guinea? it may be answered in the words of Zimmerman, that "these countries are much cooler. The desert is not only farther from the equator, but the winds blowing over the Atlas Mountains, which, like the Alps, are covered with snow, and the westerly wind coming from the sea, must considerably mitigate the heat. Nor is Abyssinia so warm as either Monomotapa or Guinea. The N.E. winds from the side of Persia and Arabia are cooled by their passage over the Red Sea; the northern winds from Egypt lose much of their heat on the chain of the mountains that is extended between the countries; the winds from the south and the west are sea winds. Thus, the only quarter from which they can derive excessive heat is from the west, as the air on this side must pass over tracts of heated lands." For a similar reason it is that negroes are not found either in Asia or South America under the equator. The situations of these countries (as the author just quoted remarks) expose them to sea-breezes and cooling winds from the Continent; and he confirms this hypothesis by observing that the mountaineers of warm climates as in Barbary and Ceylon, are much fairer than the inhabitants of the valleys; that the Saracens and Moors who conquered the N.E. part of Africa in 1700, from being brown, are become like the negroes near the equator; that the Portuguese who settled at Senegal in 1400 became blacks; and that Tudela the Jew asserts, that his countrymen in Abyssinia acquired the dark complexion of the original natives.

Compline || Composition.

Upon the whole, colour and figure may be styled habits of the body. Like other habits, they are created, not by great and sudden impressions but by continual and almost imperceptible touches. Of habits both of mind and body nations are susceptible as well as individuals. They are transmitted to offspring, and augmented by inheritance. Long in growing to maturity, national features, like national manners, become fixed only after a succession of ages. They become, however fixed at last; and if we can ascertain any effect produced by a given state of weather or of climate, it requires only repetition during a sufficient length of time to augment and impress it with a permanent character. The sanguine countenance will, for this reason, be perpetual in the highest latitudes of the temperate zone; and we shall for ever find the swarthy, the olive, the tawny, and the black, as we descend to the south. See MAN.

COMPLINE, the last division of the Romish breviary. It was instituted to implore God's protection during the night, and is recited after sunset. It is so called because it *completes* the office for the day.

COMPLUTENSIAN POLYGLOT, the name given to an edition of the Hebrew Scriptures published in 1522 at Alcalá de Henares, the ancient *Complutum*, at the expense of Cardinal Ximenes. See BIBLE, vol. iv., p. 697.

COMPLUVIUM. See ARCHITECTURE, vol. iii., p. 472.

COMPOSITE, compounded or made up of several others united together.

COMPOSITE *Numbers*, such as can be measured exactly by a number exceeding unity; as 6 by 2 or 3, or 10 by 5; so that 4 is the lowest composite number. Composite numbers, between themselves, are those which have some common measure besides unity; as 12 and 15, both of which are measured by 3.

COMPOSITE Order, in *Architecture*, the last of the five orders of columns, and so called because its capital is composed of those of the other columns, a quarter-round being borrowed from the Tuscan and Doric, a row of leaves from the Corinthian, and volutes from the Ionic. See ARCHITECTURE.

COMPOSITION, in a general sense, the uniting or putting together several things, so as to form a whole or compound.

COMPOSITION of *Ideas*, the act of uniting simple ideas in a complex idea or conception. It is opposed to analysis.

COMPOSITION, in *Grammar*, the joining of two words together; or prefixing a particle to another word, to augment, diminish, or change its signification.

COMPOSITION, in *Law*. See BANKRUPTCY, vol. ii., p. 416.

COMPOSITION, in *Literature*, the act of forming and arranging sentiments, and clothing them with language suitable to the nature of the subject.

COMPOSITION, in *Logic*, a method of reasoning by which we proceed from some general self-evident truth to other particular and singular ones.

In disposing and putting together our thoughts, there are two modes of proceeding equally within our choice; for we may arrange the truths relating to any part of knowledge as they presented themselves to the mind in the course of investigation, carrying on the series of proofs in a reverse order, till at last they terminate in first principles; or, beginning with these principles, we may take the contrary

Composition ‖ Compton.

mode, and from them deduce, by a direct train of reasoning, the several propositions we want to establish.

This diversity in the manner of arranging our thoughts gives rise to the twofold division of method established among logicians. The first is the *analytic* method, or the method of *resolution*, inasmuch as it traces things back to their source, and resolves knowledge into its first and original principles. And this stands in contradistinction to the method of composition, or, as it is otherwise called, the *synthetic* method; for here we proceed by gathering together the several scattered parts of knowledge, and combining them into one system, in such a manner as that the understanding is enabled distinctly to follow truth through all the different stages of gradation.

Composition, in *Music*. See Music.

Composition, in *Painting*, *Sculpture*, and *Architecture*, the disposition of several component parts in such a manner as to produce unity of effect, and set off the whole to advantage.

Composition, in *Printing*, commonly termed *composing*, the arranging of the types in the composing stick, to form a line; and of several lines placed in order in the galley, to make a page; and of several pages to make a form. See Printing.

COMPOST, a mixture or composition of various manuring substances. See Agriculture, § *Manures*.

COMPOSTELLA, St James of, or St James of the Sword, an ancient order of knighthood in Spain, founded either towards the close of the twelfth or in the beginning of the thirteenth century. It is the chief of the four military orders, namely, Compostella, Calatrava, Alcantara, and Manresa. This order received its rules of government from Pope Alexander III. See Santiago.

Compostella, a town in Spain. See Santiago.

Compostella, an inland town of Mexico, state of Xalisco, 100 miles W. of Guadalaxara. Tobacco was formerly cultivated in the adjacent country, but was soon found to be quite unprofitable. The soil is barren, but there are several silver mines in the neighbourhood.

COMPOUND, that which is composed or made up of different things.

Compound *Interest*, is interest charged not only on the principal sum, but also on the interest forborne.

Compound *Motion*, that motion which is effected by two or more conspiring powers. Powers are said to conspire if the direction of the one be not quite opposite to that of the other, as when the radius of a circle is conceived to revolve about a centre, and at the same time a point to move straight along it.

Compound *Numbers*, those which may be divided by some other number besides unity without a remainder; such as 18 and 20, the first being measured by 2, 6, 9, and the second by 2, 4, 5, 10.

Compound *Ratio* is that which the product of the antecedents of two or more ratios has to the product of their consequents. Thus 6 to 72 is in a ratio compounded of 2 to 6, and of 3 to 12.

COMPREHENSION (Lat. *comprehensio*, from *comprehendo*, to seize), the act or quality of comprehending or containing. Also, capacity of the mind to understand, &c.

Comprehension, in *Rhetoric*, a trope or figure by which the name of a whole is put for a part, or that of a part for a whole, or a definite for an indefinite number.

Comprehension, *Scheme of*. See Britain, vol. v., p. 429.

COMPTON, Henry, Bishop of London, the youngest son of Spencer, Earl of Northampton, was born in 1632. After the restoration of Charles II. he became cornet in a regiment of horse; but soon afterwards quitted the army for the church. He was made Bishop of Oxford in 1674, and in the following year translated to the see of London. Having been admitted into the privy-council, he was intrusted with the education of the two princesses Mary and Anne. For his firmness in refusing to suspend Dr Sharp, whose vindication of the doctrine of the Church of England against Popery had rendered him obnoxious to the court, Bishop Compton was himself suspended by James II., but was restored at the Revolution, when he and the Bishop of Bristol constituted the majority for inviting a king to fill the vacant throne. He performed the ceremony of the coronation of William and Mary, was afterwards appointed one of the commissioners for revising the liturgy, and laboured with great zeal to effect a reconciliation between dissenters and the church. During the reign of Anne he was again sworn of the privy-council, and was one of the commissioners for the union of England and Scotland. Bishop Compton died in 1713.

Compton ‖ Comum.

Compton, *Spencer-Joshua-Aboyne*, Marquis of Northampton, was born in 1790, and received his education at Trinity College, Cambridge. On quitting the university he was returned to parliament for the town of Northampton, and distinguished himself by the independence and liberality of his opinions. He succeeded to the family title in 1828, when residing in Italy, where he exerted himself on behalf of the patriots of Lombardy and Naples. On the death of Lady Northampton he returned to England and resumed his place in parliament. He was elected President of the Royal Society after the retirement of the Duke of Sussex from that office, and became known to the literary world through the pages of *The Tribute*, a work which he afterwards edited for the benefit of the family of its founder. He was known also as a lover of science. and especially attached to mineralogy and geology. The Marquis of Northampton died January 17, 1851.

COMPTONITE, in *Mineralogy*, one of the zeolite family, in delicate transparent or semi-transparent crystals, which occupy the drusy cavities of the anciently ejected masses on Mount Vesuvius. Its form is an oblique four-sided prism, truncated on its lateral edges, and terminated with an extremely dihedral summit. It was first brought to this country by Lord Compton in 1818.

COMPURGATOR, one who bears testimony or swears to the veracity or innocence of another. Compurgators were introduced as evidences in the jurisprudence of the middle ages. Their number varied according to the importance of the subject in dispute, or the nature of the crime with which the person was charged.

COMUM (*Como*), a flourishing city of Transpadane Gaul, at the extreme southern extremity of the *Lacus Larius*, and at the foot of the Rhætian Alps. Comum was founded by the Gauls, and was considered as lying within the territory of the Galli Insubres, though Pliny mentions that its foundation was in his day attributed to the Orobii, a tribe which long before that date had ceased to exist as a separate community. Though Comum seems to have been from a very early period a flourishing and important city, it has never at any time played a very conspicuous part in history. Soon after the beginning of the second century B.C., the people of Comum joined the Insubres in an attack on the Romans; but they were defeated, and their city fell into the hands of the conquerors. Comum now became a Roman colony. The first colonists who settled there, however, were unable to maintain themselves against the inroads of the Rhætian Gauls. Additional settlers were therefore sent down from time to time. Julius Cæsar in particular sent down 5000, of whom a tenth were Greeks. The colony now assumed the name of Novum Comum, which, however, it only retained for a short time. On the accession of Julius Cæsar to supreme power, Comum obtained the complete right of citizenship; yet though it was at this time at the height of its prosperity, it never took rank higher than a municipal town. The elder and the younger Pliny are believed to have been both natives of Comum or its neigh-

Comus ‖ Conca.

bourhood; and the younger Pliny had several villas on the banks of the Larian lake. His efforts to make the town an independent seat of learning do not appear to have been peculiarly successful. No interesting remains of the ancient Comum are now visible at Como, except a few inscriptions.

The modern Como is a handsome episcopal city, with a splendid marble cathedral begun in 1396. Its commerce is as flourishing as that of the ancient town used to be; and its commercial importance is greatly enhanced by the excellence of its roads and the easy navigation of the lake. Its manufactures consist chiefly of woollens, silks, cottons, soap, &c. Como was the birthplace of Pope Innocent XI. and the natural philosopher Volta. Pop. (including suburbs) about 20,000.

COMUS, a mythological personage, the god of jollity and festive mirth. The word is Greek, and properly denotes "a merry-making;" thence also applied to a band of revellers, or the village youths and maidens who danced and sung together in the choric performances in honour of the presiding deity of the district. Warton has referred to Æschylus for the first notice of this god; but the passage in the "Agamemnon" to which he alludes scarcely seems to bear out the idea of a personification of the word κῶμος. (See his note on the 58th verse of Milton's *Masque of Comus*.) It appears rather to be in the *Icones* of Philostratus (i. 2) that this deity appears for the first time; and there Comus is described as a youth of delicate mien, slumbering in a standing attitude, his legs crossed, his countenance flushed with wine, and his head, which is sunk upon his breast, crowned with dewy flowers; his left hand feebly grasps a hunting spear, while in his right there is an inverted torch.

This deity has been identified by some with the Chemosh of the Moabites, and with Beel-Phegor, Baal-Peor, Priapus, and Bacchus. However this may be, Comus is principally indebted for his celebrity to the genius of Milton; and although he had previously been introduced on the English stage by Decker and by Jonson, yet the coarse deity of those writers can scarcely again be recognized in the exquisite impersonation of Comus in Milton's celebrated masque.

CONANT, Dr John (1608–1693), a learned English divine, was educated at Exeter College, Oxford. He was appointed one of the assembly of divines, and in 1657 was admitted vice-chancellor of the university. On the restoration he was one of the commissioners at the conferences in the Savoy, but was deprived by the Act of Uniformity. After a suspension of eight years he was re-admitted into the church, and installed into the archdeaconry of Norwich, and prebendary of Worcester. During the last seven years of his life, Conant was afflicted with total blindness. His sermons were published in 6 vols.

CONATUS (Latin, *effort*), a term defined by some to mean a quantity of motion not capable of being expressed by any time or length. Thus the *conatus recedendi ab axe motus*, is the endeavour which a body, moved circularly, makes to recede or fly off from the centre or axis of its motion.

CONCA, Sebastiano, called *Cavaliero*, an historical and portrait painter of the Neapolitan school, born at Gaeta in 1679. The churches and chapels in almost every part of Italy are enriched with his compositions, of which the number is almost incredible: for he lived to a very advanced age, and continued his labours to the last. He was earnestly invited by Philip V. of Spain to visit his court, but could not be prevailed on to leave Rome. He was at last so strongly urged to visit Naples that he undertook the journey, and was received with all the respect and honour due to his merit. He there completed some very noble designs, as also at Gaeta, his native city. While at Naples he received from the king a snuff-box of great value; and in 1757 the same monarch conferred on him and his descendants a patent of nobility. At that time he was seventy-eight years of age; and it is probable that he died in the following year. He understood perspective and architecture thoroughly, and possessed a perfect knowledge of chiaroscuro. His style of composition is grand and elegant; his design correct; his attitudes and expression are full of truth, nature, and variety; and his colouring is excellent.

Concan ‖ Concave.

CONCAN, a maritime tract of western India, situate within the limits of the Presidency of Bombay; and extending from the Portuguese settlement of Goa on the south to the territory of Damaun, belonging to the same nation, on the north. On the east it is bounded by the Ghauts, and on the west by the Indian Ocean. This tract comprises the two British districts of Tannah and Rutnagherry, and may be estimated at 300 miles in length, with an average breadth of about 40. From the mountains on its eastern frontier, which in one place attain a height of 4700 feet, the surface, marked by a succession of irregular hilly spurs from the Ghauts, slopes to the westward, where the mean elevation of the coast is not more than 100 feet above the level of the sea. Several mountain streams, but none of any magnitude, traverse the country in the same direction. One of the most striking characteristics of the climate is the violence of the monsoon rains—the mean annual fall at Mahabulishwar amounting to 239 inches. It is believed that the abundant moisture borne along from the Indian Ocean by this aerial current becomes arrested and condensed by the mountain barrier of the Ghauts, and in this manner accounts for the excessive rains which deluge the Concan. The products of this country are the same as those of Malabar; and the hemp raised is said to be of a stronger quality than that raised above the Ghauts. The coast has a very straight general outline, but is much broken into small bays and harbours. This, with the uninterrupted view along the shore, the elevated coast favourable to a distant view, and the land and sea breezes which blow alternately in the twenty-four hours, and which force the vessels steering along the coast to be always within sight of it, had rendered this country from time immemorial the seat of piracy; and so formidable had the pirates become in the eighteenth century, that all ships suffered which did not receive a pass from the chiefs of the pirates. The Great Mogul maintained a fleet for the express purpose of checking them, and they were frequently also attacked by the Portuguese. British commerce having suffered from their depredations, expeditions were despatched from time to time from Bombay for the purpose of suppressing them, commencing as early as 1756; but the piratical system was not finally extinguished until the year 1812. According to ancient traditions, this country was inhabited by a tribe of savages, till they were conquered by the Hindus, who gave it to a tribe of Brahmins; and it was held by them until it was taken possession of by the Mohammedan kings of Bejapoor. It was conquered in the seventeenth century by Sevajee, the founder of the Mahratta empire. Towards the close of the same century Conajee Angria established a kingdom on this coast, extending 120 miles from Tannah to Bancoote, together with the inland country as far back as the mountains. The dominion of this prince and his family, over a portion of the tract, continued until within the last ten or twelve years, when the legitimate line of descent to the state became extinct, and the territory lapsed to the paramount power. The remainder of the Concan had been already incorporated with the British dominions since the fall of the Peishwa in 1818.

CONCATENATION (late Lat. *concatenare*), to link together), a term chiefly used in speaking of the mutual dependence of second causes upon each other.

CONCAVE (Lat. *concavus*), hollow, and arched or rounded, as the inner surface of a spherical body. Concavo-concave signifies concave or hollow on both surfaces, as in double concave lenses. Concave is the opposite of convex. Concavo-convex is applied to bodies which are

Concentaina || Concord.

concave on one side and convex on the other. See CONVEXITY.

CONCENTAINA, a town of Spain, province of Alicante, and 29 miles N. of that city. It has extensive manufactures of woollen cloths. Pop. about 5800.

CONCENTRATION literally signifies the bringing things nearer a centre. In *Chemistry*, concentration denotes the act of increasing the strength of a fluid by evaporating its more volatile part.

CONCENTRIC, having the same centre with another. It stands opposed to *eccentric*.

CONCEPCION, one of the provinces of Chile. See CHILE.

CONCEPCION, the capital of the above province, situate on the Biobio, about eight miles from the sea. It was once a flourishing city and possessed a handsome cathedral, but it has not yet recovered from the disastrous earthquake of 1835, which laid the greater part of its buildings in ruins. Its export trade consists chiefly of hides and tallow, and is carried on through the port of Talcahuano at the head of Concepcion Bay, which affords a secure anchorage ground six miles long and four miles wide. Pop. 20,393.

CONCEPTION, in *Mental Philosophy*. See METAPHYSICS.

CONCEPTION, in *Physiology*, the first formation of the embryo or fœtus in the womb.

CONCEPTION, Immaculate, of the Holy Virgin, a feast established in honour of the holy Virgin, particularly with regard to her having been conceived and born *immaculate*, or without original sin. It is held in the Roman Catholic Church on the 8th of December. The immaculate conception is the great head of controversy between the Scotists and Thomists, the former maintaining and the latter impugning it. The controversy is at present (1854) under the consideration of the pope, and will in all probability be settled by the issuing of a bull in favour of the doctrine. This feast is also celebrated in the Greek Church on the same day, under the title of the Conception of St Anne (the mother of Mary).

CONCERT, an assemblage of musicians who perform pieces of vocal and instrumental music.

CONCHITE (κόγχη, Lat. *concha*, a bivalve shell-fish), a fossil or petrified shell.

CONCHOID, in *Geometry*, the name of a curve, given to it by its inventor Nicomedes.

CONCHOLOGY. See MOLLUSCA.

CONCHYLIA, a general name for all petrified shells, as cardia, nautili, anomiæ, lepades, and the like.

CONCIATOR, in crystal glass-works, is the person who weighs and proportions the salt on ashes and sand, and works and tempers them with a strong fire till they are fit for use.

CONCLAVE (Lat. *conclave*, a chamber that may be secured by means of a key, *clavis*), the place in which the cardinals of the Roman Catholic Church meet in privacy for the election of a pope. It also denotes the assembly itself. The conclave is a series of small cells or apartments ranged in a line along the galleries and hall of the Vatican; and each cell has the arms of the particular cardinal over it. By the constitutions of the church the cardinals may make choice of any place for the conclave as they deem convenient; but it is generally held in the Vatican.

CONCLUSION, in *Logic*, the consequences or judgment drawn from premises or previous judgments.

CONCORD, the capital of the state of New Hampshire, North America, stands on both sides of the Merrimac river, here crossed by several handsome bridges, 64 miles N.N.W. of Boston. It is connected by railways with Boston, Montreal, and other places; and has several large cotton factories, paper mills, potteries, and a variety of other industrial establishments. Its neighbourhood abounds in granite, which is exported. The state house is a handsome building of hewn granite. Pop. (1840) 4897; (1850) 8584.

Concord || Concordia.

CONCORD, one of the capitals of Middlesex county, state of Massachusetts, North America, situated on both sides of the Concord river, 17 miles W.N.W. of Boston. Pop. 2249. It was here, on the 19th April 1775, that the first forcible resistance was made to the British power; and a handsome monument now marks the spot where the first blood was spilt in the war of the revolution. The monument is a granite obelisk 25 feet high, with a square base 5½ feet in diameter, and about 3 feet high, with an appropriate inscription on a slab of Italian marble. There are many other places of this name in the United States.

CONCORDANCE, a verbal index to the Bible. The earliest work of the kind is the *Concordantiæ Morales* of Antony of Padua, who lived A.D. 1195 to 1231. It was formed from the Vulgate translation, and was the basis of the larger compilation of Cardinal Hugo de Santo Caro. The first Hebrew concordance was produced by Rabbi Mordecai Nathan (Venice 1523), and was entitled *The light of the way*. An improved edition was afterwards published by Calasio, a Franciscan friar (Romæ, 1621). This was followed by the masterly work of the elder Buxtorf, based on the Masoretic divisions of the Old Testament. An edition adapted to the use of the English reader soon afterwards appeared from the pen of Dr Taylor of Norwich. These earlier works, however, have been almost entirely superseded by the Hebrew and Chaldee concordance of Dr Julius Furst. To the Septuagint, the best concordance is that of Trommius, 2 vols. fol., Amst. 1718. Of Greek concordances to the New Testament, the most valuable is that of Erasmus Schmid, Vetemb. 1638, an abridged edition of which has been published by Messrs Bagster in their *Polymicrian Series*. A greatly improved edition of the entire work has been edited by C. H. Bruder. To students acquainted only with the vernacular, the *Englishman's Concordance* to the Old and New Testaments presents invaluable exegetical aid, and is highly useful in giving a combined view of the different English renderings of the same Greek and Hebrew vocables. Of English concordances, that of Alexander Cruden stands unrivalled.

CONCORDAT, in the canon law, a covenant or agreement concerning some beneficiary matter, as a resignation, permutation, promotion, or the like.

The council of Trent (sess. vi., *de reform.*, cap. 4), speaking of concordats made without the authority and approbation of the pope, calls them *concordias quæ tantum suos obligant auctores, non successores*. And the congregation of cardinals who have explained this decree, declare also that a concordat cannot be valid so as to bind successors, unless confirmed by the pope.

In particular, it signifies an agreement between the Holy See and a sovereign prince or state, for regulating the manner of nominating to benefices and other matters connected with religion. Such was the concordat concluded at Bologna, in 1516, between Leo X. and Francis I., for the abolition of the pragmatic sanction; and, in modern times, that concluded between Napoleon and Pius VII. in 1801.

The concordat serves instead of the pragmatic sanction; or rather, it is the pragmatic sanction softened and reformed.

CONCORDIA, the goddess of concord, a Roman divinity, in whose honour several temples were erected at Rome. The most ancient of these was that built on the declivity of the Capitol by Camillus, B.C. 367. In this temple the senate frequently assembled. Having fallen into disrepair, it was restored by Livia the wife of Augustus, and consecrated by her son Tiberius, A.D. 9. It was afterwards destroyed by fire, but again restored. The second temple, constructed of brass, was erected on the Palatine Hill by Cn. Flavius; and there was a third on the Capitoline Hill. Concordia was represented as a matron

Concrete || Concubinage.

holding in her right hand a patera, or sometimes an olive branch, and in her left hand a cornucopia. Her symbols were two hands joined together, and two serpents entwined about a caduceus. She was invoked to promote peace among the members of families and the citizens.

CONCRETE (Lat. *concrescere*, to grow together, to coalesce), a compound, a mass formed by concretion. Among builders it is used to denote a composition of stone chippings or pebbles, lime, and sand, cemented together into one mass, for the purpose of forming an artificial foundation for buildings in soft or boggy ground.

CONCRETE TERM, in *Logic*, a term that includes both the quality and the subject in which it exists; as *nigrum*, a black thing.

CONCRETION, the act by which soft bodies become solid or hard; or an insensible motion of the particles of a fluid or soft body, by which they come to a consistence. It is indifferently used for induration, condensation, congelation, and coagulation.

CONCUBINAGE (Lat. *concubina*, a concubine), the state of a man and woman cohabiting together as married persons without the sanction of a legal marriage. In a scriptural sense, it denotes the state of cohabiting lawfully with a wife of second rank, who enjoyed no other conjugal right but that of cohabitation, and whom the husband could repudiate and dismiss with a small present (Gen. xxi.) In like manner he could, by means of presents, exclude his children by her from the heritage (Gen. xxv.) Such were the concubines of Nahor, of Abraham, of Jacob, Eliphas, Gideon, Saul, David, Solomon, Caleb, Manasseh, Rehoboam, Abiah, and Belshazzar. To judge from the conjugal histories of Abraham and Jacob, the immediate cause of concubinage was the barrenness of the lawful wife, who in that case introduced her maid-servant to her husband, for the sake of having children. In process of time, however, concubinage appears to have degenerated into a regular custom among the Jews; and the institutions of Moses were directed to prevent excess and abuse in that respect.

The Roman law calls concubinage an allowed custom (licita consuetudo). When this expression occurs in the constitutions of the Christian emperors, it signifies what we now sometimes call a *marriage of conscience*. The concubinage tolerated among the Romans, in the time of the republic and of the heathen emperors, was that between persons not capable of contracting legal marriage. Concubinage between such persons they looked on as a kind of marriage, and even allowed it several privileges.

Concubinage is also used to signify a marriage with a woman of inferior condition, to whom the husband does not convey his rank. Dajos (Paratilla) observes, that the ancient laws allowed a man to espouse, under the title of concubine, certain persons who were esteemed unequal to him, on account of the want of some qualities requisite to sustain the full honour of marriage; and he adds, that though such concubinage was beneath marriage both as to dignity and civil rights, yet was concubine a reputable title, and very different from that of "mistress" among us. Also, that the concubine might be accused of adultery in the same manner as a wife.

This kind of concubinage is still in use in some countries, particularly in Germany, under the title of *halb-ehe* (half-marriage), or left-hand marriage, in allusion to the manner of its being contracted, namely, by the man giving the woman his left hand instead of the right. This is a real marriage, though without the usual solemnity; and the parties are both bound to each other for ever, though the female cannot bear the husband's name and title.

Du Cange observes, that one may gather from several passages in the epistles of the popes, that they anciently allowed of such connections. The seventeenth canon of the first council of Toledo declares, that he who with a faithful wife keeps a concubine, is excommunicated; but that if the concubine serve him as a wife, so that he has only one woman, under the title of concubine, he shall not be rejected from communion.

Condamine.

It is certain the patriarchs had a great number of wives, and that these did not all hold the same rank; some being subaltern to the principal wife, or what may be termed *concubines* or half wives. Solomon had seven hundred wives and three hundred concubines; and the emperor of China is said to have sometimes two or three thousand in his harem. Q. Curtius observes, that Darius was followed in his army by three hundred and sixty-five concubines, all in the equipage of queens.

CONDAMINE, CHARLES MARIE DE LA, a practical geographer and cultivator of science in general, son of Charles de la Condamine, a receiver-general of finances, and Margaret Louise de Chources, was born Jan. 28, 1701.

His early education was by no means neglected, although he complains that he was made to learn too much by rote, without understanding the complete sense and bearing of the words which he repeated. He afterwards pursued his studies under Father Brisson; and in 1717 he supported a thesis on the Cartesian philosophy, which the Jesuits were then beginning to introduce into their seminaries. In 1719 he entered the army, and accompanied his uncle, the Chevalier de Chources, to the siege of Rosas, as a volunteer; and both on this and other occasions he exhibited proofs of the contempt of danger and the spirit of enterprise which were so much required in those pursuits that afterwards occupied a considerable portion of his life. Unlike most young men of his time, he was moderate in the pursuit of pleasure, and used to consider the disfigurement which the smallpox had left in his features as affording him some compensation for the injury done to his vanity, by diminishing the temptations to which he might otherwise have been exposed.

Having no prospect of speedy advancement in the army, and having suffered considerably in his fortune from a participation in the extravagant speculations of Law, he quitted the service, in hopes of finding a more advantageous employment in scientific pursuits. He distinguished himself as an active member of a society of arts, then recently established at Paris by the Count de Clermont; and in 1730 he obtained a situation in the Academy of Sciences, as adjunct of the class of chemistry, having previously presented to the academy a memoir on the mathematical and mechanical properties of the lathe, which obtained him considerable credit. Soon afterwards he embarked in the squadron of Duguay Trouin, and made a voyage in different parts of the Mediterranean. He passed several months at Constantinople, and visited the plain of Troy, and many other parts of the Levant; and after his return he gave an account of his tour to the academy. His servant, too, who had accompanied him, published a separate journal of his own.

Chemistry, as cultivated at that period, afforded but little scope for the employment of an active mind; and La Condamine, after the publication of one chemical memoir only, was removed from the class of chemists in the academy to that of astronomers. In this capacity he was the first to propose the measurement of a degree of latitude in the neighbourhood of the equator. His ideas were readily seconded by Maurepas, then prime minister; and he was appointed by the academy, together with Bouguer and Godin, for carrying the proposal into effect.

In this expedition he was absent from 1735 to 1745; and had to encounter difficulties of every kind. A long series of dangers and disasters, to say nothing of the awful appearance of an eruption of Cotopaxi, and the no less formidable operations of the hostile squadron of Lord Anson, required nothing less than the dauntless spirit and energy of character which he possessed to bear him up against them; and

Conda-mine.

at last the little jealousies, which will often arise among persons of science employed in the same pursuits, embarrassed and embittered the conclusion of his enterprise. The activity and fluency of La Condamine made the public disposed to imagine that Bouguer had been only his humble attendant; and Bouguer was too conscious of his own superiority as a mathematician to bear this injustice with patience. He retaliated by refusing all communication in the statement of the results of the operations; so that each observer gave ultimately a separate account of his own measurements and calculations.

In consequence of the fatigues and vicissitudes to which La Condamine had been exposed, he became extremely deaf, and partially paralytic; but the powers of his mind appear to have remained unimpaired.

In 1748 he was elected a foreign member of the Royal Society of London; and he afterwards exerted himself with great zeal and success in promoting among his countrymen the general introduction of the variolous inoculation, which had long been practised in England and elsewhere. In 1757 he visited Italy, and spent a considerable time at Rome, principally, it would appear, in order to obtain a dispensation from the pope for a marriage with his niece, who seems, notwithstanding the disparity of their ages, and his capricious and irritable temper, to have been sincerely attached to him. In 1760 he became one of the forty members of the French Academy, and contributed considerably to an improved edition of their dictionary. In 1763 he paid a visit to England, which was rendered less agreeable to him from the difficulty that he found in obtaining legal redress for some slight injury he had received. After his return, the insensibility of his limbs increased, and he was obliged to relinquish all his pursuits of science, retaining only the amusement of making some light attempts in poetry, and occasionally inserting in the periodical works of the day a few tales in verse, besides a poetical translation of a part of Virgil's *Eneid*.

His first publication was a *Memoir on the Conic Sections*, M. Ac. Par. 1731, p. 240. It contains a comparison of the equations of the various parallel sections of a given cone with that of the surface of the cone itself; but it is not distinguished either for clearness of conception or for accuracy of expression.

2. *On Metallic Vegetation*, M. Ac. Par. 1731, p. 466, H. P. 31. The experiments described in this paper relate to the precipitation of nitrate of silver, or other metallic solutions placed upon a flat surface of glass or agate, by means of an iron nail.

3. *Observations made in the Levant*, M. Ac. Par. 1732, p. 295; relating principally to navigation, geography, and natural history.

4. *Account of an Instrument for determining a Parallel Circle on the Earth's Surface*, M. Ac. Par. 1733, p. 294, H. P. 53; a telescope fixed perpendicularly on an axis parallel to that of the earth, and consequently capable of being directed only to objects situated in the parallel circle required, proper allowance being made for the effects of refraction.

5. *Description of a Variation Compass*, M. Ac. Par. 1733, p. 446. A wire is fixed in the axis of the card, and a graduated ring of paper round its circumference, half above and half below, on which the shadow of the wire is to fall at sunset.

6. *Two Memoirs on the Lathe*, M. Ac. Par. 1734, pp. 216, 295. A description of the rosette and of other parts of the figure lathe, with a mathematical determination of the epicycloids, conchoids, and other curves, which are traced by their combination. The apparatus is represented among the machines approved by the Academy, vol. v. pp. 83, 89.

7. *A Letter relating to the Variation Compass*, M. Ac. Par. 1734, p. 597.

8. *On the Determination of small Differences of Longitude*, M. Ac. Par. 1735, p. 1; a discussion of the kinds of signals best adapted for contemporaneous observations at a distance.

9. *Measurement of the Length of the Pendulum at St Domingo*, M. Ac. Par. 1735, p. 529. See COHESION.

10. *Account of the Quinquina Tree*, M. Ac. Par. 1738, p. 226.

11. *Abstract of a Journey through a part of South America*, M. Ac. Par. 1745, p. 391, H. 63.

12. *Abstract of the Geographical Operations performed in South America*, M. Ac. Par. 1746, p. 618. The length of a degree at the equator appears, from these calculations, to be 56,750 toises. Bouguer, who employs the same determination of the arc, but a different series of trigonometrical observations, makes it 56,753; and Godin, on the other hand, somewhat less than Condamine. This is more than 300 toises less than the degree measured in France, and almost 700 less than the degree in Lapland; and it gives for the earth's ellipticity, by comparison with the former, $\frac{1}{303}$, and with the latter $\frac{1}{215}$. The terminations of the base were marked by pyramids, and the length of the toise was identified by a bar of metal let into a tablet of marble.

13. *Mésure des Trois premiers Dégrès du Méridien*, 4. Par. 1751, with a complete journal of the operations.

14. *A Proposal for an Invariable Standard of Measures*, M. Ac. Par. 1747, p. 489, H. P. 82.

15. *Account of an Elastic Resin*, M. Ac. Par. 1751, p. 319, H. P. 17; a description of several trees affording the cahuchu, or caoutchouc, especially of the Hheve, or syringe trees.

16. *A History of the Variolous Inoculation*, M. Ac. Par. 1754, p. 615; a candid and judicious statement of the advantages of the inoculated above the natural smallpox, in a style calculated to meet the prejudices of the day, and the various superstitious and interested motives which retarded the practice in France, while it had become universally prevalent in England; although, in more recent times, the public spirit in this country appears to have been less favourably disposed to the admission of beneficial innovations, for it is well known how strenuously an interested or an ignorant opposition was organized against the practice of vaccination.

17. *Abstract of a Journey in Italy*, M. Ac. Par. 1757, p. 336, H. P. 6. From an examination of several ancient standards, and from a comparison of the remains of buildings supposed to have occupied a certain round number of feet, M. de la Condamine concludes that the old Roman foot was equal to 130·9 French lines; that is, to 969 thousandths of an English foot. Mr Folkes had before made it 966; but Mr Raper has shown, in the *Philosophical Transactions* for 1760, by a very careful comparison of a multitude of documents, that before the reign of Titus it somewhat exceeded 970, and under Severus and Diocletian it was less than 965; the original standard in the temple of Juno Moneta having probably been destroyed by fire. M. de la Condamine also viewed the races on the Corso with an eye equally mathematical, and observed that the Barbary horses ran at the rate of about forty English feet in a second; but his correspondents in England furnished him with unexceptionable evidence that the horse *Childers* ran the four-mile course at Newmarket at the rate of very nearly fifty English feet in a second, while no other horse exceeded forty-eight; and he observes that, in this instance, truth far outruns probability; a remark which has been somewhat misrepresented in this country, and converted, by the lovers of the amusements of the turf, into a laugh against the lovers of the amusements of science; the story being told as if the French mathematicians had demonstrated the absolute maximum of a horse's utmost possible speed, and, a bet having been made on the occasion, an English horse had been found

Conda-mine.

Condapilly ‖ Condé.

that actually exceeded the maximum. Our author also notices the awkward effect of the Roman mode of beginning the day at sunset, which renders it necessary to make continual alterations in the clocks—directions being given in the almanacks for putting them forwards or backwards a quarter of an hour at a time; and the precise time of noon happening in summer at sixteen o'clock, and in winter not till nineteen. He observes that a single signal, properly placed on the Apennines, would be visible at once near Trieste and near Monaco, giving a difference of longitude of not less than five degrees.

18, 19. *On Inoculation*, M. Ac. Par. 1758, p. 439; 1765, p. 505.

20, 21. M. de la Condamine published also a series of *Lettres sur les Dictionnaires*, and another of *Lettres sur l'Education.*

In 1768 his name is mentioned as having excited the attention of the members of the academy by a relation of Spallanzani's experiments on the reproduction of the heads of snails, which several of them repeated with success. In fact, there was scarcely any one of the sciences to which he did not occasionally render some service, although he wanted patience and perseverance to make any very important discoveries or improvements by his individual exertions only. But his knowledge was universal; he understood and wrote all languages; corresponded with men of celebrity in all countries; published upon all subjects; contributed to all the literary and scientific journals of the day; answered all criticism, and accepted all compliments, even from persons whom he despised; for he delighted in the parade of a pre-eminent reputation. His style was simple and natural, somewhat negligent, but still elegant and lively; his manner was animated and somewhat singular; his temper warm and restless; he sighed for repose, and was incapable of enjoying it; thinking nothing that occurred indifferent to him, and allowing none about him to be idle. He obtained the rank of chevalier in several orders, and was a member of several foreign academies. He held also the appointment of honorary secretary to the Duke of Orleans. At the age of sixty-eight he addressed to his wife an account of his education, and of the earlier progress of his mental faculties, as a practical illustration of his opinions respecting the cultivation of the mind. The memoir was not published. A few years before his death he printed a memorial in behalf of M. Godin, who had been reduced to indigence; and he had the pleasure of obtaining for him the assistance which he required. He suffered occasionally from a hernia; and having read of the marvellous cures which some empiric professed to have performed by the application of caustic, he made the experiment on himself, without the knowledge of his family, and fell a victim to his temerity. In the course of the six weeks that he survived, he was still employed in writing or dictating a memoir containing answers to some questions respecting the manners of the Americans. He died Feb. 4, 1774, leaving many of his books and instruments by will to the Academy of Sciences. (*Hist. Acad. Par.* 1774, p. 85.) (T. Y.)

CONDAPILLY, a town of Hindustan, in the Northern Circars, and the ancient capital of a district of the same name which is now comprised within the collectorate of Masulipatam. It is situated on a hill which has an elevation of 1700 feet above the level of the sea; and being fortified in the Indian style, was formerly a place of considerable strength. But the fortifications have of late been much neglected, and are now gone to decay. This place was first conquered from the Hindu princes about the year 1471, by the Bhamenee sovereigns of the Deccan; and it came into the possession of the British in 1765. The distance from Madras is 245 miles. N. Lat. 16. 39.; E. Long. 80. 37.

CONDÉ, Louis de Bourbon, Prince of, was born at Paris on the 8th of September 1621. He was styled Duke d'Enghien, till in 1646 he succeeded to the title of Prince of Condé by his father's death. As he was of a tender and delicate constitution, the prince sent him to the castle of Montrond, in Berri, where he spent his infancy under the care of some experienced and trustworthy persons. But when sufficiently advanced in age, the prince took upon himself the task of governor, and appointed as his assistant a gentleman of the name of M. de la Boussières. Two Jesuits distinguished for their abilities and acquirements were also given him as preceptors. Condé.

With these attendants the Duke d'Enghien went to settle at Bourges, where he prosecuted his education at the college of Jesuits, and made such progress, that before the age of thirteen he defended in public some questions in philosophy with great eclat. On his return from Montrond he received as his tutor M. de Merille, a man deeply versed in ancient and modern jurisprudence, theology, and mathematics. Under his direction the duke went through a new course of study, and acquired a critical taste in the arts and sciences, which he ever afterwards cultivated. The bent of his mind, however, inclined him to the military art. Accordingly at the age of eighteen, he obtained permission to make his first campaign as a volunteer in the army commanded by M. de la Meilleraye; and notwithstanding the misfortunes that attended this campaign through the marshal's imprudence, it was in it that the young duke laid the foundation of his subsequent renown.

On his return to Paris he waited upon Cardinal Richelieu at Ruel; and so pleased was that minister with his conversation, that he soon afterwards made proposals of an alliance with the Prince of Condé, by marrying the Duke d'Enghien to Claire Clémence de Maillé Brezé, the cardinal's niece. The duke consented to this match only in obedience to his father; but so deeply was he wounded by the constraint, that he fell dangerously ill immediately after, and it was long before he recovered.

The duke served two more campaigns as a volunteer; one under the Marshal de la Meilleraye, and the other in the army of Louis XIII. which conquered Roussillon. In 1643, at the age of twenty-two, he obtained from the king, through Cardinal Mazarin, the command of the army destined to cover Champagne and Picardy; and the appointment was confirmed after the king's death by the queen regent, Anne of Austria, to whose interest he was strongly attached. In this situation he defeated the Spaniards, who threatened France with an invasion, and destroyed their hitherto invincible infantry, at Rocroi, May 19, 1643,—an exploit which made him from that time be considered as the guardian genius of his country. Having gained a reluctant consent from the regency to his project of besieging Thionville, the duke attacked it with such skill, activity, and courage, that in two months the fortress surrendered. At length, having covered Alsace and Lorrain from the Imperialists, he returned to Paris, where he obtained the government of Champagne and of Stenai.

The three following years were little more than a series of military operations. The battle of Fribourg, in which the Duke d'Enghien triumphed over Field Marshal Count de Mercy, the greatest general in all Germany; the capture of Philipsbourg, and other places, which rendered him master of the Palatinate, and of the whole course of the Rhine; the victory of Nordlingen, by which he revenged the Viscount de Turenne's defeat at Mariendal; the siege and conquest of Dunkirk; the success of his arms in Catalonia, where, though forced to raise the siege of Lerida, he kept the Spaniards in awe, and cut to pieces their rearguard; these are the principal events which distinguish the campaigns of 1644, 1645, and 1646.

The popularity of the Duke d'Enghien, on account of these splendid victories, began now to give umbrage to Mazarin, who manifested his dislike to him on the death of

Condé. the Duke de Brezé, admiral of France. The Prince of Condé earnestly demanded for his son the Duke de Brezé's places; but Mazarin, afraid of increasing the wealth and power of a prince already too formidable, evaded his request, by persuading the queen to take the admiralty to herself. On the death of his father, the minister attempted to ruin the popularity of the young Prince of Condé by appointing him to the command of the army in Catalonia; when, on his arrival at Barcelona, he found neither troops money, artillery, provisions, nor ammunition. Enraged at this deception, Condé vented his resentment in bitter complaints and severe reproaches; but his genius enabled him to triumph over every obstacle. In the campaign of 1648, Condé thwarted the projects of the Archduke Leopold by carrying the war into the Low Countries, and by the capture of Ypres in sight of the enemy's forces.

Notwithstanding this success, Condé saw himself on the point of experiencing the greatest reverse of fortune. His army was a prey to scarcity, to nakedness, contagious distempers, and desertion. For eight months it had received no supply from the minister except half a muster. Every thing was furnished by the prince himself, who expended what money he had, and borrowed more, in order to supply his troops. When it was represented to him that he was in danger of ruining himself by such an enormous expense, he replied, that since he every day ventured his life for the service of his country, he could very well sacrifice his fortune to it. Let but the government exist, added he, and I shall want for nothing.

The French army having been reinforced by four thousand of the troops of Weimar, Condé attacked and routed the Spaniards, near Lens. He afterwards besieged Furnes, and compelled the garrison, five hundred strong, to surrender. The prince, however, was wounded above the right hip by a musket-shot; and the contusion proved so great that he was forced to submit to several incisions.

At this time a general revolt broke out at Paris, in consequence of the imprisonment of Broussel and Blancmenil, two of the leaders of the country faction, who had rendered themselves peculiarly obnoxious to the court. To quell the disturbance it was found necessary to release them; but from that time the regal authority was annihilated, and Mazarin durst no longer venture out of the Palais Royal. In this embarrassment the queen recalled the Prince of Condé, who in the meantime had retired to Ruel with the young king and Mazarin; and proposed to him the reducing of Paris by force of arms. Calming her resentment, he directed all his efforts to pacify the kingdom; and at length brought about an accommodation between the contending parties. The treachery of Mazarin, and the artifices of the popular leaders, occasioned fresh cabals and fresh troubles; but Condé at last preferred the ingratitude of the court to the arrogance of the malcontents.

On the night of the 5th January 1646, the royal family, the Duke of Orleans, Condé, and Mazarin, left Paris privately, and went to St Germains, whither the parliament sent deputies to confer with the queen in regard to her departure. Mazarin had the imprudence to dismiss the envoys without any answer. Exasperated at this, the people again took up arms in order to defend themselves; and the court resolved to suppress the party of malcontents (who had been armed principally by the instrumentality of De Retz), by blockading the capital. Accordingly, with seven or eight thousand men—the broken relics of the last campaign—the Prince of Condé, though destitute both of money and magazines, succeeded in seducing the army under Turenne from their allegiance; stopped the progress of the Duke de Longueville; got the start of the Spaniards, who were advancing to give him battle; and ultimately reduced the refractory capital. Peace was at length signed at St Germains; but neither party carried its point, and scarcely any one but Condé acquired glory in the war. After the conclusion of the treaty, the prince repaired to the capital, and received from parliament the thanks of the nation for the peace to which he had so powerfully contributed. Condé.

The important service which Condé had just rendered the court entitled him to the acknowledgments of the queen, and especially of Mazarin; but the cardinal remembered him only as a too fortunate and too powerful protector, and privately vowed to render the prince obsequious, or procure his submission. However, not to excite public indignation, he still kept up appearances with the prince, and deceived him by the most flattering proposals, which he always found means to evade. On the other hand, the prince despised the minister, and treated him with disdain. After this they were again reconciled only to be again at variance. Each in his turn courted the country party, in order to make it subservient to his designs. At length Mazarin thought of an expedient, which had but too frequently answered his purpose—of creating an irreconcilable quarrel between that party and the prince. Among the malcontents, the Marquis de la Boulaye, a man of an infamous character, had obtained the confidence of the party by false appearances of hatred to the cardinal, with whom he secretly kept up a correspondence. It is pretended that he made him an offer of killing Condé privately. Mazarin was charmed with the proposal; but he only required Boulaye to exhibit all the proofs of an assassination in which everything might concur to render the country party suspected of the crime. He was punctually obeyed; the coach was stopped; some pistols were fired at it, by which two of the footmen were dangerously wounded; and after this shameful exploit, La Boulaye took refuge in the hotel of the Duke of Beaufort, who was the hero of the party, in order, no doubt, to countenance the prince's suspicion of the malcontents. Luckily Condé was not in his coach when it was stopped; the cardinal had spread the report of his intended assassination, and, in concert with the queen and the prince, he sent the coach away empty, in order to prove the reality of the attempt. Mazarin, counterfeiting a zeal for the prince's safety, declaimed furiously against the malcontents; and inflamed Condé's resentment against the Duke of Beaufort and the coadjutor, whom he supposed to be the authors of this heinous outrage. The prince was so strongly prejudiced that he refused to hear them when they appeared before him to justify themselves. The affair was brought before the parliament; the accused defended themselves; and the coadjutor, who had discovered the cardinal's secret, unmasked the plot so well, that the prince agreed to a private negotiation with the malcontents, requiring nothing more than the coadjutor's leaving Paris, but with the rank of ambassador to Rome or Vienna. That prelate would have consented to this to satisfy Condé, had not Mazarin, some days afterwards, given him the choice of any recompense, in order to gain his concurrence in the prince's destruction. Master of the queen's mind, which he guided as he pleased, and sure of having inflamed against Condé the resentment of the malcontents, he sought and obtained, by means of the Duchess of Chevreuse, the support of that powerful faction, which connected itself the more readily with him, in the hope that the prince's fall would soon enable it without difficulty to crush the cardinal himself. The coadjutor had private conferences with the queen and the minister. Condé had been informed of the plot, and in order to discover if it were true, endeavoured to extort by surprise an admission from Mazarin's own mouth. "Cardinal," said he one day, "it is publicly reported that you have nightly meetings with the coadjutor, disguised like a trooper," accompanying this speech with a quick and penetrating look. But the cardinal, who was a perfect master of dissimulation, answered him in such a free and apparently artless manner that he entirely removed Condé's apprehensions; and the

Condé. latter slighted the information he had received of the plot forming against him. Mazarin at last found means, through the Duchess of Chevreuse, to inflame the jealousy of the Duke of Orleans, and to engage him to consent to the imprisonment of Condé. And having thus united all parties, the ungrateful and perfidious minister made preparations for privately arresting the prince; and signed an order to that effect, Jan. 18th, 1650. Condé having that day repaired as usual to the Palais Royal, to assist at council with the Prince of Conti and the Duke of Longueville, the three princes were immediately arrested and conveyed to the castle of Vincennes.

In this unexpected reverse of fortune, the fortitude and greatness of Condé's mind were remarkable. Confined with the two other princes in the tower of Vincennes, where neither supper, furniture, nor beds were provided, he contented himself with the humblest fare, and slept twelve hours without waking on a truss of straw. He still retained his cheerfulness; dedicating the greater part of his time to reading and conversation, and the remainder to playing at battle-door and shuttle-cock, to bodily exercises, and the cultivation of flowers.

Meanwhile the prince's friends, though strictly watched, found means to keep up a regular correspondence with him, and made various attempts to release him. Troops were raised by the Dukes of Bouillon and Rochefoucault, and the Viscount de Turenne; and the Princess of Condé engaged the province of Guienne to declare in his favour. But all those efforts would perhaps have been ineffectual, if other and more powerful resources had not been employed.

In that gallant and warlike age, everything was managed by the intrigues of five or six women, who possessed the confidence of the leaders of the state, and of the various parties. The Princess of Mantua, wife to one of the sons of the Elector Palatine, king of Bohemia, who principally directed the counsels in the party of the princes, found means to reconcile the Duke of Orleans, the coadjutor, and the malcontents, with the friends of the prince, and all united their efforts against the cardinal; while the parliament, on the other side, loudly demanded the release of the prisoners. The different orders of the state also united in soliciting it, insomuch that the queen was at last prevailed on to give her consent. At this news Mazarin was so confounded that he fled in the disguise of a trooper, and arrived at the gates of Richelieu, where a body of horse waited for him. The parliament, informed by the king of his flight, thundered forth an arrêt, by which he was obliged to leave the kingdom, with his family and foreign servants, in the space of fifteen days, under the penalty of being exposed to a criminal prosecution. The queen wished to follow him; but the nobles and burghers invested the Palais Royal, and prevented the execution of this project, which would have kindled a civil war. Mazarin, therefore, perceiving that it was impossible for the queen to join him, determined to go himself to restore the princes to their liberty, and to get the start of the deputies who were coming to acquaint them with their release. On his arrival at Havre, he informed the princes that they were free, and prostrating himself at his feet, entreated Condé's friendship. Condé gave him a polite reception, and spoke to him in a free and cheerful tone; but, tired with the mean submissions which the cardinal lavished upon him, left him without making any promise, and returned to Paris, where he was received with demonstrations of a most sincere and general joy.

In the civil war which ensued, Condé sided with the malcontents. Being pressed by the king's army, he retired into the faubourg of St Antoine, where he behaved with the utmost bravery; upon which the citizens opened their gates and received him, and a peace soon afterwards ensued. His hatred of the cardinal, however, induced him to quit Paris, and take refuge among the Spaniards, who made him generalissimo of their forces; and at their head he captured Rocroi. But the peace of the Pyrenees restored him to his country; and he again signalized himself at the head of the king's armies. Being afflicted with gout, he refused the command of the army in 1676, and retired to Chantilly, where he was as much esteemed for the virtues of peace as he had before been for his military talents. He died in 1686, at Fontainebleau. Condé Condillac.

Condé, a town of France, situated at the confluence of the Haine with the Scheldt, department of Nord. It is a fortress of the first class, its defences having been constructed by Vauban; and possesses a handsome church, town-hall, military hospital, &c. The navigation of the river enables it to carry on an extensive trade in coals, cattle, and corn. Manufactures—starch, leather, and cordage. In the early history of France, Condé was subjected to frequent sieges. It surrendered to the Austrians in 1794, but was recaptured at the close of the same year. Pop. 3500.

Conde sur Noireau, an ancient town at the confluence of the Durance with the Noireau, department of Calvados. Manufactures—woollens, cotton goods, leather, and cutlery. It also trades in cattle, yarn, and honey. Pop. 5970. There are several other towns and villages of this name in France.

CONDENSATION (Lat. *condensatio*), the act by which a body is rendered more dense, compact, or of greater specific gravity, by bringing its particles into closer union. The word is commonly applied to the conversion of vapour into water, by distillation, or by a natural process. Condensation is the reverse of expansion. All matter which is expansible is capable of condensation; and condensation may convert a gas into a liquid, and a liquid into a solid. Hence solidity and increased weight are consequences of condensation. Dew and rain are produced by the condensation of vapour from the air. See Evaporation and Clouds.

CONDENSER, a pneumatic machine or syringe for compressing air, by means of which ten or more atmospheres, or ten times as much air as exists in a given space under the ordinary pressure of the atmosphere, may be forced into that space.

The syringe consists of a brass cylinder in which there is a moveable piston which forces the air into a receiver; and a valve prevents the air from escaping. The receiver or vessel in which the air is condensed should be made very strong, to bear the increased force of the air: for which reason vessels of this sort are generally made of brass, and the orifice is fitted with a female screw to receive the male screw at the end of the condenser. See Pneumatics. The term is also applied to vessels in which aqueous or spirituous vapours are reduced to a more dense state, either by the injection of cold water, as in the condenser of a steam-engine; or, when this is inapplicable, as in the distillation of spirituous liquors, by surrounding the condenser with cold water, which is perpetually renewed, and is applied over a large surface of the condensing vessel. See Distillation, Steam-Engine, &c.

CONDER (Fr. *conduire*, to guide), a name given to a person who stands on a cliff or on any elevated position during the time of fishing, for the purpose of directing the fishermen by signs in which direction the shoals are passing; the peculiar appearance which is occasioned in the water by the motion of the fish being more readily observed from an eminence than from the level of the water. Conders are otherwise called *balkers*.

CONDILLAC, Etienne Bonnot de, Abbé de Mureaux, well known as an eminent writer on metaphysics and education, was born at Grenoble in 1715. He was brother

Condillac. to the Abbé de Mably; and, like him, arrived at high celebrity, though in a different line of pursuit. He seems to have been actuated by the purest motives of utility to his species, in directing his exertions to the elucidation of those subjects in metaphysical science, the imperfect state of which had involved the studies, as well as the public pursuits, of the thinking world, in perplexity, and had retarded the attainment of that degree of sound knowledge and of happiness for which the faculties of man entitled him to hope. The field of metaphysical research had been for some time laid open by the destruction of the imperious authority of Aristotle and the schools; a variety of contending doctrines, which had made their appearance, created in active minds a spirit of independence; and no admiration of the genius of another prevented the suggestions of the philosophic critic from mingling themselves with the illustrations of the enlightened pupil. Locke had led the way to a mode of investigation now rising into favour, and promising to impart a luminous simplicity to the science of mind; and philosophers emulated one another in their efforts to correct or to extend the doctrines of this author, or to found upon them others distinguished by new improvements. Condillac was one of the first who introduced this style of metaphysical inquiry into French literature. His earliest work was his *Essai sur l'Origine des Connoissances Humaines*, which appeared in 1746. This work contains those favourite opinions which are exhibited with more correct taste in his subsequent productions. It is not, however, superseded by the latter, as it contains a variety of interesting illustrations peculiar to itself; and although here we find his errors particularly prominent, that circumstance seems rather to proceed from the absence of art and of plausibility, than from the subsequent adoption of views more radically correct. From the outline which he first formed of philosophic methods, he seems never to have departed. The object of the first part of this essay is to confirm and extend the doctrine of Locke, that all ideas originate in the senses, and consist of sensations variously modified. Readers who conceive that Locke's doctrine, when followed to its consequences, tends to lower the estimation in which the human mind ought to be held, will probably attach the same blame to Condillac. His curious saving clause will not vindicate his opinions among the philosophers of this country, however convenient it might be found among the adherents of the Roman Catholic church, that the depression of the soul on the senses is one of the effects of the fall of man, and a proof of his present state of degradation. Readers who are not ambitious of possessing a fixed theory in a department of metaphysics so abstruse, will be pleased with those traits of acuteness in the observation of mental phenomena which abound in this essay, and which are often expressed with great felicity, even while the slight distortions communicated to some of his representations of facts by the tendencies of his theories obtrude themselves on our notice. The doctrine now mentioned is followed up by two other leading positions, "that the association of ideas is the foundation of the most important mental operations," and "that language is absolutely necessary to the development of the human faculties." Ideas, he asserts, cannot be associated with one another, except by being associated with words or other signs which become the materials of a language. On this doctrine he establishes a definition of memory, which is altogether unique, that it consists in the recalling of words or circumstances relating to a perception; the recalling of the perception itself belongs to imagination, while it is reminiscence that makes us recognise it as one which we have formerly entertained. He denies all memory to animals, because they have no language. Thus a futile fallacy led him to form a verbal distinction, founded on no difference in the nature of things. A person destitute of language, and wishing to have it in his power, on future occasions, to recal a particular idea, might certainly find means adapted to his purpose, by associating it with different objects. These objects would serve the same purpose as the signs of which [illegible] consist. Some such associations are essential to memory. The slightest attention will show us that words or signs serve no other purpose than is done by all kinds of ideas, in assisting the mind to make use of one another. What this author calls a sign, is merely another idea intentionally associated with that which we principally wish to recollect. We may give the latter numerous associations, that it may have many chances of being recalled. We associate it either with the most important or with the readiest of our perceptions, that it may be recalled more perfectly, or with greater certainty. The only circumstances that render some perceptions better adapted to this end than others, are their importance, their familiarity, and their analogy with those which have been previously used. We generally choose our instruments of private recollection from the materials of language, because these materials are already employed for communication. They are rendered convenient by their variety, and by the classifications and analogies which were followed in the first formation of them, as necessary for rendering them the media of communication, and which, by connecting them powerfully together, give them a high adaptation for extensive arrangements. Language, in that state of improvement in which it exists in a cultivated age, extends intellectual operations; but it neither adds any radically distinct faculty, nor gives origin to any new genus of mental exercise. Condillac says, that "a man without language could not recal his ideas, except when placed in the same circumstances in which they had been formerly presented." The obvious answer to this is, that language, in so far as it serves this purpose, consists in the multiplication of the assisting circumstances in which a man is placed when a perception is formed. Many ingenious illustrations are subjoined, which are deserving of attention; but when well considered they will lead to conclusions differing from those which the author endeavours to establish. In viewing the mind in its active state, he justly observes, that objects attract its attention only as they are connected with our temperament, our passions, our condition, and our wants; and this principle is afterwards beautifully applied to the illustration of the earliest acquisitions of knowledge, and of the difference of character between them and many that succeed at a later period. But no person would affirm that our wants are the signs of our perceptions, though various perceptions are powerfully recalled by their means.

The opinions of the author certainly led him to ascribe too much to language. It is to the want of signs that he traces the whole disadvantages of the deaf, whereas we know that they are entirely owing to the deficiencies of their mental intercourse with others, that is, to their privation, not of the private, but of the social use of language. We find that the great improvements now made in the art of communicating with the deaf have made these disadvantages to disappear. The young man of Chartres, who was born deaf, but acquired the faculty of hearing when of adult age, and was therefore able to describe the state of his understanding during his former deafness, declared, that when he made the sign of the cross, and joined in the other ceremonies of the Roman Catholic religion, he had never attached to them any meaning, or supposed that any thing was represented by them. Thus, for want of language, he is represented as destitute of ideas. In this instance, however, we only perceive

Condillac. the facility with which men imitate one another's acts and professions, without exercising independent thought. The difference between this deaf man and most other persons was, that he took the propriety of the ceremonies for granted, being entirely led by example, while those who had heard their meaning explained acquiesced with reverence and complacency in certain verbal positions connected with them, without ever inquiring into their meaning or their merits. Another illustration is taken from a man, who, though he enjoyed the faculty of hearing, had lived apart from all association with his species in the forest of Lithuania. But it is easy to show that the great mental deficiencies of that individual arose from the want of society, and not simply from the want of a language to supply his private meditations with signs.

It is in the art of calculation that the utility of signs is most conspicuous in forwarding the progress of intellectual operation, and it is there that we find a language presented to the eye, which is adapted in a most perfect degree to the purposes of the mind. Hence the use of signs for expressing our ideas of number is a favourite topic with Condillac and the other adherents of the doctrines of the Nominalists. The number ninety-nine could not be distinguished from a hundred, except by language. Ninety-nine objects placed together would not convey a different perception from a number varying from it by one less or one more. It is an error, however, to imagine, that the words one hundred, or the ciphers (100) by which the number is represented, give us a perfect idea of any number. They only represent one relation of it to a certain mode of accumulation, the decimal series. Independently of all language, general features may be perceived to characterize objects too complicated to be comprehended by any human mind.

Condillac, seduced by his favourite theories, condemns one of the most profound and useful of the practical observations of Locke, that the best way of arriving at correct knowledge is to consider ideas by themselves, independently of their signs. This exercise our author pronounces to be utterly impracticable; and all that he attempts to recommend in its stead is the precaution of employing only such words as are well understood. How can words be understood, unless the ideas which they represent are considered as detached from all association with them, and thus exempted from the embarrassing influence of fallacious analogies?

Regarding language as a necessary instrument of mental operations, he makes some observations on the parts of speech, and the manner in which they are connected in sentences. He describes with ingenuity the steps by which words pass from expressing sensible qualities to become the names of mental faculties. Here we perceive a glimmering of some truths which have been since luminously displayed in the *Philosophical Essays* of Mr Dugald Stewart. He introduces at the same time some speculations on the origin of abstract terms, which are not entitled to equal approbation. He takes occasion, however, to make one remark which is both beautiful and just, that men have too often imagined that words perfectly explain the essence and nature of things, whereas they express in reality nothing more than some imperfect analogies. This position, followed to its consequences, would suggest a correction of a great part of the author's errors.

In describing the pronoun, he gives way to a species of metaphysical mysticism, by which he is grievously misled. He conceives that this class of words must be of late formation, because some difficulty must have occurred in substituting another word for the proper name of an object. He did not here consider that nothing of the essence of an object, nothing but qualities, circumstances, or accidents, is expressed by the proper name, more than Condillac. by the pronoun. The same man may be "John," "father," "brother," "master," "subject," "I," "thou," or "he," according to the occasions on which the mention of him is introduced. All the designations applied to him are equally proper and easily made.

Yet this work is well worthy of an attentive perusal. We find in it a brilliancy of expression which renders it more amusing than metaphysical dissertations often are; although it must be confessed that there is in some instances a false simplicity, arising from an attempt to represent metaphysical science as easier than it really is. In his subsequent works he acknowledges that he had fallen into some errors from the precipitate views which he took of the mental powers; but he specifies no particulars; and a reader who does not acquiesce in all his improved views will not easily see the exact corrections which the author made on those contained in his *Essai*.

In 1749 he published his *Traité des Systèmes*, the object of which was to show the futility of the doctrines derived from those hypothetical systems which were the offspring of an erroneous mode of procedure in the pursuit of knowledge; such as those which set out with general or abstract maxims, and pretend to establish on them a body of profound science. Another kind consists of arbitrary suppositions, laid down as principles for the explanation of things which cannot be otherwise accounted for. These are a convenient resource for ignorance; they are formed with so much pleasure and so little trouble, that a man in bed may, by their aid, create and govern the universe. He illustrates the conspicuous influence which this mode of systematizing had on opinions in metaphysics. He takes a view of the system of innate ideas as maintained by Descartes; that of Malebranche, who reduced all knowledge and all mental activity to operations which had the divine essence for their objects; that of Leibnitz, who explained the laws both of matter and of mind by general functions pertaining to simple and indivisible beings, which he called *monades*; and that of Spinoza, who reduced all nature and all existence to one simple substance, of which the various phenomena, material and mental, are only modifications. The last of these systems had created some commotion in the philosophical and religious world, as adverse to a belief in moral distinctions. Condillac treats the argument with a dignified delicacy, as having received a wrong direction in the writings of that author, in consequence of the erroneous methods of investigation which he employed. His words are, "Does Bayle believe that he has refuted Spinoza, by exposing the consequences which he himself draws from the system of that philosopher? If these are not really its consequences, he does not attack Spinoza. If they are, Spinoza will reply that they are not at all absurd, and only appear so to persons who are unable to ascend to the principles of things. Destroy, he will say, my principles, if you would overthrow my system; or if you let my principles alone, assent to the propositions which are their necessary consequences." "My object," says Condillac, "has been to show that Spinoza had no idea of the positions which he advanced; that his definitions are vague, his axioms inaccurate, and his propositions entirely the work of imagination, and include nothing that can lead to the knowledge of things. Having done this, I proceed no farther. To attack the phantoms which arise from his principles, would be as preposterous as the feats of the knights-errant, who combated the spectres of the sorcerers. The wisest plan is to destroy the enchantment." Having shown the radical fallacy of the principles adopted by the preceding writers, he points out the cases in which hypotheses assist human knowledge. The first is,

Condillac. when we can exhaust all the hypotheses that can be formed on any subject, and possess a rule for distinguishing that which is admissible. Of this we have examples in the pure mathematics. A second kind of hypothesis includes those which are employed in astronomy, provided they are limited to the object of accounting for the revolutions of the heavenly bodies. A third occasion on which they ought not to be rejected is, when they facilitate observation, by giving greater palpability to truths attested by experience. He mentions the importance of general systems formed by a process of induction. He points out the necessity of general systems in politics, founded on the character and condition of the different classes of men who constitute the body politic; and concludes with a view of the advantage derived from system in the arts. He gives some useful practical observations on the application of mathematical and metaphysical analysis. This treatise abounds in excellent remarks on human character, as displayed both in intellectual pursuits and in the business of life. His comparison of Locke and Malebranche is a masterpiece of description.

Next in order, his *Traité des Sensations* made its appearance in 1754; a work which displays a truly philosophical spirit, uniting boldness with circumspection. The mode in which he investigates the origin of ideas of sense, and the progress of intellectual operation, had the merit of some originality, and afforded an undoubted advantage to the prosecution of the most interesting inquiries. He considers the sense in a separate state, by forming the supposition of a being created without sensations. He supposes this being in the first instance to be endowed with the sense of smell, and describes the mental character which would thus be formed. He gives a similar account of the other senses, and examines successively the effects of their combinations, till he arrives at the description of a complete human being.

His uniform aim is to show *that all ideas and all mental phenomena consist of sensations transformed.* Those who reject that doctrine will still acknowledge the beauty and ingenuity of his train of description. The conclusion itself is refuted by the slightest reflection on the very scope of the author. He evidently supposes the man who becomes thus complete by receiving his different external senses in succession, to have been previously in possession of dormant intellectual faculties; for his descriptions, while they apply to man, will not apply to many other animated beings whose senses are equally perfect, because the use which they are able to make of the impressions received is either incomparably more limited or different in kind. If the results of intellectual operation are nothing else than sensations transformed, the transformation is certainly more important than the original materials, and the transforming power cannot be lightly esteemed by any one who values extended knowledge. The favourite theme of the author, however, detracts but little from the pleasure which this ingenious work imparts. Some would pronounce the discussions which it contains to be not strictly analytical. Analysis should begin with man as he exists in a complicated state, with all his senses as well as his faculties entire, and proceed to separate his constituent powers by successive subdivisions, till, in its progress downwards, it arrives at the description of each sense and each species of intellectual operation in a separate and simple state. The description of a man endowed in that kind of succession which Condillac describes, is a purely hypothetical process, more allied to arbitrary synthesis than to analysis. By analysis, however, the author means, in a general way, the task of surveying in succession the parts of which compound objects consist, and examining separately the relations by which they are connected, without any reference to the order of procedure. Condillac. Decomposition and recomposition he, in a subsequent work, represents as alike belonging to analysis, and though from etymology the Greek word *synthesis* is the same with that of the Latin word *composition*, he limits the former term to that mode of composition which he condemns, that which begins with general or abstract doctrines, and which regards these as the ground of systems pretending to explain the existing world. Although his order of description of the senses is so far hypothetical as to have nothing corresponding to it in the natural history of man, he regarded it as sufficiently capable of being substantiated by close comparison with every man's experience, and thus distinguished from the offspring of an arbitrary synthesis.

These works having procured for the author a distinguished character in the philosophical world, he was appointed preceptor to the infant Duke of Parma, grandson of Louis XV.; and, in applying himself to the discharge of the duties of that office, he brought into exercise the same talents which had shone so conspicuously in his writings. He composed a course of studies (*Cours d'Etudes*) in thirteen volumes, including *Grammaire*, *l'Art d'Ecrire*, *l'Art de Raisonner*, *l'Art de Penser*, occupying the first four volumes, succeeded by nine volumes *On Ancient and Modern History*. His *Grammaire* exhibits, in his own able manner, doctrines in universal grammar nearly allied to those which generally prevailed, and which we find in the *Grammaire Générale et Raisonnée* of the Port Royal. The author's favourite principle, that every language is an analytical method, runs through the body of his work, and probably leads him to pay too great respect to the technical differences of the parts of speech, as indicating thoughts of different classes. *L'Art d'Ecrire* is a most agreeable and enlightened system of general criticism, and adds to this the merit of exhibiting an interesting view of French literature, in the examples of good and of faulty writing by which the precepts contained in it are illustrated. The whole rules relative to style are referred to one principle, that a writer ought to conform his diction and his imagery to the most fundamental associations of ideas. His rules thus deduced do not exhibit any such difference from those of other authors as to form in his readers a style marked by any singularities. On the contrary, we find him exempting literature from the shackles of some rules, the close observance of which secures an apparent accuracy at the expense of a natural ease, and showing his susceptibility to the influence of a pure taste by bestowing approbation on passages which a critic of a more formal cast would have thought himself called upon to censure. His *Art de Raisonner* is a work of singular excellence and utility. It is a luminous exemplification of the rules of reasoning, in the steps of that mental progress by which physical philosophers have unfolded the laws of motion, the principles of mechanics, and the theory of the heavenly bodies. He discriminates with just and beautiful effect the different kinds of evidence on which the various doctrines of those branches of natural philosophy rest. This treatise is well worthy of being known in our language, as it exhibits an uncommonly pleasing road to an elegant department of physical knowledge, and furnishes a model for the prosecution of other studies. His *Art de Penser*, notwithstanding all the ability which it displays, will probably be found the least interesting part of the *Cours d'Etudes*, as it chiefly consists in an explanation and recommendation of the author's peculiar notions on the nature of mind. His *Ancient and Modern History* forms a body of morality and legislation. His details are not inspirited with the ardent eloquence of a popular historian who excites a deep interest in indi-

Condillac. vidual characters or insulated events. He does not exhibit paintings to the imagination, but contents himself with furnishing leading principles to the understanding. His style, though pure, is without ornament and without fire, and hence his history has been much less read than his other works.

In 1768 he was admitted into the Academy of Sciences, on the death of the Abbé d'Olivet; but he never afterwards appeared at any of the meetings of that body.

His attention being habitually directed to those subjects in which intellectual exertion was most wanted, for the advancement of objects of general utility, he published, in 1776, the results of his studies on Political Economy, in a work entitled *Le Commerce et le Gouvernement, considerés relativement l'un à l'autre.* This work became an object of attack to the Economists; and the author, no doubt, like most others who have written on that subject, committed some mistakes. Yet he essentially improved the discussions connected with it, and he exhibits a model of luminous arrangement in his mode of delivering his opinions.

The extended fame of Condillac procured for him a most honourable testimony of esteem from the Polish nation. The council of public instruction of that nation requested him, through the medium of Count Ignatius Potocki, to draw up an elementary treatise on logic, for the use of their palatinal schools. This gave birth to his *Logique*, which was published in 1780, a few months before his death. The object of this work is to give a condensed account of the principles of *analysis*, taken in the acceptation already mentioned. This process, he observes, is taught by nature, and is always conducted with accuracy when man is in quest of the means of supplying the urgent necessities of his being. It is when curiosity forms to him a separate order of objects for his gratification, that he becomes precipitate in grasping at conclusions, and embraces them with readiness, though not the produce of that rigorous correctness of method which necessity imposes on his earlier pursuits. In giving an account of the origin of ideas and the mental faculties, he exemplifies his views of analysis, and, at the same time, prepares the way for further applications of the mental powers of his pupils. He adheres to his doctrine of the supreme and exclusive influence of language in conducting all intellectual pursuits. Generalization and classification are, with him, nothing more than the contrivance of generic names. The art of reasoning is made to consist in the formation of an appropriate language for the different sciences. He considers the justness of our reasonings as depending on the degree of perfection of the languages which we possess. The superior certainty of mathematical compared with other knowledge is ascribed by him to the superior accuracy of mathematical language. Hence his favourite illustrations of the progress of the mind are taken from arithmetic and algebra. This principle is certainly carried by him to great excess in the framing of his general positions; yet we find him on other occasions recommending to his readers to cultivate the unbiassed study of nature, and to choose their words rather from the correctness of their application to objects, as they have fallen under actual observation, than from having their meaning fixed by the unsatisfactory formality of verbal definitions. He lays down some highly useful rules for the prosecution of knowledge. His errors arise chiefly from a strained effort to give to his subject a degree of simplicity not adapted to its nature. Hence some of his maxims are more quaint than just; but, compared with the complicated systems of logic previously in use, that of our author formed an improvement which merited the grateful reception that was given to it; and, even at the present day, if we pardon the paradoxical generalities by which it is disfigured, we may profitably trace, in company with the author, the steps by which many intellectual attainments are made, and the means by which the process admits of being facilitated. Conditional ‖ Condom.

The last work of Condillac, his posthumous treatise, entitled *La Langue des Calculs*, formed an important acquisition to science, which has not in this country been duly appreciated. In some subordinate points it is not unexceptionable; for example, he here, as in some of his former works, particularly his *Art de Raisonner*, perpetually repeats the assertion as of the greatest importance, that just reasoning consists in tracing identical propositions, and in passing from identity to identity. Aware of the objection to which this assertion was exposed, that identical propositions can amount to nothing more than futile and stagnant truisms, he imagines that this objection is answered by stating that, in the different steps of a process of calculation, there is *an identity of ideas*, but *a difference in words*, which is certainly a gross paralogism. In one or two passages he states with greater truth, though apparently by accident, that a process of calculation consists in considering the same objects in different points of view; a proposition which ought to have had that conspicuous place in his treatise which he gives to his doctrine of perfect identity. If this single alteration is made in the mind of the reader, the *Langue des Calculs* will be perused with the highest profit. An English translation of it would form an important accession to the means of an enlightened education in this country, as leading, by pleasant steps, to the highest scientific attainments.

Condillac is to be considered as in the soundest sense of the word an amiable man. If he had an apparent reserve, and in some respects a want of fervour, these apparent defects were more than compensated by the steadiness of his conduct. In early life he was intimate with J. J. Rousseau, Diderot, and Duclos. But he indulged no hazardous speculations on the general interests of mankind, and cherished no modes of thinking which tended to divide or distract the age. He was sincerely public-spirited; and his conciliating sentiments will, perhaps, among those who most accurately weigh them, be respected as morally sublime. As a well-wisher to the fortunes of his species, he acted on a principle which he considers as having uniformly operated in the production of former improvements. He dwells on the value of the attainments already made, as an exercise fitted to create a spontaneous disposition to extend them, divested of the spirit of party, and exempt from rashness. Hence his works were not only much read by individuals, but were employed in many of the continental seminaries of education, and, without exciting discontent or apprehension, except among the inflexible scholastics of Spain, proved successful in illuminating the age in which they appeared. He died in August 1780, on his estate near Bangenci, where he had passed a life of retirement, though not more allied to solitude than as it was exempt from the scenes of public bustle and prevalent ambition. See *First Preliminary Dissertation*, vol. i., p. 172. (H. D.)

CONDITIONAL, not absolute, but subject to conditions.

Conditional Conjunctions, in *Grammar*, are those which serve to make propositions conditional; as *if, unless, provided, &c.*

Conditional Propositions, in *Logic*, such as consist of two parts connected together by a conditional particle.

Conditional Syllogism, a syllogism where the major is a conditional proposition. Thus,

If there is a God, he ought to be worshipped.
But there is a God;
Therefore he ought to be worshipped.

CONDOM, a town of France, department of Gers, and

Condor ‖ Condorcet.

capital of a cognominal arrondissement, is situated on the Baise, which is here crossed by two stone bridges. The town itself is very irregularly built, but its suburbs are adorned with handsome villas. In the market square is a noble Gothic edifice, once the cathedral, but now reduced to the status of a parish church. Manufactures—cotton and woollen fabrics, and earthenware: its principal trade is in rural produce. Bossuet was bishop of Condom in 1669. Pop. 7027.

CONDOR, the largest of the Vulturidæ. See index to Ornithology.

CONDORCET, Marie-Jean-Antoine-Nicolas-Caritat, Marquis of, a French philosophical, political, and biographical writer of distinguished eminence, descended from an ancient family in the principality of Orange, was born at Ribemont in Picardy, in 1743. He received his education at the college of Navarre, where he was distinguished at an early period of life for his strong attachment to the study of physics and mathematics. On his entrance into public life, he established a friendly intercourse with Voltaire, D'Alembert, and other literary characters who professed opinions analogous to his own, and formed a very powerful party among the French literati, whose united efforts to propagate their ideas of religion and politics have been applauded or condemned according to the principles of their different judges. Condorcet first attracted the attention of the public as a mathematician, obtaining their approbation for his treatise on integral calculations, which he composed at the age of 22. In the year 1767 his solution of the problem of the Three Bodies made its appearance, and in the following year the first part of his Essay on Analysis. In the year 1769 he was received as a member of the Academy of Sciences, the memoirs of which were greatly enriched by him with different papers on the most abstruse branches of mathematical science. His justly-merited reputation pointed him out as a fit person to cooperate with D'Alembert and Bossut in assisting the celebrated minister and able financier M. Turgot with arithmetical calculations. In the mean time he laboured indefatigably in the study of politics and metaphysics, and de[illegible] anonymous publication, the sect of philosophers to which he had attached himself, from an attack made upon them in the *Trois Siécles;* and replied to M. Necker's essay on Corn Laws. He was appointed secretary to the Academy of Sciences in the year 1773, when he employed much of his time in writing eulogies on such of its deceased members as Fontenelle had passed over in silence. Condorcet having, like D'Alembert and some others, united in himself the characters of an elegant writer and a man of profound research, was admitted into the French academy in 1783, when he pronounced an oration on the influence of philosophy, which was ordered to be printed. From the time of D'Alembert's death, which happened this year, he filled the situation of secretary to that academy, rendering his name conspicuous by the publication of eulogies on different eminent characters. His panegyric on D'Alembert, to whom he was most sincerely attached, is a very elaborate performance, and is esteemed as a candid account of the genuine merits of that great philosopher. The encomium he bestowed on Euler furnished him with a favourable opportunity of giving a circumstantial account of the specific improvements and inventions conferred on a peculiar branch of science by the labours of that illustrious individual. His eulogy on the minister Turgot was read with avidity, and admired by all those who approved of Turgot's plans of government and system of finance. In the year 1787 he published his Life of Voltaire, which, whatever be the opinion of that philosopher's merits, is highly elaborate, and replete with lofty panegyric. The last of his biographical works was a eulogy on the celebrated Dr Franklin, published in 1790; but all of these will be read with some degree of prejudice by those who are inimical to the school of philosophy to which Condorcet belonged. Condorcet.

The French Revolution, which the writings of Condorcet and his associates unquestionably accelerated, naturally interested his feelings, and called forth his exertions; and at an early period he employed his talents to promote those reforms which, as he thought, were to pave the way to a new order of things. A work entitled *La Bibliothèque de l'Homme Public,* intended to exhibit an analysis of the writings of the most eminent politicians, was chiefly conducted by him; as was also a newspaper called *La Chronique de Paris,* filled with declamation against royalty. He had likewise a share in the celebrated *Journal de Paris.* About the time when the king fled to Varennes, he proposed a paper called *Le Republicain,* the intention of which is clearly deducible from its title. He was an indefatigable member of the Jacobin club, and spoke frequently, though not forcibly, at their meetings. He was chosen a representative for Paris when the constituent assembly was dissolved, and followed the general political course of the Brissotine party. He exerted his abilities in devising a plan for public instruction, the draft of which is contained in two elaborate memoirs on the subject; but, though it contains some exalted and enlarged ideas, it was too extensive and sweeping to be ever reduced to practice. He was likewise author of the manifesto addressed to the European powers by the people of France on the approach of a war. While he was president of the assembly he wrote a letter of expostulation to the king, which some have considered as unnecessarily severe; and when the king was insulted by the populace at the Tuileries, in being offered the red cap, it is said that he vindicated their proceedings. While he was degrading royalty in this manner, it seems that he was secretly soliciting the office of tutor to the Dauphin, and rejected by the king on account of his avowed infidelity. He has also been charged with the basest ingratitude by those who regard him as accessory to the murder of the Duc de la Rochefoucault, to whom he was closely allied by a marriage exceedingly fortunate for his interests; but this is generally believed to be a calumny. When the trial of the king came to be debated, Condorcet gave it as his opinion that he could not legally be brought to judgment. His conduct, however, in regard to the sentence was rather of an ambiguous nature, and betrayed that timidity and want of resolution which formed a prominent feature of his political career. The judgment pronounced by Madame Roland on this extraordinary man seems an impartial estimate of his merits. "The genius of Condorcet," said that lady, "is equal to the comprehension of the greatest truths; but he has no other characteristic besides fear. It may be said of his understanding, combined with his person, that it is a fine essence absorbed in cotton. The timidity which forms the basis of his character, and which he displays even in company, does not result from his frame alone, but seems to be inherent in his soul; and his talents furnish him with no means of subduing it. Thus, after having deduced a principle or demonstrated a fact in the assembly, he would give a vote decidedly opposite, overawed by the thunder of the tribunes, armed with insults, and lavish of menaces. The properest place for him was the secretaryship of the academy. Such men should be employed to write, but never permitted to act." After the execution of the king, the Girondist party employed him to frame a new constitution; the plan of which was presented to the convention, and obtained their approbation. It was not so highly esteemed by the people at large; and it has, perhaps not without reason, been considered as a mass of metaphysical absurdities. During the violent struggle between the Girondist and Mountain parties, Condorcet took no decided part with either; a circumstance which seems to have been owing to the native timidity of his mind, and his

Condorcet. abhorrence of the state of public affairs. He was not comprehended among the number of those who were sacrificed with their leader Brissot; but having employed his pen against the victorious party, he fell under the invincible displeasure of Robespierre, who issued a decree of accusation against him in July 1793. He, however, found means to effect his escape from the arrest, and during nine months concealed himself in Paris. But at length dreading that the tyrant would order a domiciliary visit for the purpose of discovering the place of his retreat, he passed through the barriers without being noticed, and went to the house of a person in whom he confided, on the plain of Mont-Rouge. Unfortunately for Condorcet, however, this friend was at that time in the metropolis; and he was in consequence reduced to the necessity of passing two dreary nights in the open fields, a prey to hunger and cold. On the third day he obtained an interview with his friend, who unhappily durst not venture to shelter him under his roof; so that he was once more compelled to wander in the fields. At length, worn out by hunger and fatigue, and on the point of perishing for want of sustenance, he applied at a public house for an omelette, which he obtained and devoured greedily. His cadaverous appearance and uncommonly keen appetite roused the suspicion of a municipal officer who happened to be present; and the ambiguity and hesitation which characterized his answers when interrogated, justified his apprehension. He was accordingly consigned to a dungeon, to be next day conducted to Paris; but his melancholy fate rendered such a measure unnecessary. He was found dead in the morning; and, as it was generally understood that he constantly carried with him a dose of poison, to this cause his melancholy fate was ascribed. Thus, on the 28th of March 1794, terminated the career of Condorcet, who for many years sustained a brilliant and honourable reputation in the republic of letters. His manners were replete with urbanity, and he was as well qualified to please in company as could be expected in a man who was conceived, whether rightly or not, to be destitute of heart. "La bonté brillait dans ses yeux," says Grimm, "et il aurait eu plus de tort qu'aucun autre de n'être pas honnête homme, parce qu'il aurait trompé davantage par sa physionomie, qui annonçait les qualités les plus paisibles et les plus douces." His character, though not exempt from pride, was always peaceful and obliging. He appeared timid and embarrassed in a numerous circle; but among his friends he displayed a gaiety and liveliness quite fascinating, and never made any pretensions to superiority on account of the great extent of his knowledge. He had read a great deal, and his memory was prodigious. Soon after his death appeared his *Sketch of an Historical Draught of the Progress of the Human Mind*, in which he strongly advocates his favourite scheme of the gradual perfectibility of human nature. In spite of its fanciful character, it is clearly the effort of a superior genius, and acquires peculiar interest as being composed while its author was in circumstances of danger and distress. The idea of man's progressive advancement towards perfection and happiness inspired him with consolation under his complicated misfortunes. Condorcet, although an enemy to revealed religion, was certainly a man of virtue and integrity; and his generous and arduous services on behalf of liberty and social improvement entitle him to a conspicuous place amongst those who have wielded the destinies of his country.

A uniform edition of the works of Condorcet was printed at Paris in 1804, in 21 vols. 8vo. For a complete list the reader is referred to the *France Littéraire* of M. Ersch. It will be sufficient here to notice the more remarkable, which are as follow:—1. *Essai d'Analyse*, Paris, 1768, 4to; 2. *Lettres d'un Théologien à l'Auteur du Dictionnaire des Trois Siècles*, Berlin, 1774, 8vo; 3. *Eloges des Académiciens de l'Académie Royale des Sciences, morts depuis* 1666 *jusqu'en* 1699, Paris, 1775, 12mo; 4. *Eloge et Pensées de Pascal*, London, 1776, 8vo; 5 *Essai sur l'Application de l'Analyse à la probabilité des décisions rendues à Pluralité des Voix*, Paris, 1785, 4to, 6 *Vie de M. Turgot*, London, 1786, 8vo, 7. *Vie de Voltaire*, Geneva, 1787, and London, 1790, 2 vols. 18mo, 8 *Rapport sur l'Instruction Publique, présenté à la Convention Nationale*, Paris, 1792, 8vo, 9. *Bibliothèque de l'Homme Public, ou Analyse Raisonnée des principaux ouvrages Français et étrangers sur la Politique en général, la Legislation, les Finances, &c.*, Paris, 1790, 1792; 10 *Esquisse d'un Tableau Historique des progrès de l'Esprit Humain*, ouvrage posthume, 1795, 8vo, 11 *Moyen d'apprendre à compter sûrement et avec facilité*, Paris, 1799, 12mo, 12 A volume of notes to the *Recherches sur la Nature et les Causes de la Richesse des Nations*, translated from the English of Dr Adam Smith. Along with Lecroix he published a new edition of Euler's *Lettres à une Princesse d'Allemagne*; and he contributed to the *Journal Encyclopédique*, the *Journal des Mois*, the *Révolutions de Paris*, the *Journal d'Instruction* [illegible] other periodicals. (See *Notice sur la Vie et les Ouvrages de Condorcet*, by Diannyère, 1796, 8vo.)

Condottieri Confederatica.

CONDOTTIERI (*chiefs*), in Italian history, a class of mercenary adventurers in the fourteenth and fifteenth centuries, who put themselves at the head of military bands, and carried on war on their own account, destroying some towns, ransoming others, and plundering on every side. See ITALY.

CONDRIEU, a town of France, department of Rhone, on the river of that name, 21 miles south of Lyons. It has about 3500 inhabitants, and carries on a considerable trade in grain, and in the white wines, for which the district is celebrated.

CONDUCTORS OF ELECTRICITY. See ELECTRICITY.

CONDYLURA, a name first applied by Illiger to an American genus of the family [illegible] the *Plantigrada*, the *star-nosed shrews*. They resemble our mole in habit and manners, but their nasal disk is rayed, and their tails are longer. Latreille has applied this name to a genus of Mollusca.

CONE, a solid body or figure of which the base is a circle, and which diminishes in diameter till it terminates in a point, which is called its vertex. A sugar-loaf is a familiar example. The term is also applied to the conical-shaped fruit of several evergreen trees, as that of the pine, fir, cypress, and cedar.

CONEGLIANO, a town of the delegation of Venetian Lombardy, and 15 miles north of Treviso. It manufactures silk and woollen goods, and has some trade in wine. Pop. (1843) 6459. Marshal Moncey was created Duke of Conegliano by Napoleon.

CONFARREATIO, a ceremony observed among the ancient Romans at the nuptials of those persons more particularly whose children were destined for the priesthood. Confarreatio was the most solemn of the three forms of marriage; but in later times this ceremony fell much into disuse; hence Cicero mentions but two, namely, *coemptio* and *usus*. In the ceremony of confarreatio, according to Servius, the pontifex maximus, or flamen dialis, joined and contracted the man and woman, who went through the form of partaking of the same cake of salted bread, called *far*, or *panis farreus*; whence the term *confarreatio*. Ulpian says that the ceremony consisted in the offering up of some pure wheaten bread, and rehearsing a certain formula, in presence of ten witnesses. Dionysius Halicarnassensis adds, that the man and woman partook of the same wheaten bread, and threw a part on the victim, which was a sheep. This form of marriage could only be dissolved by another equally solemn ceremony, called *disfarreatio*. The children sprung from this kind of marriage were styled *patrimi* and *matrimi*; and from these alone were chosen certain priests—as the *flamen dialis* and the vestal virgins. According to Festus, those were so called whose parents were both living; and if the father only was alive, they received the appellation of *patrimi* or *patrimes*; or if the mother only, they were called *matrimi* or *matrimes*.

CONFEDERATION OF THE RHINE, the name of a well-known league entered into by several German princes in 1805, by which they separated themselves from the em-

Confederation.

pire, and formed a new political association, under the protection of France. This league was an immediate consequence of the reverses of Austria in the campaign of 1805, and was the first great and avowed measure of Buonaparte to assume the control of the German empire. After remaining in force somewhat more than seven years, it fell, along with its prime mover; but is still deserving of historical notice for its effects, both in giving for a time a co-operating power to France, and in serving as an introduction to subsequent changes in the organization of the Germanic body.

The treaty in question was signed at Paris on 12th July 1806, and ratified at Munich on the 25th of the same month. It consisted of forty articles, and was subscribed by the following powers:—

	Contingents.
The Emperor of France, who engaged to furnish a contingent of	200,000 men.
The King of Bavaria	30,000
The King of Wirtemberg	12,000
The Prince Primate	
The Grand Duke of Baden	8,000
The Grand Duke of Berg	5,000
The Grand Duke of Hesse-Darmstadt	4,000
The Duke of Nassau, The Duke of Aremberg, The Prince of Nassau-Weilburg, The Prince of Hohenzollern Hechingen, The Prince of Hohenzollern Siegmaringen, The Prince of Lichtenstein, The Prince of Salm-Salm, The Prince of Salm-Kyrburg, The Prince of Isenburg-Birstein, The Prince of Leyen	4,000 collectively.

Most of the subscribing princes assumed, on this occasion, titles different from those which they had borne when members of the empire. It was stipulated that they should renounce most of the laws and all the peculiar titles of the empire; that their common interests should be discussed in a diet to be assembled at Frankfort on the Maine, and to be divided into the colleges of kings and princes, with the Prince Primate as president of the former, and the Duke of Nassau of the latter; that the members of the confederation should be unconnected with any power except France, between which and the confederation an intimate compact was formed, and the emperor of which was declared hereditary protector of the alliance, with the right of nominating the future prince primates. It was further stipulated, that the confederated princes should exercise the rights of sovereignty over the territories newly incorporated by this act with their dominions, leaving private property, however, undisturbed; and that, in the event of any neighbouring power making preparations for war, the contracting parties should arm to the extent of the above-mentioned contingents. Finally, it was provided that other German princes and states should be allowed to accede to the confederation; and the league was accordingly strengthened by the Grand Duke of Wurzburg (on 3d October 1806), with a contingent of 2000 men; by the king of Saxony (on 11th December 1806) with 20,000 men; by the king of Westphalia (in 1807), with 25,000; and in the course of that and the following year, by the Saxon princes, the Dukes of Mecklenburg, and, in short, by all the lesser princes of the west and north of Germany.

Immediately after the communication of the treaty of confederation to the German diet in August 1806, the Emperor Francis made a formal abdication of the title of Emperor of Germany; the ancient constitution of which, long in a state of decline, now became completely dissolved. Buonaparte had soon occasion to put his new auxiliaries to the test—the war with Prussia breaking out in the course of a couple of months after the formation of the alliance. The victory of Jena, and its unparalleled results, rivetted the yoke around the necks of his new vassals, and supplied him with recruits to go through the short but sanguinary campaign of 1807 in Poland. Unfortunately, the confederation afforded him a numerous and efficient body of auxiliaries at a very interesting period, we mean in April 1809, when Austria, encouraged by the resistance of Spain, ventured, alone and unassisted, to take the field in the assertion of her independence. But the battle of Wagram put an end to her hopes, and rendered Buonaparte the uncontrolled arbiter of Germany; a station which, in all probability, he would have continued to hold for life, had he not wasted, in the deserts of Russia, the finest army that Europe ever saw. This loss was most acutely felt by the states of the confederation, particularly by Bavaria, its first and principal member.

Confervæ || Confession of Faith.

It was in the beginning of December 1812 that the great mortality took place among the Bavarians, after they were brought up from Wilna, in the vain hope of affording protection to the wreck of the French as they fled across the Beresina. The general melancholy occasioned by the death of so many of their brave countrymen, and a conviction of the insatiable ambition of Buonaparte, raised among the states of the confederation a spirit of national independence, and paved the way to that alliance which it was soon in the power of Austria and Prussia to offer to their German neighbours. Hence the easy entry of the allies into Saxony in April 1813, and the memorable defection of the Saxons in the battle of Leipsic on the 18th of October; and hence, also, the conclusion of a treaty between Austria and Bavaria in the month last mentioned, the eager march of the Bavarians to Hanau to intercept the retreating French, and the obstinate though unavailing conflict which took place in the neighbourhood of that city.

The Confederation of the Rhine, already virtually dissolved, became finally annulled in 1814, and was replaced at the Congress of Vienna by an association on a larger scale under the name of the Germanic Confederation. Of this new and comprehensive body a more particular account will be found under the head GERMANY. (J. L—E.)

CONFERVÆ, a division of *algæ* or *water plants*, containing many species which agree in having jointed tubular stems, and living chiefly in fresh water.

CONFESSION, among divines, the verbal acknowledgment which a Christian makes of his sins.

Among the Jews it was the custom, on the annual feast of expiation, for the high priest to make confession of sins to God in the name of the whole people. And besides this general confession, the Jews were enjoined, if their sins were a breach of the first table of the law, to make confession of them to God; but violations of the second table were also to be acknowledged to their brethren. The practice of auricular confession, now elevated to the dignity of a sacrament in the Roman Catholic Church, seems to have originated in the ninth century, but did not become obligatory till the thirteenth. Confession once a-year to a priest was first enjoined by Innocent III.; and the priest is bound not to reveal it, under pain of the highest punishment.

Confession of Faith, a formulary detailing the articles of faith held by any church. The most ancient of these are the Apostles', the Nicene, and Athanasian creeds (which see under their respective heads). As standards of the Romish Church may be reckoned the decrees and catechism of the Council of Trent, the creed of Pius IV. (promulgated 1564), and subordinately Bossuet's Exposition of the Catholic Faith. The recognised creed of the Greek Church is that drawn up by Mogila, metropolitan of Kiow, in 1642. In the Church of England, all candidates for ordination subscribe the 39 articles, and the 3 articles of the 36th canon relating to the supremacy of the king. The Book of Com-

Confessional || Conflagration.

mon Prayer and the Homilies are also recognised expositions of the doctrines of this church. The confession of the Westminster Assembly, drawn up in 1643, was in 1690 ratified by act of parliament as the doctrinal standard of the Church of Scotland.

CONFESSIONAL, or CONFESSIONARY, a place in churches under the great altar, where the bodies of deceased saints, martyrs, and confessors were deposited.

This word is also used by the Roman Catholics for that place in a church where the confessor sits to hear confessions.

CONFESSOR, one who confesses. The term was used in early times to denote a Christian who made a solemn profession of the faith, and suffered in its defence. A mere saint is called a confessor, to distinguish him from the roll of dignified saints, such as apostles, martyrs, &c. In ecclesiastical history, the word confessor is frequently used as synonymous with martyr; but afterwards it was applied to those who, after having been persecuted and tormented, were permitted to live and die in peace; and at last it was also applied to those Christians who had lived a good life and died with the reputation of sanctity. According to St Cyprian, he who presented himself to torture, or even to martyrdom, without being called to it, was not denominated a *confessor*, but a *professor*; and if one, from want of courage, abandoned his country, and became a voluntary exile for the sake of the faith, he was called *exterris*.

CONFESSOR also signifies a priest in the Roman Catholic church who hears confessions and grants absolution. The church calls him in Latin *confessarius*, to distinguish him from *confessor*, which is a name consecrated to saints. The confessors of the kings of France, from the days of Henri IV. have, with rare exceptions, been Jesuits; but before his time the Dominicans and Cordeliers shared the office between them. The confessors of the house of Austria have also ordinarily been Dominicans and Cordeliers; but the later emperors have all employed Jesuits.

CONFIGURATION (Lat. *configuratio*), external form; the figure which bounds a body, and gives it its external appearance; being that which, in a great measure, constitutes the specific difference between bodies.

CONFIRMATION, the act of confirming or establishing. In an ecclesiastical sense, it denotes the ceremony of laying on of hands, in the admission of baptized persons to the enjoyment of Christian privileges. The antiquity of this ceremony is, by all the older writers, carried as high as the apostles, and founded upon their example and practice. In the primitive church, the ceremony was performed immediately after baptism, if the bishop were present at the solemnity. Among the Greeks, and throughout the East, it still accompanies baptism; but the Roman Catholics make it a distinct and independent sacrament. Seven years is the stated age for confirmation; however, persons are confirmed sometimes before and sometimes after that age. The person confirmed releases his godfather and godmother, by taking upon himself the baptismal vows in their place. The order of confirmation in the church of England does not determine the precise age of the persons to be confirmed.

CONFLAGRATION (Lat. *conflagratio*), a general burning or consuming with fire; as of a city or a forest.

The word is applied in particular to that grand catastrophe when the world is to be changed by fire, as it formerly was by water. The opinion that the end of the world is to be effected by the agency of fire is very ancient, and was common amongst heathen philosophers. (Ovid, *Metamorph.* i. 256.) Other testimonies are quoted by Grotius (*De Veritate Rel. Chr.*, lib. i. § 22). It is not easy to discover the origin of this opinion; it can scarcely be traced to tradition derived from revelation, since there is no distinct reference to such a catastrophe in the Old Testament. It is, moreover, remarkable, considering how universal and definite is the ordinary belief on the subject, that there is only one passage in the New Testament, viz., 2 Pet. iii. 7–10, which can be adduced as speaking distinctly of this event. This passage is, indeed, very explicit; but it should not be forgotten that some learned and able expositors (among whom are Lightfoot and Owen) have referred it altogether to the destruction of Jerusalem and of the Jewish polity. If, however, with the majority of interpreters, we refer the prediction to the end of the world, we could not have a more distinct statement of the fact that the present order of things is to be terminated by the world we inhabit and all the works of man it contains being 'burnt up.' There is no reason for assuming that the whole material universe is to be involved in this catastrophe; the mention of the heavens leads our thoughts no further than the atmosphere and vapours surrounding this planet. Nor should we regard this conflagration as involving the absolute *destruction* or annihilation of the world: it is more consistent with the narrative itself, as well as with physical science, to consider it as introductory to a new and better state of things—"new heavens and a new earth wherein dwelleth righteousness" (ver. 11). By what means the conflagration is to be effected we are not informed, and all attempts to explain how this is to be accomplished must be mere speculation. Such an event is not inconsistent with physical facts. We know that the temperature of the earth increases gradually and with considerable regularity as we descend below the surface (Phillips, *Geology*, vol. ii. p. 232), and have every reason to believe that the central mass is intensely hot. We know, moreover, that there are subterranean fires of great extent, if not forming part of this heated central mass. The means, therefore, of combustion are near at hand. But even if there were no such central heat, chemistry points out very easy means by which the conflagration may be effected through the agency of various elementary substances (Phillips, *Geology*, vol. ii. p. 211). We find evidence also in the pyrogenous rocks which form so large a part of the crust of the earth, that the world has already been subjected, if not to conflagration, yet to a more intense and general action of heat than any which is now observed on the surface of the earth; and it is clearly not impossible that the action may be yet more intense and more general. Some conceive that the conflagration is to be effected miraculously, by fire from heaven; while others suppose an eruption of the central fire sufficient for the purpose. Others look for the cause of the conflagration in the atmosphere, and suppose that some of the meteors there engendered in unusual quantities, and exploded with unusual vehemence, from the concurrence of various circumstances, may effect the object. The astrologers sought to explain it by a conjunction of all the planets in the sign Cancer; as the deluge, according to them, was occasioned by their conjunction in Capricorn. Others, again, have maintained, that the world is to undergo conflagration from the near approach of a comet in its return from the sun.

Confolens || Confucius.

CONFOLENS, a town of France, capital of a cognominal arrondissement in the department of Charente, situate on the right bank of the Vienne, 37 miles N.E. of Angouleme. It has a tribunal of primary instance; and some trade in corn, cattle, and timber. Pop. (1851) of town 3069, of arrondissement 71,440.

CONFORMITY, in the schools, is the congruency or relation of agreement between one thing and another; as between the measure and the thing measured, the object and the understanding, the thing and the division thereof.

CONFUCIUS, the Latinized form given originally by the Jesuits to the name of the great Chinese philosopher Khoung-fou-tseu. As a sage and a religious lawgiver, Confucius is regarded by his countrymen as the greatest man China has produced. He was unquestionably an extraordinary man, remarkable in the influence he exer-

Confucius. cised over his countrymen when alive, and the still greater influence he has ever since exercised by his writings. Confucius was born about 550 years before Christ, in the kingdom of Loo, a portion of north-eastern China, nearly corresponding with the modern province of Shan-tung. At that time China was divided into nine independent states; and it was not till three centuries later that it was united into one kingdom. From his earliest years Confucius was distinguished by an eager pursuit of knowledge. From his father, who was prime minister of the state in which he lived, he inherited a taste for political studies; but being left an orphan when still but a child, he was educated for the most part in retirement by his mother Ching and his grandfather Coum-tse. The anecdotes which are related of his boyhood tend to show that he was distinguished by those qualities most highly esteemed by his countrymen, and afterwards most strictly enforced by himself—a profound reverence for his parents and ancestors, and for the teaching of the ancient sages. "Coum-tse, his grandfather," says one of his biographers, "was one day sitting absorbed in a melancholy reverie, in the course of which he fetched several deep sighs. The child observing him, after some time approached, and, with many bows and formal reverences, spoke thus—'If I may presume, without violating the respect I owe you, sir, to inquire into the cause of your grief, I would gladly do so. Perhaps you fear that I who am descended from you may reflect discredit on your memory by failing to imitate your virtues.' His grandfather, surprised, asked him where he had learned to speak so wisely. 'From yourself, sir,' he replied; 'I listen attentively to your words, and I have often heard you say that a son who does not imitate the virtues of his ancestors deserves not to bear their name.'"—*Meng-tseu*, i. 4. It may be well to remark here that the accounts given of his life are credible enough. There seems no good reason to doubt the facts related of him by his biographers; and a full and authentic life of the sage might easily be compiled by collating the various biographies, and expunging the few wonderful incidents which may readily be distinguished as the interpolation of some marvel-loving admirer. In this respect the accounts we have of Confucius differ materially and strikingly from those of Gotama Buddha, and Zoroaster, the contemporaneous sages of Northern India and Persia, whose biographies are almost entirely composed of the legendary and miraculous, from which their genuine history can hardly be disentangled.

The position which his father had held in the state seems to have inspired Confucius at an early age with a desire to distinguish himself in moral and political studies, and prompted him to investigate the early history of his country. He laboured zealously to fit himself for filling offices of high political trust; and in his endeavours to master the learning of the early sages he was ably assisted by his grandfather. He married at nineteen years of age, and is said to have divorced his wife a few years afterwards, when she had given birth to a son, that he might devote himself without interruption to study; but owing to the general contempt of women in the East the subject is only slightly alluded to by his biographers.

He entered upon political employment at twenty years of age, as "superintendent of cattle," an office probably established that the revenue might not be defrauded, and necessary where much of it was paid in kind. In this situation his reverence for antiquity and the ancients did not prevent Confucius from attempting reforms and checking long-established abuses. Under his administration men who were dishonest were dismissed, and a general inquiry was set on foot with a view to the reformation of all that was unworthy or pernicious. The activity of Confucius brought him into favour with his sovereign, and he was promoted to the "distribution of grain," an office of which it is not easy to discover the nature. Whatever were his Confucius. duties, however, the energy that Confucius displayed was extremely distasteful to his colleagues. He was now in the vigorous manhood of 35, and the eyes of the nation were turned to him as their future prime minister, when a revolution occurred in the state which drove him from power.

Deprived of his office, he wandered for eight years through the various provinces of China, teaching as he went, but without as yet making any great impression upon the mass of the people. He returned to Loo in his forty-third year. His enemies, during those eight years, had gradually lost their authority; and he was again employed in political offices of trust and responsibility. Immorality prevailed at this time to a frightful extent. Confucius set himself up fearlessly as a teacher of virtue. His admonitions were not thrown away; and having gained the approbation of the king a few years after his return from exile, he was appointed prime minister with almost absolute authority. The enemies of order and virtue excited troubles on his elevation; but Confucius sternly repressed the symptoms of dissatisfaction, and though of compassionate disposition, he did not hesitate to resort to capital punishment when necessary to rid himself of his enemies.

Reformation made rapid strides in the territories of Loo; the nobles became more just and equitable; the poor were not oppressed as before; roads, bridges, and canals were formed. "The food of the people," says his biographer, "was the first care; it was not until that had been secured in abundance that the revenues of the state were directed to the advancement of commerce, the improvement of the bridges and highways, the impartial administration of justice, and the repression of the bands of robbers that infested the mountains." For four years he steadily persevered in his endeavours, until Loo began to be regarded as a model state by the surrounding kingdoms. It was not the interest of the neighbouring princes to permit this state of things to continue. One of them, more crafty than the others, knowing the weakness of the sovereign of Loo, trained some fascinating courtezans after his own views, and sent them as a present to the voluptuous prince. They were greedily received, for the king had long tired of Confucius and his stern morality. The courtezans roused him and his nobility to action. A strong party rose against the sage; and at the age of 57, he was driven once more from his native state to wander as a teacher through the different provinces of China.

It was only by concealment and disguise that the life of the exiled prime minister was preserved. For twelve years he wandered from province to province, at first harassed, persecuted, hunted, but after a while allowed to travel unmolested. A faithful little band of disciples collected around him in his wanderings, and their numbers, as time advanced, might soon be counted by thousands. Seventy-two of these, we are told, were particularly attached to him, but only ten of them were "truly wise." With these ten he finally retired at the age of 69 to a peaceful valley in his native province, where, in the midst of his disciples, he passed a happy literary period of five years, in collating and annotating the works of the ancients. These sacred books have been for twenty-three centuries the fountains of wisdom and goodness to all the educated of China. They are the works in which every student must be a proficient ere he can hope to advance in the political arena, and for twenty-three centuries have had an incalculable influence on a third of the human race.

His life was peacefully concluded in the midst of his friends at the age of 73, in the valley to which he had retired five years previously. It has been for all succeeding ages a sacred spot—a place of pilgrimage for the learned and the superstitious; and the Chinese of 1854, amid conflicting Buddhism and Christianity, still point with reve-

Confucius. rence to the tomb of their great sage in the province of Shan-tung.

In his manner of teaching, Confucius was strikingly contra ted with the other great religious teachers of Asia—Gotama Buddha, Zoroaster, and Mohammed. He made no pretensions to universal knowledge or external inspiration. "I was not born," said he to his disciples, "endowed with all knowledge. I am merely a man who loves the ancients, and who do all I can to arrive at truth." (*Lun-yu*, vii. 19.) On particular points of religious and other knowledge he was equally frank in his confessions of ignorance. Having been asked, for instance, by his disciples, how superior spirits might be acceptably worshipped, he candidly answered that he did not know; although with strange inconsistency, when asked of military matters, his reply was, "If you had asked me of ceremonies or sacrifices, I might have been able to reply to you, but with regard to the military science I never studied it." (*Lun-yu*, xv. 1.) On another occasion, when asked what death was, he gave the memorable answer, "When I know not the nature of life, how shall I inform you what death is?" (*Lun-yu*, xi. 11.) "He was entirely without self-love," says Meng-tseu, one of his most enthusiastic disciples, "he was entirely without self-love, prejudice, obstinacy, and egotism; when he saw any one in mourning, or in the garb of a magistrate, or blind, or older than himself, if seated, he rose at his approach." His disciples, however, were not satisfied with this simplicity and unaffected abnegation of mystery. They came to him on one occasion in a body, demanding that he should teach them the recondite subtilties of his doctrine, the *esoteric* dogmas, which should be theirs and theirs only, but which should be hid from the world. "O my disciples," he exclaimed, as they thus importuned him, "do you believe then that I have for you hidden doctrines? I have not. What I have done and what I have thought I have duly communicated to you, for such has ever been my method of instruction." (*Lun-yu*, vii. 23.) The disciple who records this transaction adds, that the subjects he taught were four, "literature, the practice of virtue, rectitude, and fidelity." In his precepts, as his disciples have handed them down to us, there is nothing austere or repulsive; no attempt whatever made to bind down the minds of his followers to any rigidly ascetic rule of his own. On the contrary, he desired them to be open to every enlivening and ennobling idea, to practise singing and music, to cultivate and reverence the sublime, to open their hearts to the influence of joy—in short, by every means consistent with virtue to render their existence happy.

Simple and natural as he was, however, in his manner of life and method of teaching, he himself informs us, in a saying recorded by one of his disciples that he was not understood by his age. (*Lun-yu*, xiv. 37.)

But although he saw all men in arms against him often, he met their assaults with all the calmness of a Socrates. "When I examine myself," he says boldly, "and find my heart right, although I should have for adversaries a thousand or ten thousand men, I will march without fear against my enemies." (*Meng-tseu*, i. 2.)

The literary labours of Confucius consisted, for the most part, of a revision of the sacred books, which had been from time immemorial regarded by the Chinese as the sources of all true wisdom and knowledge. These he pruned of many extravagancies; and, in the text as well as in the notes, stated his own opinions, and added much to the original value of the works. Of the sacred books thus edited there are two classes—the first, the most highly esteemed, and generally called by Europeans the classical works of the first order, consist of five works or *kings*, (*king* or *kung*, meaning sacred book); the Y, the Chou, the Chi, the Li, and the Tchun-tsiou. The classical books of the second order are four in number. The Chinese call them the See-chou: two of them are treatises by Confucius, one on the art of government, and the other on the golden mean; the other two are the Lun-yu, a collection of his sayings, and Meng-tseu, a philosophical treatise bearing the name of its author or disciple, Latinized by the Jesuits into Mencius. Confucius.

The Y-king, or "sacred book of changes," called also Ye-king and Uk-king by European writers, is the first and the most esteemed of "the classical works of the first order." The foundation of the treatise, as it has come down to the present day, consisted of what are generally called "the trigrams or enigmatical lines of Fohi." This Fohi, who must not be confounded with Fo the Chinese Buddha, is reported to have been the first king of China, the first lawgiver and sage; and the date of his reign is thrown back by the Chinese historians to twenty-five centuries before our era. These trigrams consist of three lines varied by one or more of them being broken in the midst; two of these trigrams are in each variation placed together, and out of the six lines thus combined, sixty-four variations are formed. These serve as the divisions of the work. "It was not at first, properly speaking, a book," says M. Visdelou, "nor anything approaching to it; it was but a very obscure enigma, and more difficult a hundred times to explain than that of the Sphinx." Twelve centuries before our era, according to Chinese tradition, another monarch (Ouen-ouang or Ven-vang) undertook, like another Œdipus, to solve the enigma; adding, for that purpose, to each hexagram a short sentence scarcely less obscure than the lines themselves. The successor of Ven-vang added a concise interpretation to each of these enigmatical sentences, and in this crude state the work remained until the time of Confucius. Confucius, by giving full explanations to these hexagrams, at once unintelligible and highly revered, annexing in fact a dissertation to each, procured for his own opinions the sanction of antiquity. The praises lavished upon the Y-king by enthusiastic disciples of Confucius are unbounded—"it so comprehends the heaven and the earth," exclaims one "that there is nothing good which it does not contain." "Not only is it the origin of the other canonical books," asserts a second, "but it is as it were the elucidator of all things visible and invisible." "To know the other books and not to know the Y-king," cries a third, "would be to examine a river and neglect its source; to take the branches and leave the root."

The origin of these mystical trigrams is thus accounted for by Chinese tradition. As Fohi was one day walking on the banks of the Hoang-ho, there came towards him on a sudden from the stream a great dragon, or tortoise, or turtle. Fohi was not a whit appalled by this apparition; watching the animal attentively, he discovered the trigrams on its back. Fohi copied them immediately. The transaction was of course miraculous.

Through the watchful jealousy of his disciples, the Y-king has reached our time exactly as it was left by Confucius. Of its contents, M. Visdelou,[1] one of its translators, gives the following account:—"It embraces a great variety of subjects; it is in fact the Encyclopædia of the Chinese. Its contents, may, however, be reduced to three heads, to wit, metaphysics, physics, and morals." "These subjects are not treated of methodically and in order. They are merely treated of in detached passages. It may be said to contain a fourth head—the explanation of destiny. From the earliest antiquity it has served for predictions, of which, like all rude nations, the Chinese are particularly fond."

The Chou-king (also written Chu-king, Seu-king, and Chang-chou by European writers) is the second of the five

[1] *Y-king, antiquissimus Sinarum liber quem ex Latinâ interpretatione P. Regis aliorumque ex Soc. Jesu P. P.*, edidit Julius Mohl. Stuttgartiæ, 1834. The introduction prefixed to this translation is from M. Visdelou's *Disquisition on the Y-king*.

Confucius. first-class canonical books. It consists of a plain historical narrative of the events which occurred during the first dynasties of Chinese kings. Like the Y-king, the Chou appears to have received its present form from Confucius, and it abounds in moral reflections and appropriate inculcations as to the pursuit and practice of virtue.

The Chi-king, the third of these works (written Seeking by Marshman), consists of 311 popular odes, some selected, and others composed by Confucius—all of a patriotic and moral character. These poems are usually committed to memory by Chinese students and sung on public occasions, as well as in the festivities of private life. "The verses of the Chi-king," said Confucius to his disciples, "are as a speculum, offering to us the contemplation of good and evil: they teach us to serve our parents at home and our king abroad." (*Lun-yu*, 17.) "It is evident," says M. Biot, "that this collection of pieces, all perfectly authentic, and of a form generally simple and naive, represents the manners of the ancient Chinese in all their unsophisticated simplicity, and that it offers to any one who wishes to make a study of these manners a mine more easy to explore than the historical works such as the Chou-king, in which the facts relating to the manners and social constitution of the ancient Chinese are combined with long moral discourses."[1]

The Li-king (called also Li-ki and Ly-khee) or book of ceremonies, is the fourth of the great canonical works. It appears, from the imperfect accounts of those who have investigated the subject, to have been a collection by Confucius of the various customs inculcated by former sages. Some maintain, however, that it is entirely his own work. Whether quite original, or only a compilation, it is certain that it went through his hands, and that he inculcated the greatest reverence for it upon his disciples. "My son," said he to a young man, "unless you have studied the book of rites, you cannot thoroughly understand how to act in conformity with established usage and with virtue." In the Li-king all the minutiæ of daily life are dwelt upon, and the proper mode of action inculcated, under almost all possible contingencies. It is of course by far the most voluminous of the *kings*, being nearly equal in bulk to all the others put together. "One has but to read the Li-king," says a student of Chinese philosophy, "to understand the fixedness and immobility of Chinese customs."[2]

The fifth and last of these canonical books is the Tchuntsiou (the Chun-chou of Marshman). *Tchun* means spring, and *tsiou* autumn; and the work was so called because Confucius commenced it in the former season, and ended it in the latter. It was the work of the philosopher's extreme old age, and consists, for the most part, of a continuation of the Chou-king, particularly containing a history of his native state, Loo, for two hundred and forty years. It contains a fuller account of the political system inculcated by Confucius than any of the other sacred books.

The physical system inculcated by the Chinese philosopher somewhat resembled that of the early Grecian sages, and was undoubtedly in advance of the opinions of the age. The five *king* or elements stand at its base—water, fire, wood, metals, and earth. Of these, says the Chou-king, water flows and is ever in motion; fire burns and ascends; wood is crooked and straightens itself; the metals are earthy and susceptible of change; the earth is humid and descends. Each of these so-called elements is symbolized by one or more mystical lines placed in various positions. The universe, according to this fanciful theory, has been generated by the union of two material principles—a heavenly and an earthly, Yang and Yn. The heaven and the earth represent the corporeal substance of these principles; their intellectual manifestations pervade all things. In consequence of its origin and nature, the universe is destined to be destroyed and reproduced constantly after countless ages in never-ending successions. The proper office of the material and heavenly Yang is to produce, to make strong and to sustain. Its nature is firmness, inflexibility, and perseverance. What rises, what appears, what produces or contains motion, exists from it. The nature of Yn is to give place to, to fall to decay, to be weak, opaque, slow, inert, save when receiving vigour and motion from Yang, to obey and to be obsequious. Confucius.

The heavens and the earth being thus mystically united as Yang and Yn, the origin of man appears to be intimately connected with their union. "The heaven and the earth," says the Y-king, "had a beginning; and if that can be said of them, how much more truly of man?" "After there was a heaven and an earth, all material things were formed; male and female appeared, man and woman." We seek, however, in vain, for a Creator in the system. True, there is a Tai-y, a "Grand Unity," a mysterious "heaven," whose existence is declared to have been prior to all other existences, and particularly to the material developments of Yang and Yn; but although this Tai-y has many of the characteristics of the Godhead, he or it is not represented as *creating*.

The system of Confucius agrees with the universal traditions of our race, that man was originally happy and pure, and that, by his own act, he fell from that happiness and purity. So far Confucius agrees with our Christian teaching; but he goes on to inculcate that, by his own act, man can recover the happiness and purity he has lost. The object of one of his small treatises, entitled *Ta Hio*, is expressly declared to be "to bring back fallen man to the sovereign good—to what is perfect." "All people are naturally good," he asserts, "but a desire of pleasure changes them." With an earnest wish to develop "the inward light," pure and sincere intentions, fixed determination, a calm spirit, and much meditation, the Chinese teacher believed it quite possible for man to attain to this "sovereign good." Virtue he divides into two great parts; *first*, the reverence for Heaven and superior beings, for parents and those in authority, with the worship due to the former class; and, *secondly*, that justice or equity which consists in rendering to every one his due.

The tutelary spirits, to whom Confucius teaches that worship is due, are divided into two classes—the spirits of mountains, rivers, and other natural objects, and the disembodied spirits of our ancestors—to both of which propitiatory sacrifices are due. "There is a Chinese book," says, M. De Guignes, "compiled from the writings of Confucius, which gives figures of the two orders of spirits, informs us where they reside, and the particular object for which they should be invoked."[3] The duty of filial obedience and reverence is inculcated by the Chinese sage with an earnestness unknown in any other system. Indeed his entire political system is based solely on this foundation. Of all crimes, filial disobedience is the greatest and least expiable. Even truth may be sacrificed by the son to hide the faults of the father.

His political system, founded on the idea he entertained of the parental relationship, is one of absolute unmitigated despotism. The sovereign stands in a purely paternal relation to his subjects, and revolt or disobedience is under any circumstances a crime. He enumerates clearly and distinctly the duties both of the sovereign and of the people; but if the sovereign choose to be a tyrant, his lieges, so far as Confucius teaches, have no redress.

Of the extraordinary estimation in which Confucius has been always held by his countrymen, we scarcely require any proofs. Although he was allowed to end his days

[1] *Recherches sur les Mœurs des Anciens Chinois.*
[2] *Calcutta Review*, vol. vii., p. 386.
[3] *Historical Essay on the Study of Philosophy amongst the Ancient Chinese.*

Confusion of Tongues || Congo.

in comparative obscurity, his descendants have ever since enjoyed, during seventy generations, the highest honours and privileges. They are indeed the only hereditary nobility in the empire. They are found principally in the neighbourhood of the district in which Confucius lived; and it was computed 150 years ago, that they numbered 11,000 males. Through every revolution in Chinese history their privileges and honours have hitherto remained intact.

In every city of the empire, of the first, second, and third class, there is one temple at least dedicated to Confucius. The civil and political rulers, nay, the emperor himself, are all equally bound to worship there. The service appointed for this worship is similar to that which each family performs in honour of its ancestors in their "hall of the ancients." A plain tablet is erected above an altar, on which there is a suitable inscription. Sweet smelling gums are burned in the chamber with frankincense and tapers of sandal wood; fruit, wine, and flowers are placed upon the altar; and appropriate verses are chanted from the Chi-king in praise of deceased worth and wisdom. The ceremony concludes with an address resembling a prayer, delivered by the highest dignitary present. (*Les livres sacrés de l'Orient*, par M. Pauthier, Paris, 1840; *Y-king antiquissimus Sinarum liber*, edidit J. Mohl, Stuttgartiæ 1834; *The Works of Confucius*, Marshman, Serampore, 1809; *Le Chou-king*, traduit et enrichi de notes, &c., Paris, 1770; *China*, by S. Kidd, London, 1841; *The Calcutta Review*, vol. vii.) (W. K.)

CONFUSION OF TONGUES. See LANGUAGE.

CONGÉ D'ELIRE, in ecclesiastical policy, the king's license or permission to a dean and chapter to choose a bishop; or to an abbey or priory, of his own foundation, to choose their abbot or prior.

The sovereign of England, as temporal head of the church, had formerly the appointment of all ecclesiastical dignities; investing first *per baculum et annulum* (by crosier and ring), and afterwards by letters patent. But now, the queen, on demand, sends her *congé d'élire* to the dean and chapter, with a letter missive containing the name of the persons she would have them elect; and if they delay the election twelve days, the nomination devolves on the sovereign, who may appoint by letters patent.

CONGELATION. See COLD.

CONGER. See EEL, index to ICHTHYOLOGY.

CONGIUS, in *Roman Antiquity*, a measure for liquids, containing the eighth part of an *amphora*, or six *sextarii*. It was equal to the larger *chous* of the Greeks, or six pints English nearly.

CONGLETON, a market-town and municipal borough of Cheshire, parish of Astbury and hundred of Northwich, 33 miles east from Chester. It stands in a deep valley on the banks of the Dane, and derives a considerable trade from the manufacture of silk ribbons, cotton, and leather, and from extensive coal mines in the vicinity. In its western suburb are numerous mansions with ornamental shrubberies. The principal buildings in the town are the guildhall, the market-hall, and the three parish churches. Congleton is the seat of a county court and petty sessions. Its municipal corporation consists of 6 aldermen and 18 councillors, of whom one is mayor. It is a station on the North Staffordshire railway, and communicates with Macclesfield by a canal. Pop. (1851) 10,520.

CONGO, a considerable country of S.W. Africa, extending from the river Congo or Zaire, which separates it from Loango on the north, to the Dando separating it from Angola on the south. On the west it is bounded by the Atlantic, and on the east by unknown countries in the interior. Various boundaries, however, have been assigned to it by different writers. The Portuguese, by whom it was discovered in 1487, included under this name, not only Congo proper, but also Loango, Angola, and Benguela. The accounts of the splendour, population, and civilization of this country given by the missionaries and others sent out by the Portuguese is altogether incredible. One states that the king could muster an army of 900,000 men, and that he actually opposed the Portuguese with 80,000, who were however completely overthrown by 400 Europeans and 2000 negroes. Of its former population and splendour neither trace nor tradition remains; and of the benefits which resulted to the inhabitants from their intercourse with Christians, the only evidences which existed at the time of Captain Tuckey's visit were a few forts and factories for carrying on the slave trade, and some crucifixes, which were not however held in equal veneration with their own Pagan fetiches, or representations of tutelary deities. Congo.

In the general appearance of its surface, in its natural products, and in the state of society and the condition of the native inhabitants, this country is by no means so interesting as many other parts of Africa. Along the sides of the river the mountains are numerous, but not high; the most elevated probably not exceeding two thousand feet. These are destitute of vegetation, with the exception of a few rank grasses; and the lesser ranges of hills are without those gigantic and wide-spreading forests which we might expect to find in such a climate. Only a few large trees are scattered upon their sides and summits. Between the bases of these hills, however, and the margins of the river, the alluvial banks, which extend from the mouth to a considerable distance upwards, are clothed with exuberant vegetation, presenting to the eye one continuous forest of majestic trees, covered with ever-green foliage. The river is studded with numerous islands, which are mantled with the thick mangrove, intermingled with the tall and elegant palm, whilst others are covered with the Egyptian papyrus. The alluvial flats are succeeded by naked and precipitous mountains, resting on micaceous slate, which forms the two banks of the river for at least fifty miles; the only interruption to this range of heights being a few narrow ravines, in which the villages of the natives are situated. Many of the hills are also crowned with small villages; and the soil is sufficient for the cultivation of the ordinary articles of food, but it is of an indifferent description. Beyond these masses of mica slate the geological character of the country changes. The granite hills give way to those of limestone, and numerous promontories of marble project into the river, with fertile vales between them. The whole country, according to Captain Tuckey, wore a more inviting aspect as they penetrated into the interior; and towns and villages followed each other in rapid succession far beyond the Congo territory. But the sickly state of the party put a stop to the expedition, just as the improved condition of the country held out a prospect of its complete success.

The climate is said to be cool, dry, and agreeable. A westerly breeze sets in from the Atlantic a few hours after sunset, and continues till midnight—thus materially cooling and purifying the air. Of course much depends upon locality, and accordingly at different situations, and these not very far apart, the range of the thermometer in the shade at noon showed a difference sometimes of thirty degrees. The winter in Congo is compared to the mild spring or autumn of Italy: it is not subject to heavy rains, but every night the earth is fertilized by falls of dew.

The vegetable productions of this country are numerous, but for the most valuable of these the natives are indebted to the Portuguese. The staple products are manioc or cassava, yams, and maize. To these may be added, sweet potatoes, pumpkins, millet of two or three species, calavanses, cabbages, spinach, pepper, capsicum, the sugar-cane, and tobacco. Of fruits they have the plantain, the papaw, oranges, limes, and pine apples. The principal beverage of the inhabitants is the juice of the palm tree, which goes by the name of palm wine. It is of three different kinds, and is a refreshing and wholesome liquor.

Congo.

There is a sufficiency of domestic animals for food, but very little care appears to be bestowed upon them. They consist chiefly of goats, hogs, fowls, the common and Muscovy duck, and pigeons. There are also a few sheep, which have a coat of hair instead of wool. No beasts of burden of any description were found in the country. Of wild animals there is a great variety; but from the indolent habits of the natives they have never been converted to any useful purpose. Elephants, leopards, buffaloes, monkeys, and antelopes of various species abound. There are also several other kinds of quadrupeds in abundance, and the supply of wild fowl is plentiful. The country appears to be remarkably free from those noxious insects which swarm almost universally in tropical climates: fleas, bugs, and black ants must, however, be excepted. The lower part of the Congo river abounds in excellent fish, of which bream, mullet, and cat-fish are the most abundant. Many of the natives gain a livelihood by fishing for these, and also in dragging for a shell-fish which bears a resemblance to the pecten. The river swarms with hippopotami, and alligators, or rather crocodiles. The flesh of the former is excellent food, though but little used.

The principal articles of subsistence, at least in the dry season, appear to be manioc, ground nuts, and palm wines. Yams and Indian corn are also used. Of the latter they have regularly two crops a-year. Animal food is not in very general use, although sold in the market held daily at Embamma. The negroes are exceedingly filthy in their preparation and eating of animal food. The fowls are broiled with the feathers unplucked, and pieces of goat without the skin or even the hair being removed; and they are devoured voraciously when scarcely warm. Cannibalism, however, appears to be totally unknown in Congo.

None of the villages seemed to be of great extent, the largest apparently not exceeding one hundred huts. Their huts are formed of mats woven from a reedy grass, or the fibres of plants; six pieces of which, being put together, compose the house. That of the Chenoo or chief, however, is formed more skilfully of palm leaves, and encompassed with a fence of reeds. The villages are usually embosomed in the midst of palms and other lofty trees. The household furniture and utensils, in simplicity and rudeness, are on a par with the domestic inclosures. They make baskets of the fibres of the palm tree; bowls and bottles of gourds and other vegetables, for holding provisions and water; earthen vessels for boiling their victuals, with wooden spoons to eat them; while a mat of grass thrown on a raised platform constitutes their only bedding. The articles of dress are equally primitive, the common people being satisfied with a small apron tied round the loins, and an ornamented cap made of grass. Rings of brass or iron enclasp the arms and ankles, and sometimes bracelets of lions' teeth are used. The women in general adorn their necks, arms, and legs with strings of beads.

For agricultural purposes, a rude hoe is the principal or only implement in use; but a slight scratch on the surface of the ground is sufficient for securing a good crop in that propitious climate. The natives make no provision for future contingencies, such as a year of scarcity; they only raise what will exactly meet their wants until the usual harvest time comes round. This, it would appear, arises principally from indolence, and not from a distrust in the right and security of property. This is so well understood by them, that almost all their disputes arise from their tenacity in the division of property, whether in land or stock; and the amount of this is frequently so trifling that it is not uncommon to see a fowl or a pig partitioned amongst three or four proprietors.

The paramount sovereign of Congo resides at a place of the same name, situated at about six days' journey into the interior, supposed to be the St Salvador of the Portuguese. Besides this regal personage, society in Congo appears to consist—first, of the Chenoo; secondly, of the members of his family; thirdly, of the Mafooks; fourthly, of the Foomoos; fifthly, of the fishermen, coolies, and labouring people; and, sixthly, of the domestic slaves. The title and authority of the Chenoo are hereditary in the female line: none of his sons can inherit unless the mother be of royal blood. The Chenoo is little distinguished from his subjects by dress or accommodation; and his ensign of office consists of a rod of black wood inlaid with lead or copper. The daughter of the Chenoo chooses her own husband, over whom she has sovereign control, and can sell into slavery if she pleases. The members of the royal family are the Chenoo's councillors, by whose advice he acts in all matters of consequence. The Mafooks are the collectors of the revenue, who begin their career as interpreters, and having realized what is there considered a competency, are entitled to pass into the higher grade of tax-gatherers. The Foomoos are those who possess houses and lands of their own, with two or three wives, and perhaps a few slaves to work for them. They would appear to be the yeomanry of the country. The fishermen and labourers have no fixed property of their own, and are therefore much at the disposal of the Chenoo. The domestic slaves are not numerous, and are not considered as transferable property, unless they are found guilty of some serious crime.

Congo.

The natives of Congo are about the middle size, and they have in a somewhat less degree both the black colour and the characteristic features of the race. Their physiognomy is mild, and said to bear the stamp of simplicity and innocence. They are lively, good-humoured, and hospitable to strangers. In energy and reflection they appear to be below the other African tribes, and their habits of indolence are inveterate. This forms the chief bar to the progress of improvement throughout the continent. As is generally the case amongst an uncivilized people, the most laborious offices are here performed by the weaker sex. Every man has wives in proportion to his rank; the Chenoo has sometimes fifty. But the practice of polygamy has caused the diffusion of very loose ideas in the relations of the sexes; a glass of rum or a few beads being a sufficient allurement even to the highest women in the country. A case of thieving came under the notice of Captain Tuckey, yet he speaks favourably of their general honesty. The atrocious crime of poisoning, however, evidently prevails amongst them.

With respect to religion, the Congoese are Pagans of the lowest description. A *fetiche* (from the Portuguese *fetico*, signifying a charm, witchcraft, magic) is a sort of tutelary deity, and seems to be the Alpha and Omega of their veneration. Anything serves for a fetiche; the guardian genius being nowise fastidious about the symbol which recognises his existence. The beak of a bird, the fin of a fish, or the hoof of a quadruped, answers the purpose perfectly well. The making of these fetiches is carried on as a trade by a certain class of men, who may be styled the priesthood of the country. These ridiculous appendages are considered as absolutely necessary for guaranteeing the safety of the houses and persons of the negroes, and they are looked upon as talismans of infallible efficacy in preventing every evil to which human nature is liable. The fetiche is employed in the discovery of theft. For this purpose it is exposed in some public place, when the people of the village dance round it, and with hideous yells call upon it either to reveal the thief, or to oblige him to deposit in some fixed place the article stolen, under the penalty of destruction to himself and his relations. The restoration of the stolen article seldom fails to ensue after this public exhibition. The Congoese have but a very vague idea of a good and evil principle, or a future state; and the fetiche system seems to constitute the religion of the country. With respect to the number of the inhabitants it is impossible to form even a conjecture.

Congo ‖ Congregation.

CONGO, or ZAIRE, a large river of Africa, which falls into the Atlantic Ocean in about the sixth degree of south latitude. From the volume of water which it discharges into the ocean, the probable length of its course, the greater part of which is still unknown, and the rapidity of its current, it is entitled to be ranked amongst the first class of rivers. It was for a length of time surmised that the Niger and the Congo were identically the same river. This opinion, however, has been exploded by the discovery of the termination of the former river by the Messrs Lander. But the source of the latter still remains as a problem to be solved by the enterprise of travellers. The breadth of the Congo at its mouth is about ten or twelve miles; and its depth is extraordinary, no bottom having been found by Captain Tuckey, who sounded it with a line of 113 fathoms. Its breadth at 140 miles from its mouth continues to be from two to three miles. At this point the narrows commence, when the river contracts to from three to five hundred yards in breadth, and so continues for a very considerable distance upwards. The banks are lined with bristling rocks, which in several places shoot in ledges across the bed of the river, and form rapids or cataracts. It is only, however, during the periodical floods that the lowest and most formidable of these deserves the name of cataract. Beyond these mountainous regions the Congo again expands to the breadth of two, three, or even four miles, and flows with a current of from two to three miles an hour. At the place where Captain Tuckey relinquished his journey, which was about 280 miles from Cape Pedron, on the sea-coast, the banks were clothed with luxuriant vegetation. Beyond this limit nothing certain is known of its course; but the natives stated that there was no obstacle to its continued navigation, with the exception of a rapid, which, however, was passable by canoes.

CONGOON, a town of Fars, in Persia, situated on the northern shore of the Persian Gulf. It contains about 6000 inhabitants, and has an excellent roadstead, where a frigate may ride in safety in the most tempestuous weather. Good water and firewood, which are both scarce in the gulf, may be procured at this place.

CONGREGATION (Lat. *con* and *grex* a flock), the act of bringing together or assembling; an assemblage of persons or of things. It is used appropriately for an assembly of persons met together for religious worship; and is also applied to an assembly of ecclesiastics,—as to those assemblies of cardinals appointed by the pope, and distributed into several chambers, for the discharge of certain functions and jurisdictions, after the manner of our offices and courts. The first of these is the congregation of the holy office, or the inquisition; the second that of jurisdiction over bishops and regulars; the third that of councils, which has power to interpret the Council of Trent; the fourth that of customs, ceremonies, precedencies, canonizations, called *the congregation of rites;* the fifth that of St Peter's fabric, which takes cognizance of all causes relating to piety and charity, part of which is due to the church of St Peter; the sixth, that of waters, rivers, roads; the seventh, that of fountains and streets; the eighth that of the index, which examines the books to be printed or corrected; the ninth that of the council of state, for the management of the territories belonging to the pope and church; the tenth, *de bono regimine*, the cardinal nephew being the chief of this and the preceding one; the eleventh that of money; the twelfth that of bishops, in which those who are to be promoted to bishoprics in Italy are examined, and which is held before the pope; the thirteenth that of consistorial matters, the chief of which is the cardinal dean; the fourteenth a congregation for propagating the faith; and the fifteenth that of ecclesiastical immunity, for settling suits against churchmen. There is also a congregation of alms, which takes care of everything that relates to the subsistence of Rome and the state of the church.

Congregation ‖ Congreve.

CONGREGATION is also used to signify a company or society of religious persons cantoned out of a particular order, and forming, as it were, an inferior order, or subdivision of the order itself.

The word is also applied to assemblies of pious persons in the manner of fraternities, frequent among the Jesuits, in honour of the Virgin, &c.

CONGREGATIONALISTS, a sect of Christians, so called because they hold that the affairs of each society of Christians should be managed by the members, as a congregate body, acting under their spiritual rulers, and neither by any extrinsic power, nor by the rulers acting apart from the members. See INDEPENDENTS.

CONGRESS, in political affairs, an assembly of commissioners, envoys, or deputies, from several courts, meeting to concert matters for their common good.

CONGRESS, in America, the assembly of delegates from the United States. See UNITED STATES.

CONGREVE, WILLIAM, the celebrated English dramatist, was a younger brother of an ancient family in Staffordshire. His father was employed as steward on the estates of the Earl of Burlington in Ireland, where he resided many years; and there the future poet was born in 1672. Young Congreve, when he came to England, entered into the Middle Temple, and began to study the law; but the bent of his mind soon attracted him to polite literature and poetry. His first performance was a novel entitled *Incognita, or Love and Duty reconciled.* He soon afterwards began his comedy of the *Old Bachelor*, which, though merely the amusement of his leisure hours during a slow recovery from illness, yet was in itself so perfect, that Dryden is said to have declared he had never in his life seen such a first play. When brought on the stage in 1693, it met with universal approbation, and established his fame as a writer of dramatic poetry. It procured him the friendship of Lord Halifax, and elicited a peculiar mark of distinction from Queen Mary. In the following year, he produced the *Double Dealer*, which, for reasons which are not so obvious, did not meet with so much success as its precursor. In 1695 his comedy of *Love for Love* was produced at the opening of the new theatre in Lincoln's Inn Fields, and met with such triumphant success that he was immediately offered a share in the management of the house, provided he would furnish them with one play yearly. This offer he accepted; but whether through indolence, or from that fastidiousness which made him elaborate his works, his *Mourning Bride* did not appear till 1697, nor his *Way of the World* till two years afterwards. The indifferent reception which the latter of these met with from the public completed that disgust for the theatre already forced on him by a long contest with Jeremy Collier in regard to the moralities of the English stage and some of his own pieces in particular, and determined Congreve to write no more for the stage. He seems, however, to have abandoned literary composition altogether, as the only pieces written after this period consist of small and fragmentary poems, all of which have been preserved as memorials of this celebrated dramatist. This apathy in regard to literary pursuits seems to have been increased, if it were not produced, by the affluence in which his earlier efforts had placed him. Through the friendship of Lord Halifax he was appointed one of the commissioners for licensing hackney coaches, or, according to Coxeter, a commissioner of the wine license. Lord Halifax also bestowed on him a place in the pipe office, and not long afterwards gave him a situation in the customs worth L.600 per annum; while in the year 1718 he was appointed secretary of Jamaica; so that his income, towards the latter part of his life, was upwards of L.1200 a-year.

Congreve. The greater part of the last twenty years of his life was spent in ease and retirement; and he either ceased, or affected to cease, caring for his reputation. His conduct in this matter seems to have proceeded in a great measure from pride, as may be seen from the following anecdote related of him by Cibber:—"When the celebrated Voltaire was in England, he waited upon Mr Congreve, and passed some compliments upon the merit and reputation of his works. Congreve thanked him, but at the same time told that ingenious foreigner that he did not choose to be considered as an author, but only as a private gentleman, and in that light expected to be visited. Voltaire answered, that if he had never been anything but a private gentleman, in all probability he had never been troubled with that visit." Voltaire observes, in his own account of the interview, that he was not a little disgusted with so unseasonable a piece of vanity.

Congreve towards the close of his life was much afflicted with gout and blindness. His death, which took place January 19, 1729, was hastened by a fall from his carriage while residing at Bath for the benefit of the waters. He was buried in Westminster Abbey.

"Congreve," says Dr Johnson, "has merit of the highest kind. He is an original writer, who borrowed neither the models of his plot nor the manner of his dialogue. He formed a peculiar idea of comic excellence, which he supposed to consist in gay remarks and unexpected answers; but that which he endeavoured he seldom failed of performing. His scenes exhibit not much of humour, imagery, or passion; his personages are a kind of intellectual gladiators; every sentence is to ward or to strike; the contest of smartness is never intermitted; his wit is a meteor playing to and fro with alternate coruscations. His comedies have therefore, in some degree, the operation of tragedies; they surprise rather than divert, and raise admiration oftener than merriment. But they are the works of a mind replete with images, and quick in combination." It may be added, that their licentiousness and immorality have been severely but justly censured. Of Congreve's miscellaneous poetry nothing favourable can be said. His powers seem to desert him when he leaves the stage, and he becomes feeble, impotent, and dull, without elevation of fancy, selection of language, or skill in versification.

There is an elegant edition of his works in three volumes 8vo, printed by Baskerville in 1761.

Congreve, *Sir William*, Bart., (1772–1828), inventor of the rocket called by his name, was member of parliament successively for Gatton and Plymouth. He was also a general of artillery, and co-operated with the Duke of York in reforming the British army. He wrote an *Elementary Treatise on the Mounting of Naval Ordnance* (Lond. 1812); and a *Description of the Hydro-pneumatic Lock* (Lond. 1815). He died at Toulouse in 1828.

The Congreve rockets, first used against Boulogne in 1806, are of various dimensions, and differently armed, as they are intended for the field or for bombardment. Those of the former class carry shells or case-shot; those of the latter are armed with a very combustible material contained in a strong metallic cylindrical case with a conical head. When once inflamed, this substance is unextinguishable, it scatters its burning particles in every direction, and when spent, the ball explodes like a grenade. The rocket is projected horizontally, and makes a loud whizzing noise in its passage through the air. The ammunition used varies from 6 to 42 lbs. and upwards. These rockets were certainly a very important invention; but from their liability to deflection and other defects, they are now regarded as less advantageous than the ordinary red-hot shot and bombs. The secret of their composition also is not so great as to defy imitation by foreign artillerists.

Congruity ‖ Cona.

CONGRUITY, (Lat. *congruo* to agree), a suitableness or relation of agreement between things.

It is a matter of experience that congruity, wherever perceived, is agreeable; and that incongruity is disagreeable. The only difficulty is to ascertain what are the particular objects which in conjunction suggest these relations; for there are many objects that do not. The sea, for example viewed in conjunction with a picture, or a man viewed in conjunction with a mountain, suggests neither congruity nor incongruity. It seems natural to infer, what indeed will be found true by induction, that we never perceive congruity or incongruity except among things which are connected together by some relation; such as a man and his actions, a principal and his accessories, a subject and its ornaments. Congruity is so nearly allied to beauty as commonly to be regarded as a species of it; and yet they differ so essentially as never to coincide. Beauty, like colour, is placed upon a single subject; congruity upon a plurality; and a thing beautiful in itself may, with relation to other things, produce the strongest sense of incongruity.

Congruity is also to be distinguished from propriety; congruity being the genus of which propriety is a species.

CONI or CUNEO, an administrative division of Piedmont, bounded north by that of Turin; east by Alessandria; south and west by the Apennines and Maritime Alps. It embraces an area of 2700 square miles, and is divided into the provinces of Cuneo, Alba, Mondovi, and Saluzzo. The surface of the division is intersected by numerous branches from the Alps and Apennines; but the inclosed valleys, which are well watered by the tributaries of the Po, yield abundance of corn, maize, and fruits, for the wants of the inhabitants, who are principally employed in agriculture and in the rearing of silk. Mulberries are extensively cultivated in the low grounds as food for the silkworm; while the higher slopes are covered with chestnut forests, and the elevated table-land affords a luxuriant summer pasturage. The principal streams are the Tanaro, the Stura, the Vraita, and the Maira. Of these the Tanaro is navigable, but only for a short distance. The mineral products of Coni include iron, lead, slate, and marble, &c. Pop. (1848) 600,872.

Coni or Cuneo, the capital of the cognominal province, situated on the right bank of the Stura, at its confluence with a mountain torrent called the Gesso, 46 miles S.W. from Turin. It was famous in Piedmontese warfare as a place of great strength; but in 1801, after the battle of Marengo, it was dismantled by the French, and its fortifications have been only replaced by a wall. It is the seat of a bishopric (founded in 1817), and the official residence of the intendant-general of the division. The principal public buildings are the cathedral and churches, the royal college, and town-hall. Coni possesses extensive manufactories of cloth and silk, and is the great mart for the agricultural produce of the district. Pop. 18,000, exclusive of the garrison.

CONIA, the fluid alkaloid to which the poisonous qualities of hemlock are owing. It is transparent at the ordinary temperature of the air, but becomes turbid when gently heated—a quality peculiar to this fluid.

CONIC SECTIONS.

INTRODUCTION.

Introduction.

THE mathematicians of antiquity regarded the straight line and the circle as the most simple of all geometrical lines, and the celebrated geometer Euclid has employed no other in his well known *Elements*. By these alone the ancients resolved a great number of problems, of which the more simple are contained in Euclid's *Elements;* but many of higher difficulty were resolved in his other writings, and in treatises of Archimedes and Apollonius, which have only in part reached our times. There is, however, from the very nature of geometrical science, a limit to the applicability of the straight line and circle. Some problems admit of only one solution: these can be resolved by the intersection of two straight lines. Others again admit of two solutions, and such require lines which intersect each other in two points; therefore they may be resolved by the straight line and circle, or two circles.

If, however, a problem be of such a nature as in its most general form to admit of three solutions, it must necessarily be determined by the intersection of two lines which intersect each other in three points: it therefore cannot be resolved by the straight line and circle alone. Now the ancients had actually proposed to themselves such problems, and in this way it may be supposed they had discovered the necessity of admitting other lines, in addition to the straight line and circle, into their geometry.

The interest which mankind take in mathematical speculations is but little in comparison to that which is excited by works of poetry, oratory, or history; hence it has happened that ancient treatises on these subjects have had a better chance of descending to our times. It is not, therefore, wonderful that none of the works of the more early Greek geometers have reached us, nor have we any work of great antiquity professedly written on the subject of the conic sections. Our curiosity must therefore rest satisfied with the knowledge of a few incidental notices and facts gleaned from different authors.

The discovery of the conic sections seems to have originated in the school of Plato, in which geometry was highly respected and much cultivated. It is probable that the followers of that philosopher were led to the discovery of these curves, and to the investigation of many of their properties, in seeking to resolve the two famous problems of the duplication of the cube, and the trisection of an angle, for which the artifices of the ordinary or plane geometry were insufficient. Two solutions of the former problem, by the help of the conic sections, are preserved by Eutocius,[1] and are attributed by him to Menæchmus, the scholar of Eudoxus, who lived not much posterior to the time of Plato: and this circumstance, added to a few words in an epigram of Eratosthenes,[2] has been thought sufficient authority, by some authors, to ascribe the honour of the discovery of the conic sections to Menæchmus. We may at least infer that, at this epoch, geometers had made some progress in developing the properties of these curves.

The writings of Archimedes that have reached us explicitly show that the geometers before his time had advanced a great length in investigating the properties of the conic sections. This author expressly mentions many principal propositions to have been demonstrated by preceding writers; and he often refers to properties of the conic sections, as truths commonly divulged and known to mathematicians. His own discoveries in this branch of science are worthy of the most profound and inventive genius of antiquity. In the quadrature of the parabola he gave the first and the most remarkable instance that has yet been discovered, of the exact equality of a curvilinear to a rectilinear space. He determined the proportion of the elliptic spaces to the circle; and he invented many propositions respecting the mensuration of the solids formed by the revolution of the conic sections about their axes.

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It is chiefly from the writings of Apollonius of Perga, a town in Pamphylia, on the subject of the conic sections, that we know how far the ancient mathematicians carried their speculations concerning these curves. Apollonius flourished under Ptolemy Philopater, about forty years later than Archimedes. He formed his taste for geometry, and acquired that superior skill in the science, to which he is indebted for his fame, in the school of Alexandria, under the successors of Euclid. Besides his great work on the conic sections, he was the author of many smaller treatises relating chiefly to the geometrical analysis, the originals of which have all perished, and are only known to modern mathematicians by the account given of them by Pappus of Alexandria, in the seventh book of his *Mathematical Collections*. (See APOLLONIUS.)

The work of Apollonius on the conic sections, written in eight books, was held in such high estimation by the ancients, as to procure for him the name of the great geometer. The first four books of this treatise only have come down to us in the original Greek. It is the purpose of these four books, as we are informed in the prefatory epistle to Eudemus, to deliver the elements of the science; and in this part of his labour the author claims no further merit than that of having collected, amplified, and reduced to order, the discoveries of preceding mathematicians. One improvement introduced by Apollonius is too remarkable to be passed over without notice. The geometers who preceded him derived each curve from a *right cone*, which they conceived to be cut by a plane perpendicular to its slant side. It will readily be perceived, from what is shown in the first section of the fourth part of the following treatise, that the section would be a parabola when the vertical angle of the cone was a right angle, an ellipse when it was acute, and a hyperbola when it was obtuse. Thus each curve was derived from a different sort of cone. Apollonius was the first to show that all the curves are produced from any sort of cone, whether right or oblique, according to the different inclinations of the cutting plane. This fact is one remarkable instance of the adherence of the mind to its first conceptions, and of the slowness and difficulty with which it generalizes.

The original of the last four books of the treatise of Apollonius is lost; nor is it easy to ascertain in what age it disappeared. In the year 1658 Borelli discovered at Florence an Arabic manuscript entitled *Apollonii Pergæi Conicorum Libri Octo*. By the liberality of the Duke of Tuscany, he was permitted to carry the manuscript to Rome, and, with the aid of an Arabic scholar, Abraham Ecchellensis, he published in 1661 a Latin translation of it. The manuscript, although from its title it was expected

[1] In Arch. lib. ii. *De Sph. et Cyl.*

[2] *Ibid.*

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to be a complete translation of all the eight books, yet was found to contain only the first seven books: and it is remarkable, that another manuscript, brought from the East by Golius, the learned professor of Leyden, so early as 1664, as well as a third, of which Ravius published a translation in 1669, have the same defect. All the three manuscripts agreeing in the want of the eighth book, we may now consider that part of the work of Apollonius as irrecoverably lost. Fortunately, in the *Collectiones Mathematicæ* of Pappus, in whose time the entire treatise of Apollonius was extant, there is preserved some account of the subjects treated in each book, and all the *Lemmata* required in the investigations of the propositions they contain. Dr Halley, who in 1710 gave a correct edition of the Conics of Apollonius, guided in his researches by the lights derived from Pappus, has restored the eighth book with so much ability as to leave little room to regret the original.

The last four books of the Conics of Apollonius, containing the higher or more recondite parts of the science, are generally supposed to be the fruit of the author's own researches; and they do much honour to the geometrical skill and invention of the great geometer. Even in our times the whole treatise must be regarded as a very extensive, if not a complete work on the conic sections. Modern mathematicians make important applications of these curves, with which the ancients were unacquainted; and they have been thus led to consider the subject in particular points of view, suited to their purposes; but they have made few discoveries of which there are not some traces to be found in the work of the illustrious ancient.

The geometers who followed Apollonius seem to have contented themselves with the humble task of commenting on his treatise, and of rendering it of more easy access to the bulk of mathematicians. Till about the middle of the 16th century, the history of this branch of mathematical science presents nothing remarkable. The study of it was then revived; and since that time this part of mathematics has been more cultivated, or has been illustrated by a greater variety of ingenious writings.

Among the ancients the study of the conic sections was a subject of pure intellectual speculation. The applications of the properties of these curves in natural philosophy have, in modern times, given to this part of the mathematics a degree of importance that it did not formerly possess. That which, in former times, might be considered as interesting only to the learned theorist and profound mathematician, is now a necessary attainment to him who would not be ignorant of those discoveries in nature that do the greatest honour to the present age.

It is curious to remark the progress of discovery, and the connexion that subsists between the different branches of human knowledge; and it excites some degree of admiration to reflect, that the astronomical discoveries of Kepler, and the sublime theory of Newton, depend on the seemingly barren speculations of Greek geometers concerning the sections of the cone.

Apollonius, and all the writers on conic sections before Dr Wallis, derived the elementary properties of the curves from the nature of the cone. In the second part of his treatise *De Sectionibus Conicis*, published in 1665, Dr Wallis laid aside the consideration of the cone, deriving the properties of the curves from a description *in plano*. Since his time authors have been much divided as to the best method of defining those curves, and demonstrating their elementary properties; many of them preferring that of the ancient geometers, while others, and some of great note, have followed the example of Dr Wallis.

In support of the innovation made by Dr Wallis, it is urged, that in the ancient manner of treating the conic sections, young students are perplexed and discouraged by the previous matter to be learnt respecting the generation and properties of the cone; and that they find it no easy task to conceive steadily, and to understand, diagrams which represent lines drawn in different planes; all these difficulties are avoided by defining the curves *in plano* from one of their essential properties. It is not our intention particularly to discuss this point; and we have only to add, that in the following treatise we have chosen to deduce the properties of the conic sections from their description *in plano*, as better adapted to the nature of a work designed for general readers.

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A geometrical treatise on the conic sections must necessarily be founded upon the elements of geometry. As Euclid's *Elements of Geometry* are generally studied, and in every one's hands, we have chosen to refer to it in the demonstrations. The edition we have used is that published by the late Professor Playfair of Edinburgh. Although the references are made to Euclid's *Elements*, yet they will also apply to the treatise on GEOMETRY given in this work; for a table is there given, indicating the particular proposition of our treatise that corresponds to each of the most material propositions in Euclid's *Elements*.

The references are to be thus understood: (20, 1, E.) means the 20th prop. of the first book of Euclid's *Elements*; (2 Cor. 20, 6, E.) means the second corollary to the 20th prop. of the sixth book of the same work; and so of others. Again, (7) means the seventh proposition of that Part of the following treatise in which such reference happens to occur; (Cor. 1) means the corollary to the first proposition; (2 Cor. 3) means the second corollary to the third proposition, &c.—such references being all made to the propositions in the division of the treatise in which they are found.

We shall conclude this brief history of this most interesting part of the ancient geometry, with a catalogue of authors and their works.

Archimedes *On the Quadrature of the Parabola, and on Conoids and Spheroids.* Archimedes lived about 180 years before the Christian era. The best editions of his works are Torelli's, in Greek and Latin, Oxford, 1792; and Peyrard's French translation, Paris, 1808.

Collectiones Mathematicæ Pappi Alexandrini, lib. vii. Bononiæ, 1660. Here some account of Apollonius' Conics, and the Lemmata, is given. Apollonius lived about forty years later than Archimedes. There have been various editions of his Conics, viz. *Apollonii Pergæi Conicorum libri iv. cum Commentariis* R. P. Claudii Richardi. Antwerp, 1655.

Apollonii Pergæi Conicorum lib. v. vi. vii., Paraphraste Abalphato Asphahnense, ex Arabico in Latinum per Abraham Ecchellensem Maronitam redditi, cum Notis J. Alfonsi Borelli. Florent. 1661.

Apollonii Perg. Con. Sect. lib. v. vi. vii. in Græcia deperditi, jam vero ex Arabico MS. ante quadringentos annos elaborata opera subitanea Latinitate donati a Christiano Ravio. Upsal, 1669.

Apollonii Conica Methodo Nova illustrata et succincte demonstrata, per Isaacum Barrow. London, 1675.

Emendatio et Restitutio Conicorum Apollonii Pergæi. Autore Francisco Maurolyco. Coloniæ, 1675.

Apollonii Pergæi Conicorum libri octo, et Sereni Antissensis de Sectione Cylindri et Coni libri duo. Oxford, 1710. This is Dr Halley's edition. The first four books, together with the Lemmata of Pappus, and the commentaries of Eutocius, have been published from Greek manuscripts, accompanied with a Latin translation; the fifth, sixth, and seventh books, which also contain the Lemmata, have been translated from Arabic into Latin; the eighth

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has been restored by Dr Halley. The books of Serenus are in Greek and Latin.

De Maximis et Minimis, Geometrica Divinatio in quintum Conicorum Apollonii Pergæi, nunc desideratum librum. Autore Vincentio Viviani. Florence, 1659.

De Locis Solidis, Secunda Divinatio Geometrica in quinque libros injuria temporum amissos Aristæi Senioris Geometræ. Aut. Vin. Viviani. &c. *Opus Conicorum, continens Elementa Tractatuum ejusdem Viviani.* Florence, 1701.

Apollonius Cattus, a work on Conics in German, by Benjamin Bramer, printed 1634.

Claudii Mydorgii Patricii Parisini Prodromi Catoptricorum et Dioptricorum: sive Conicorum Operis ad abdita radii reflexii et refracti mysteria prævii et facem præferentis. Libri iv. priores. Paris, 1641.

Francisci a Schooten Leydensis de Organica Conicarum Sectionum in plano descriptione. Lugd. Batavor. 1646.

P. Gregorii a Sto. Vincentio, *Opus Geometricum Quadraturæ Circuli et Sectionum Coni decem libris comprehensum.* Antverpiæ, 1647.

Johannis Wallisii *De Sectionibus Conicis nova methodo expositis tractatus.* Oxonii, 1655.

Joannis de Witt *Elementa Curvarum Linearum per Franciscum Schooten edita cum Cartesii Geometria.* Amstelodami, 1659 et 1661.

Euclides Adauctus et Methodicus Mathematicaque Universalis. Autore Guarino. Augustæ Taurin. 1671.

Nouvelle méthode en Géométrie pour les Sections des superficies Coniques et Cylindriques qui ont pour base des cercles, ou des paraboles, des ellipses, et des hyperboles. Par Ph. de la Hire. Paris, 1673.

Nouveaux Elémens des Sections Coniques, &c. par M. de la Hire. Paris, 1679.

Sectiones Conicæ in novem libr. distributæ, &c. Aut. Phil. de la Hire. Paris, 1685.

Traité des Lignes du Premier Genre, expliquées par une Méthode nouvelle et facile, par M. Ozanam. Paris, 1687.

Sectionum Conicarum Elementa nova methodo demonstrata. Autore Jacobo Milnes. Oxoniæ, 1702.

Traité Analytique des Sections Coniques, et de leur usage, &c. Ouvrage posthume de M. le Marquis de l'Hôpital. Paris, 1707.

Compendio delle Sezioni Coniche d'Apollonio di P. Guido Grando. Firen. 1722.

Delle Sezioni Coniche dedotte nuovamente in Piano del cerchio di Vincent. Santini. Luca, 1722.

Sectionum Conicarum Elementa methodo facillime demonstrata. Autore L. Trevigar. Cantabrigiæ, 1731.

A Treatise on Conic Sections, by R. Steel. Dublin, 1723.

Elementa Sectionum Conicarum. Autore Nicolas de Martino. Tomii ii. Neapoli, 1734.

Elements of Conic Sections, in three books, by R. Jack. Edinburgh, 1742.

A Mathematical Treatise, containing a System of Conic Sections, &c. by J. Muller. London, 1736.

Sectionum Conicarum Elementa. Autore Josepho Boscovich. This treatise forms part of his *Elementa Universæ Matheseos.* Romæ, 1754.

De Sectionibus Conicis tractatus geometricus, in quo ex natura ipsius Coni Sectionum affectiones facillime deducuntur methodo nova. Autore Hugone Hamilton. Dublin, 1758. There is an English translation of this excellent work.

Sectionum Conicarum libri quinque. Autore R. Simson. Edinburgi, 1735 and 1750. Introduction.

Antonii Rochii *Conicarum Sectionum nova methodo expositarum specimen de proportionum compositione syntagma.* Patavii, 1756.

Introduction aux Sections Coniques, par M. Mauduit. Paris, 1761.

Sectionum Conicarum Compendium. Autore D. Octaviano Cametti. Venetiis, 1765.

The Elements of the Conic Sections, in three books, by W. Emerson. London, 1767.

The Elements of the Conic Sections, as preparatory to the reading of Newton's *Principia,* by the Rev. S. Vince. Cambridge, 1781.

Elements of Conic Sections, &c. by Charles Hutton, LL.D. 1787.

Sectionum Conicarum Libri Septem. Accedit Tractatus de Sectionibus Conicis, et de Scriptoribus qui earum doctrinam tradiderunt. Autore Abramo Robertson, A. M. Oxonii, 1792.

A Geometrical Treatise on Conic Sections, in four books, &c. by the Rev. Abram Robertson. Oxford, 1802.

A Short Treatise on the Conic Sections, in which the three Curves are derived from a general description on a Plane, by the Rev. T. Newton. Cambridge, 1794.

A System of Conic Sections adapted to the Study of Natural Philosophy, by the Rev. D. M. Peacock. 1810.

A Compendious and Practical Treatise on the Construction, Properties, and Analogies of the Three Conic Sections, by the Rev. D. Bridge. 1811.

Essai de Géométrie Analytique appliqué aux Courbes et aux Surfaces du second ordre, par J. B. Biot. Paris, 1810.

A Treatise on Lines of the Second Order. This is part of a work entitled *Geometry of Curve Lines,* by Sir John Leslie, formerly Professor of Mathematics, afterwards of Natural Philosophy, in the University of Edinburgh. Edinburgh, 1821.

A Treatise on the Conic Sections, in five books, by G. Walker, F. R. S. London, 1794.

The Elements of the Ellipse, together with the Radii of Curvature, by James Adams. London, 1818.

An Analytical System of the Conic Sections, by the Rev. H. P. Hamilton. Cambridge, 1828.

A Geometrical Treatise on the Conic Sections, by William Wallace, Professor of Mathematics in the University of Edinburgh. Edinburgh, 1833.

Hamilton's *Conic Sections,* 8vo, London, 1843.

Hymers's *Conic Sections,* 8vo, London, 1845.

H. Sonnet et G. Frontera, *Elémens de Geom. Anal.* Paris, 1854.

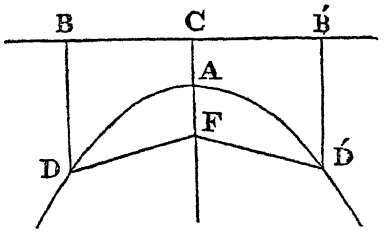
Salmon's *Conic Sections,* 8vo, London, 1855.

Todhunter's *Plane Co-ordinate Geometry,* London, 1855.

There is much valuable matter relating to the conic sections in several works which do not treat expressly on the subject; particularly in Newton's *Principia,* lib. i. The learned Jesuits Le Seur and Jacquier have given a concise treatise in their commentary on the work, at Prop. 8, lib. i. Maclaurin has treated of the conic sections in his *Geometria Organica,* sect. 1; in his Fluxions, chap. xiv., and in sect. 2 of the appendix to his Algebra. Euler has treated of them in his *Introductio in Analysin Infinitorum,* lib. ii., cap. 5; and De Moivre in his *Miscellanea Analytica,* lib. viii., cap. 2.

PART I.—OF THE PARABOLA.

Definitions.



I. If a straight line BC, and a point without it F, be given in position in a plane, and a point D be supposed to move in such a manner that DF, its distance from the given point, is equal to BD, its distance from the given line; the point D will describe a line DAD′, called a *Parabola.*

II. The straight line BC, which is given in position, is called the *Directrix of the parabola.*

III. The given point F is called the *Focus.*

IV. A straight line perpendicular to the directrix, terminated at one extremity by the parabola, and produced indefinitely within it, is called a *Diameter.*

V. The point in which a diameter meets the parabola is called its *Vertex.*

VI. The diameter which passes through the focus is called the *Axis of the parabola;* and the vertex of the axis is called the *Principal Vertex.*

Corollary. A perpendicular drawn from the focus to the directrix is bisected at the vertex of the axis.

VII. A straight line terminated both ways by the parabola, and bisected by a diameter, is called an *Ordinate to that diameter.*

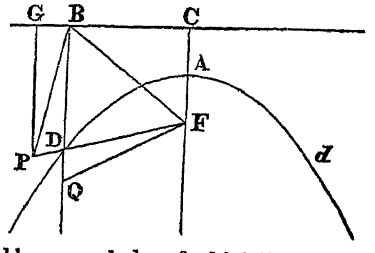
VIII. The segment of a diameter between its vertex and an ordinate, is called an *Absciss.*

IX. A straight line quadruple the distance between the vertex of a diameter and the directrix, is called the *Parameter,* also the *Latus Rectum of that diameter.*

X. A straight line meeting the parabola only in one point, and which everywhere else falls without it, is said to *touch* the parabola at that point, and is called a *Tangent to the parabola.*

Proposition I.

The distance of any point without the parabola from the focus is greater than its distance from the directrix; and the distance of any point within the parabola from the focus is less than its distance from the directrix.



Let DA*d* be a parabola, of which F is the focus, GC the directrix, and P a point without the curve, that is, on the same side of the curve with the directrix; PF, a line drawn to the focus, will be greater than PG, a perpendicular to the directrix. For, as PF must necessarily cut the curve, let D be the point of intersection; draw DB perpendicular to the directrix, and join PB. Because D is a point in the parabola, DB = DF (Definition 1), therefore PF = PD + DB; but PD + DB is greater than PB (20, 1, E.), and therefore still greater than PG (19, 1, E.), therefore PF is greater than PG.

Again, let Q be a point within the parabola; QF, a line drawn to the focus, is less than QB, a perpendicular to the directrix. The perpendicular QB necessarily cuts the curve; let D be the point of intersection; join DF. Then DF = DB (Def. 1), and QD + DF = QB; but QF is less than QD + DF, therefore QF is less than QB.

Cor. A point is without or within the parabola, according as its distance from the focus is greater or less than its distance from the directrix.

Prop. II.

Every straight line perpendicular to the directrix meets the parabola, and every diameter falls wholly within it.

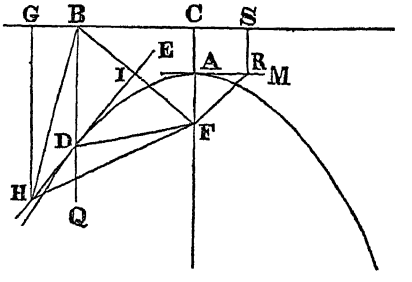
(See Figure to Prop. I.)

Let the straight line BQ be perpendicular to the directrix at B; BQ shall meet the parabola. Draw BF to the focus, and make the angle BFP equal to FBQ; then, because QBC is a right angle, QBF and PFB are each less than a right angle, therefore QB and PF intersect each other; let D be the point of intersection, then DB = DF (5, 1, E.); therefore D is a point in the parabola. Again, the diameter DQ falls wholly within the parabola; for take Q any point in the diameter, and draw FQ to the focus, then QB or QD + DF is greater than QF; therefore Q is within the parabola (Cor. 1).

Cor. The parabola continually recedes from the axis, and a point may be found in the curve that shall be at a greater distance from the axis than any assigned line.

Prop. III.

The straight line which bisects the angle contained by two straight lines drawn from any point in the parabola, the one to the focus, and the other perpendicular to the directrix, is a tangent to the curve in that point.



Let D be any point in the curve; let DF be drawn to the focus, and DB perpendicular to the directrix; the straight line which bisects the angle FDB is a tangent to the curve. Join BF meeting DE in I, take H any other point in DE, join HF, HB, and draw HG perpendicular to the directrix. Because DF = DB, and DI is common to the triangles DFI, DBI, and the angles FDI, BDI, are equal, these triangles are equal, and FI = IB; and hence FH = HB (4, 1, E.): but HB is greater than HG (19, 1, E.); therefore the distance of the point H from the focus is greater than its distance from the directrix, hence that point is without the parabola (Cor. 1), and therefore HDI is a tangent to the curve at D (Def. 10).

Cor. 1. A perpendicular to the axis at its vertex is a tangent to the curve. Let AM be perpendicular to the axis at the vertex A, then RS, the distance of any point in AM from the directrix, is equal to CA, that is to AF,

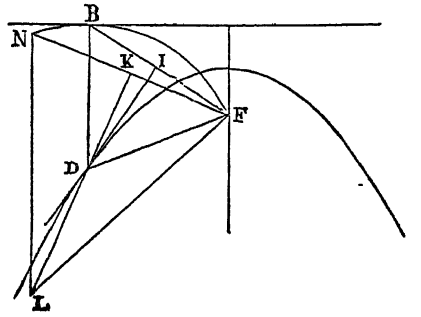
Parabola. and therefore is less than RF, the distance of the same point from the focus.

Cor. 2. A straight line drawn from the focus of a parabola perpendicular to a tangent, and produced to meet the directrix, is bisected by the tangent. For it has been shown that FB, which is perpendicular to the tangent DI, is bisected at I.

Cor. 3. A tangent to the parabola makes equal angles with the diameter which passes through the point of contact, and a straight line drawn from that point to the focus. For BD being produced to Q, DQ is a diameter, and the angle HDQ is equal to BDE, that is, to EDF.

Cor. 4. The axis is the only diameter which is perpendicular to a tangent at its vertex. For the angle HDQ, or BDE, is the half of BDF, and therefore less than a right angle, except when BD and DF lie in a straight line, which happens when D falls at the vertex.

Cor. 5. There cannot be more than one tangent to the parabola at the same point.

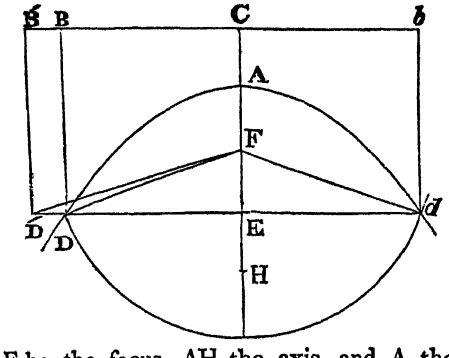


For let any other line DK, except a diameter, be drawn through D; draw FK perpendicular to DK; on D for a centre, with a radius equal to DB or DF, describe a circle, cutting FK in N; draw NL parallel to the axis, meeting DK in L, and join FL. Then FK = KN (3, 3, E.), and therefore FL = LN. Now BD being perpendicular to the directrix, the circle FBN touches the directrix at B (16, 3, E.); and hence N, any other point in the circumference, is without the directrix, and on the same side of it as the parabola; therefore the point L is nearer to the focus than to the directrix, and consequently is within the parabola.

Scholium. From the property of tangents to the parabola demonstrated in Cor. 3, the point F takes the name of the *Focus*. For rays of light proceeding parallel to the axis of a parabola, and falling upon a polished surface whose figure is that produced by the revolution of the parabola about its axis, are reflected to the focus.

Prop. IV. Problem.

To find any number of points in a parabola, having given the focus and axis.



Let F be the focus, AH the axis, and A the vertex. Suppose the problem resolved, and that D is a point in the parabola. In FA produced take AC equal to AF, and through C draw the directrix BC*b*: draw DF to the focus, Parabola. DE perpendicular to the axis, and DB perpendicular to the directrix: Take AH equal to FD.

Because AH is equal to DF, and DF is greater than AF (Cor. Prop. 2), therefore AH is greater than AF, and H is always in AF produced.

Now CE is equal to AH, for each is equal to DF; therefore, taking from these the equals AC, AF, we have AE = FH.

Construction. In AF produced take any point H, and take AE equal to FH. Through E draw DE*d* perpendicular to the axis, and with F as a centre, at the distance AH, describe a circle which will cut the perpendicular in D and *d*: these are points in the parabola. For AE = FH, therefore CE = AH, and DB = DF, therefore D is in the parabola, and in the same way it appears that *d* is in the parabola.

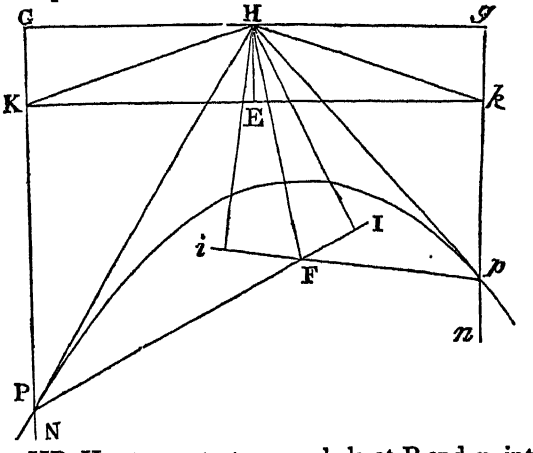
Cor. 1. Any perpendicular to the axis meets the parabola in two points, and in no more, and the straight line between the points is bisected by the axis. For if the perpendicular could meet the curve in another point D′, then FD′ being joined, we would have FD′ equal to D′B′, that is, to DB or to FD, which is impossible (19, 1, E.).

Cor. 2. Every chord D*d*, in a parabola, perpendicular to the axis, is bisected by the axis, and therefore is an ordinate to it. For the chord in the parabola is also a chord in a circle, the centre of which is in the axis of the parabola.

Scholium. From this proposition it appears that the parabola is composed of two branches, which recede continually from the directrix and from the focus, also from the axis (Cor. Prop. 2). And it appears that the indefinite spaces between the curve and axis on each side are exactly alike, so that if the whole space comprehended within the parabola were divided into two portions by cutting it through the axis, and one of them were turned over upon the other, they would entirely coincide.

Prop. V.

If a straight line be drawn from the focus of a parabola to the intersection of two tangents to the curve; it makes equal angles with straight lines drawn from the focus to the points of contact.



Let HP, H*p*, tangents to a parabola at P and *p*, intersect each other at H; draw PF, *p*F, HF, to F the focus; the line HF makes equal angles with FP, F*p*.

Draw PK, *pk* perpendicular to the directrix, and join HK, H*k*. The triangles HPK, HPF have PK = PF, PH common to both, and the angles KPH, FPH equal (3), therefore they are in every way equal (4, 1, E.), and have HK = HF, and the angle HKP equal to HFP. In the same way it may be shown, that the triangles H*pk*, H*p*F, are in every way equal, and therefore H*k* = HF, and the

Parabola. angle HKp is equal to HFp: But HK being equal to Hk, for each has been proved equal to HF, the angles HKk, HkK are equal (5, 1, E.), and adding to these the right angles PKk, pkK, the angles HKP, Hkp are equal; but these have been proved equal to HFP, HFp; therefore these last are equal, and the line HF makes equal angles with FP, Fp.

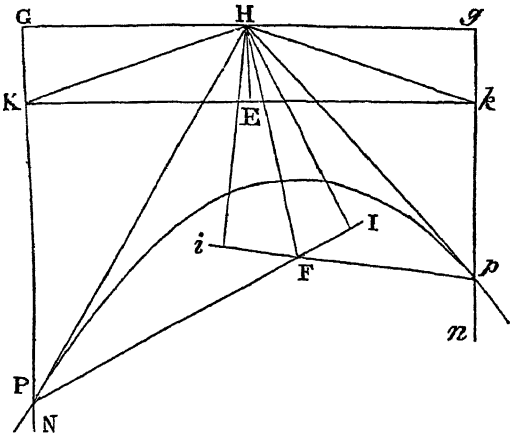
Cor. 1. Perpendiculars drawn from the intersection of two tangents, to lines drawn from the points of contact through the focus, are equal. For HI, Hi, being drawn perpendicular to PF, PF, the triangles HFI, HFi, are manifestly equal (26, 1, E.), and therefore HI = Hi.

Cor. 2. Perpendiculars from the intersection of two tangents to diameters passing through the points of contact are equal.

Draw GHg through H perpendicular to PK, pk, and because the triangles HPG, HPI have HP common to both, the angles at P equal, and the angles G and I right angles, the triangles are in every way equal (26, 1, E.), and hence HG is equal to HI. In like manner it is proved that Hg is equal to Hi; but HI is equal to Hi, therefore HG is equal to Hg.

Prop. VI.

If a straight line be drawn from the intersection of two tangents to the focus, and another perpendicular to the directrix; these will make equal angles with the tangents.



Let F be the focus of a parabola, and Kk the directrix; and let straight lines HP, Hp, which intersect each other at H, touch the parabola at P and p, also let HF be drawn to the focus, and HE perpendicular to the directrix; the angles PHE, pHF are equal.

The same construction being made as in Prop. V.

In the triangles HEK, HEk, it may be shown, as in that proposition, that HK is equal to Hk; and therefore that the angle HKE is equal to the angle HkE (5, 1, E.). The angles HEK, HEk are also equal; therefore the angles KHE, kHE are equal (26, 1, E.). Now the angle KHE = KHP + PHE; but the triangles KHP, FHP are in every way equal (as was shown in Prop. V.) Therefore KHP = FHP, and hence

$$\text{KHE} = \text{FHP} + \text{PHE} = \text{FHE} + 2\text{PHE}.$$

In the same way it appears that

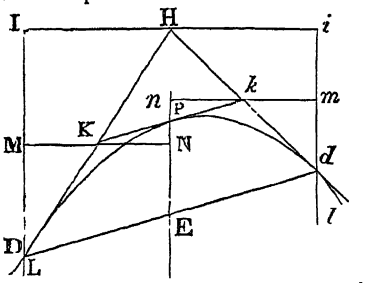
$$k\text{HE} = \text{FH}p + p\text{HE} = \text{FHE} + 2\text{FH}p;$$

therefore FHE + 2PHE = FHE + 2FHp;

and hence 2PHE = 2pHF and PHE = pHF.

Prop. VII.

If two tangents to a parabola be at the extremities of a chord, and a third tangent be parallel to the chord; the part of this tangent intercepted between the other two is bisected at the point of contact. Parabola.



Let HD, Hd, be tangents at the extremities of the chord Dd, and KPk a tangent parallel to Dd, meeting the other tangents in K and k; the line Kk is bisected at P, the point of contact.

From H, K, k, the intersections of the tangents, draw perpendiculars to the diameters passing through their points of contact, viz. HI, Hi, perpendicular to DL and dl; and KM, KN, perpendicular to DL and PE, and km, kn, perpendicular to dl and PE.

The triangles DHI, DKM, are manifestly equiangular, also the triangles dHi, dkm; therefore

$$\text{HD} : \text{DK} = \text{HI} : \text{KM} \text{ (4, 6, E.)},$$

and Hd : dk = Hi : km.

But because Kk is parallel to Dd,

$$\text{HD} : \text{DK} = \text{H}d : dk \text{ (2, 6, E.)};$$

therefore HI : KM = Hi : km.

Now HI = Hi (2 Cor. 5), therefore KM = km.

But KM = KN, and Km = Kn (2 Cor 5);

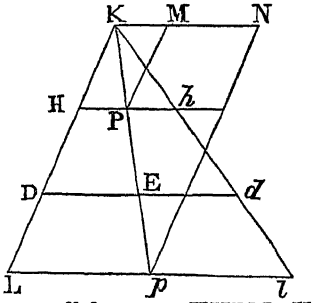
therefore KN = kn.

And since KN : kn = KP : kP (Cor. 6, E.),

therefore KP = kP.

Lemma.

Let KLl be a triangle, having its base Ll bisected at p, and let Hh, any straight line parallel to the base, and terminated by the sides, be bisected at P; then P, p, the points of bisection, and K, the vertex of the triangle, are in the same straight line; and that line bisects Dd, any other straight line parallel to the base.



Complete the parallelograms KHPM, KLpN. The triangles KHh, KLl being similar, and Hh, Ll similarly divided at P and p,

$$\text{KH} : \text{KL} = \text{H}h : \text{L}l = \text{HP} : \text{L}p,$$

hence the parallelograms KHPM, KLpN are similar. Now they have a common angle at K, therefore they are about the same diameter, that is, the points K, P, p are in the same straight line (26, 6, E.).

Next, let Dd meet Kp in E, then

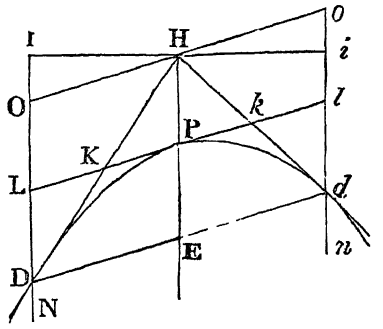
$$\text{HP} : \text{DE} (= \text{KP} : \text{KE}) = \text{P}h : \text{E}d;$$

therefore DE is equal to Ed.

Prop. VIII.

Any chord parallel to a tangent is bisected by the diameter which passes through the point of contact, or is an ordinate to that diameter.

Parabola.



The chord D*d*, which is parallel to the tangent KP*k*, is bisected at E by PE, the diameter that passes through the point of contact.

Let DH, *d*H be tangents, and DN, *dn* diameters at the extremities of the chord; let the tangent at P meet the other tangents in K and *k*, and the diameters in L and *l*, and through H draw OH*o* parallel to D*d*, and IH*i* perpendicular to the diameters DN, *dn*.

Because of the parallels L*l*, O*o*, and DO, *do*, the triangles DKL, DHO are similar, also the triangles *dkl*, *d*H*o*, and the triangles OHI, *o*H*i*, therefore

DK : DH = KL : HO,
and *dk* : *d*H = *kl* : H*o* (4, 6, E.);

But because D*d* is parallel to K*k*,

DK : DH = *dk* : *d*H (2, 6, E.),
therefore KL : HO = *kl* : H*o*;
but HO : HI = H*o* : H*i*,

therefore, *ex. æq.* KL : HI = *kl* : H*i*.

Now HI = H*i* (2 Cor. 5), therefore KL = *kl*; but KP = *kp* (7), therefore PL = P*l*, and ED = E*d* (34, 1, E.)

Cor. 1. Straight lines which touch a parabola at the extremities of an ordinate to a diameter intersect each other in that diameter; for K*k* and D*d* being bisected at P and E, the points H, P, E lie in a straight line. (Lemma.)

Cor. 2. Every ordinate to a diameter is parallel to a tangent at its vertex: For if it be not, let a tangent be drawn parallel to the ordinate; then the diameter which passes through the point of contact would bisect the ordinate, and thus the same line would be bisected in two different points, which is impossible.

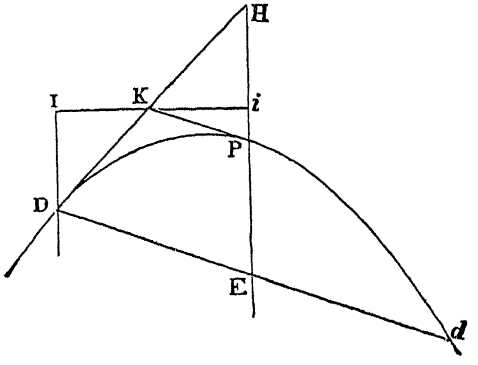
Cor. 3. All ordinates to the same diameter are parallel to each other.

Cor. 4. A straight line that bisects two parallel chords, and terminates in the curve, is a diameter.

Cor. 5. The axis is perpendicular to its ordinates, and every other diameter cuts its ordinates obliquely.

Prop. IX.

If a tangent at any point in a parabola meet a diameter, and from the point of contact an ordinate be drawn to that diameter; the segment of the diameter between the vertex and tangent is equal to the segment between the vertex and the ordinate.



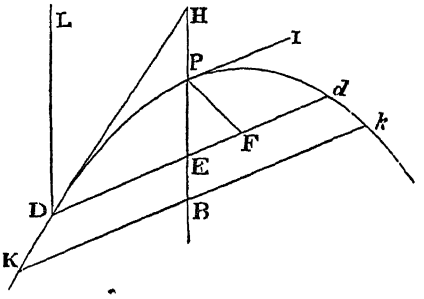
Let DH, a tangent to the curve at D, meet the diameter EP in H, and let DE*d* be an ordinate to that diameter: the segment HE is bisected in P. Parabola.

Draw PK, a tangent at P, meeting the tangent DH in K, and draw IK*i*, perpendicular to the diameter PE at *i*, and meeting a diameter drawn through D at I.

The triangles DKI, HK*i* are similar (29, 1, E.), therefore IK : K*i* = DK : KH (4, 6, E.); and because in the triangle DHE, KP is parallel to the side DE, DK : KH = EP : PH, therefore IK : K*i* = EP : PH; but IK and K*i* are equal (2 Cor. 5), therefore EP and PH are equal.

Prop. X.

If an ordinate to any diameter pass through the focus; the absciss is equal to one fourth of the parameter of that diameter, and the ordinate is equal to the whole parameter.

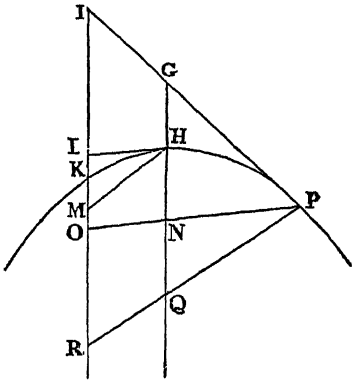


Let DE*d*, a straight line passing through the focus, be an ordinate to the diameter PE; the absciss PE is equal to one fourth the parameter, and the ordinate D*d* is equal to the whole parameter of the diameter PE.

Let DH, PI be tangents at D and P; let DH meet the diameter in H; draw PF to the focus, and DL parallel to EP. The angles HPI, IPF, being equal (3), and PI parallel to EF (2 Cor. 8), the angles PEF, PFE, are also equal (29, 1, E.), and PE = PF = $\frac{1}{4}$ the parameter (Def. 9 and Def. 1). Again, the angle HDE is equal to LDH (3), and therefore equal to DHE; consequently ED is equal to EH, or to twice EP (9): therefore D*d* is equal to 4EP, or to 4PF, that is, to the parameter of the diameter.

Prop. XI.

If any two diameters of a parabola be produced to meet a tangent to the curve; the segments of the diameters between their vertices and the tangent are to one another as the squares of the segments of the tangent intercepted between each diameter and the point of contact.



Let QH, RK, any two diameters, be produced to meet PI, a tangent to the curve at P, in the points G, I; then,

HG : KI = PG^2 : PI^2.

Parabola. Let PN, a semi-ordinate to the diameter HQ, meet KR in O, and let PR, a semi-ordinate to the diameter KO, meet HN in Q; from H draw parallels to NO and QR, meeting KR in L and M; thus HL is a tangent to the curve, and HM a semi-ordinate to KR.

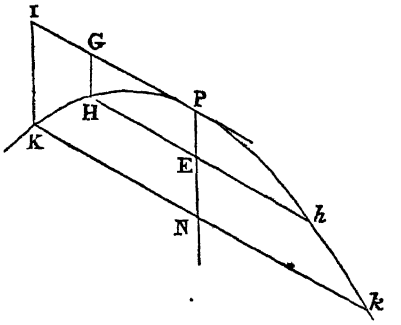
Now KI = KR, and KL = KM (9);
therefore, by subtraction, LI = MR = HQ.
But LO = HN = HG (9);
therefore, by addition, IO = GQ.

The triangles PGN, PIO, are similar, as also PGQ, PIR,

therefore GN, or 2GH : IO = PG : PI,
and GQ : IR, or IO : 2IK = PG : PI.

Hence, taking the rectangles of the corresponding terms,
2GH · IO : 2IO · IK = PG^2 : PI^2,
therefore GH : IK = PG^2 : PI^2.

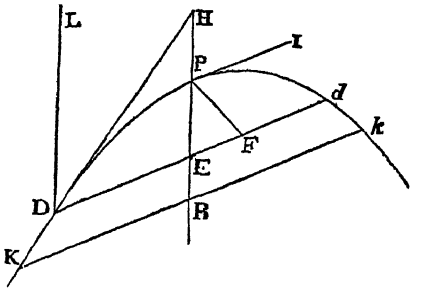
Cor. The squares of semi-ordinates, and of ordinates to any diameter, are to one another as their corresponding abscisses.



Let HE*h*, KN*k* be ordinates to the diameter PN; draw PG a tangent to the curve at the vertex of the diameter, and complete the parallelograms PEHG, PNKI; then PG, PI, are equal to EH, NK, and GH, IK, to PE, PN, respectively; therefore HE^2 : KN^2 = PE : PN.

Prop. XII.

If an ordinate be drawn to any diameter of a parabola; the rectangle under the abscis and the parameter of the diameter is equal to the square of the semi-ordinate.



Let KB*k* be an ordinate to the diameter PB; the rectangle contained by PB, and the parameter of the diameter is equal to the square of KB, the semi-ordinate.

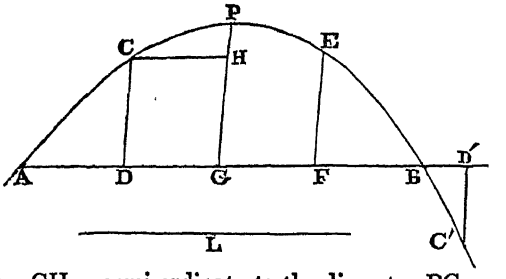
Let DE*d* be that ordinate to the diameter which passes through the focus. The semi-ordinates DE, E*d* are each half of the parameter, and the abscis EP is one fourth of the parameter (10);

therefore D*d* : DE = DE : PE,
and D*d* · PE = DE^2 (16, 6, E.).
But D*d* · PE : D*d* · PB, or PE : PB = DE^2 : KB^2 (Cor. 11);
therefore D*d* · PB = KB^2.

Scholium. It was on account of the equality of the square of the semi-ordinate to a rectangle contained by the parameter of the diameter and the abscis, that Apollonius called the curve line to which the property belonged a *Parabola*. Parabola.

Prop. XIII.

If AB, an ordinate to a diameter PG, is cut by any other diameter CD in D; the rectangle AD · DB contained by its segments is equal to the rectangle contained by CD, the segment of the diameter between its vertex and the ordinate, and the parameter of the diameter PG.



Draw CH, a semi-ordinate to the diameter PG, and let L be its parameter.

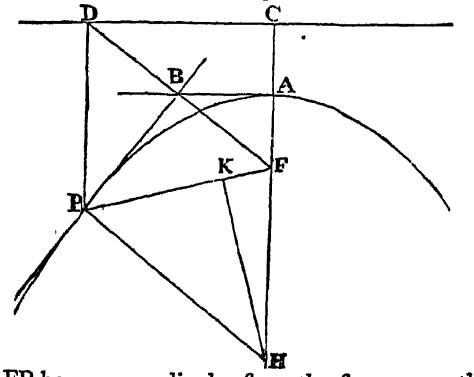
Because AG^2 = L · PG (12),
and DG^2 = CH^2 = L · PH,
therefore AG^2 — DG^2 = L (PG — PH),
that is (5 and 6, 2, E.), AD · DB = L · CD.

Cor. If a chord AB is cut by any two diameters CD, EF, the rectangles AD · DB, AF · FB, are to one another as CD, EF, the segments of the diameters between their vertices and the chord.

For since AD · DB = L · CD; and AF · FB = L · EF;
therefore AD · DB : AF · FB = L · CD : L · EF = CD : EF.

Prop. XIV.

A straight line drawn from the focus of a parabola, perpendicular to a tangent, is a mean proportional between the straight line drawn from the focus to the point of contact, and one fourth the parameter of the axis.



Let FB be a perpendicular from the focus upon the tangent PB, and FP a straight line drawn to the point of contact; let A be the principal vertex, and therefore FA equal to one fourth of the parameter of the axis; FB is a mean proportional between FP and FA.

Produce FB and FA to meet the directrix in D and C, and join AB. The lines FC, FD are bisected at A and B (2 Cor. 3), therefore (2, 6, E.) AB is parallel to CD, or perpendicular to CF, and consequently is a tangent to the curve at A (1 Cor. 3). Now BP is a tangent at P, therefore the angle AFB is equal to BFP (5); and since the angles FAB, FBP are right angles, the triangles FAB, FBP are equiangular; hence

FP : FB = FB : FA.

Cor. 1. The common intersection of a tangent, and a perpendicular from the focus to the tangent, is in a straight line touching the parabola at its vertex.

Parabola.

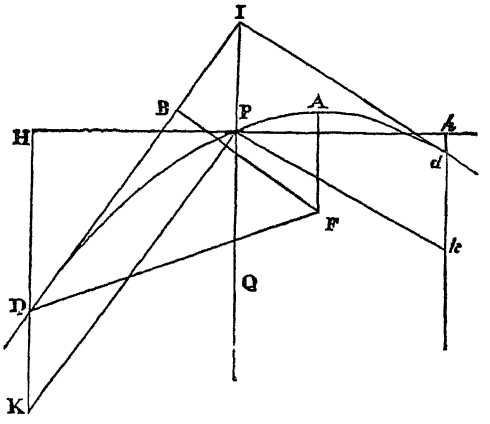
Cor. 2. If PH be drawn perpendicular to the tangent, meeting the axis in H, and HK be drawn perpendicular to PF; PK shall be equal to half the parameter of the axis. For the triangles HPK, FBP, are manifestly equiangular; therefore

$$HP : PK = PF : FB = FB : FA = FD : FC.$$

But if PD be joined, the line PD is evidently perpendicular to the directrix (3), therefore the figure HPDF is a parallelogram, and HP = FD, therefore PK = FC = half the parameter of the axis.

Prop. XV.

If from a point in a parabola a perpendicular be drawn to any diameter, and also, from the same point, an ordinate to that diameter: the square of the perpendicular is equal to the rectangle contained by the abscis of the diameter and the parameter of the axis.



Let P be a point in a parabola, DK any diameter, PH a perpendicular, and PK a semi-ordinate to that diameter; the square of PH is equal to the rectangle contained by DK and the parameter of the axis.

Let F be the focus, and FA the segment of the axis between the focus and vertex, and therefore one fourth of the parameter; join FD, draw DB touching the parabola at D, and FB a perpendicular from the focus on the tangent. The triangles PKH, FDB are similar, for the angle FDB is equal to BDH (3 Cor. 3), that is, to PKH (2 Cor. 8), and the angles at B and H are right angles, therefore their sides are proportionals,

$$\text{and } KP^2 : PH^2 = DF^2 : FB^2.$$

But since $DF : FB = FB : FA$ (14),

$$DF^2 : FB^2 = DF : FA \text{ (2 Cor. 20, E.)};$$

therefore $KP^2 : PH^2 = DF : FA = 4\ DF \cdot DK : 4\ FA \cdot DK$.

Now $KP^2 = 4\ DF \cdot DK$ (12), therefore $PH^2 = 4\ FA \cdot DK$.

Cor. 1. Hence, if two diameters DK, *dk*, on opposite sides of a third PQ, be at equal distances from it, semi-ordinates PK, P*k* to the other two, drawn from P the vertex of the middle diameter, will cut off equal abscisses DK, *dk*. For the perpendiculars PH, P*h*, on the two extreme diameters, are equal.

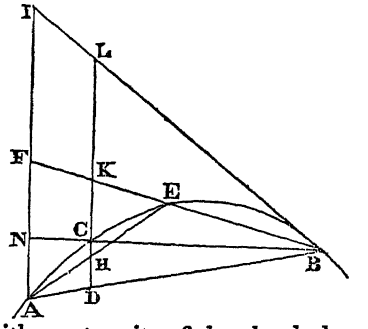
Cor. 2. And if tangents DI, *d*I, be drawn at the vertices of the extreme diameters, they will intersect each other in the middle diameter QP produced. For the tangents being parallel to the ordinates (8), each will cut off from PQ a segment PI equal to the abscis of the diameter at the point of contact; and the abscisses DK, *dk* being equal, the tangents will cut off equal segments from PQ, and therefore will pass through the same point I.

Cor. 3. And if two diameters be at equal distances from a third, on opposite sides, and chords be drawn from the vertex of the middle diameter to the vertices of the other two, tangents drawn parallel to the chords will intersect each other in the middle diameter produced. For the semi-ordinates PK, P*k*, are the halves of chords so drawn, and DI, *d*I are tangents parallel to these chords.

Parabola.

Prop. XVI.

Let CD, any diameter of a parabola whose vertex is C, intersect a chord AB in D; from the ends of the chord inflect straight lines AE, BE, to E, any point in the curve, and let these cut the diameter in H and K, the point H being in AE, and K in BE; the segments AD, BD of the chord shall have the same ratio as the segments CH, CK of the diameter between its vertex and the inflected lines.



From A, either extremity of the chord, draw AF parallel to the diameter CD, meeting BE in F.

By similar triangles, $BF : BK = BA : BD$,

$$\text{and } FE : KE = AF : HK;$$

therefore, taking the rectangles of corresponding terms of the ratios,

$$BF \cdot FE : BK \cdot KE = BA \cdot AF : BD \cdot HK.$$

But (13) $BF \cdot FE : BK \cdot KE = AF : KC = BA \cdot AF : BA \cdot KC$ (1, 6, E.);

$$\text{therefore } BD \cdot HK = BA \cdot KC;$$

$$\text{and hence } BA : BD = HK : KC;$$

$$\text{and, by division, } AD : BD = HC : KC.$$

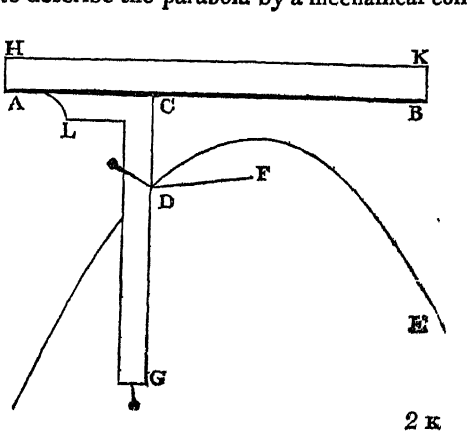
Cor. Let BA be any chord in a parabola, and BI a tangent to the curve at one extremity of the chord; let any straight line DCL parallel to the axis meet the chord in D, the curve in C, and the tangent in L; the chord AB and the line DL will be similarly divided at D and C, that is, AD : DB = DC : CL.

Draw chords to E, any point in the curve, and let them meet DL in H and K: by the proposition AD : DB = HC : CK.

Suppose now that the point E moves along the curve, until at last it come to B, the point of contact of the tangent; the line BK will then become BL, and AH will become AD, and the ratio of CH to CK will become the ratio of CD to CL; therefore AD : DB = CD : CL.

Prop. XVII. Problem.

The directrix and focus of a parabola being given by position, to describe the parabola by a mechanical construction.

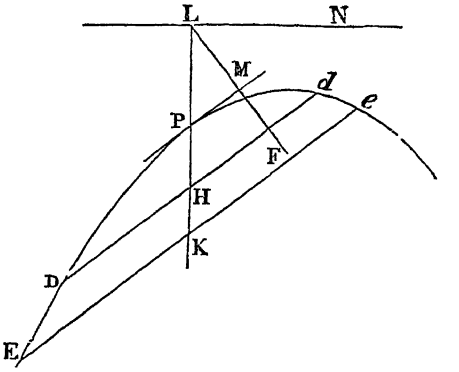


Ellipse.

Let AB be the given directrix, and F the focus. Place the edge of the ruler ABKH along the directrix, and keep it fixed in that position. Let LCG be another ruler of such a form that the side LC may slide along AB, the edge of the fixed ruler ABKH, and the part CG may have its edge CD constantly perpendicular to AB. Let GDF be a string of the same length as GC, the edge of the moveable ruler; let one end of the string be fixed at F, and the other fastened to G, a point in the moveable ruler. By means of the pin D let the string be stretched so that the part of it between G and D may be applied close to the edge of the moveable ruler, while at the same time the ruler slides along BA, the edge of the fixed ruler; the pin D will thus be constrained to move along CG, the edge of the ruler, and its point will trace upon the plane in which the directrix and focus are situated, a curve line DE, which is the parabola required. For the string GDF being equal in length to GDC, if GD be taken from both, there remains DF equal to DC; that is, the distance of the moving point D from the focus is equal to its distance from the directrix, therefore the point D describes a parabola.

PROP. XVIII. PROBLEM.

A parabola being given by position, to find its directrix and focus.

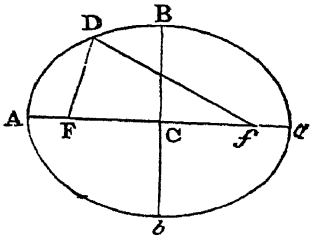


Ellipse.

Let DP*d* be the given parabola; draw any two parallel chords D*d*, E*e*, and bisect them at H and K; join KH, meeting the parabola in P; the straight line PHK is a diameter (4 Cor. 8), the point P is its vertex, and D*d*, E*e* are ordinates to it. In HP produced take PL equal to one fourth part of a third proportional to PH and HD, and draw LN perpendicular to PL, the line LN will evidently be the directrix (12, and Def. 9). Draw PM parallel to the ordinates to the diameter PK, then PM will be a tangent to the curve at P (2 Cor. 8). Draw LM perpendicular to PM, and take MF = ML, and the point F will be the focus of the parabola (3 Cor. 3).

PART II.—OF THE ELLIPSE.

DEFINITIONS.



I. If two points F and *f* be given in a plane, and a point D be conceived to move around them in such a manner that D*f* + DF, the sum of its distances from them, is always the same; the point D will describe upon the plane a line AB*ab*, which is called an *ellipse*.

II. The given points F, *f* are called the *foci* of the ellipse.

III. The point C which bisects the straight line between the foci is called the *centre*.

IV. The distance of either focus from the centre is called the *eccentricity*.

V. A straight line passing through the centre, and terminated both ways by the ellipse, is called a *diameter*.

VI. The extremities of a diameter are called its *vertices*.

VII. The diameter which passes through the foci is called the *transverse axis*, also the *greater axis*.

VIII. The diameter which is perpendicular to the transverse axis is called the *conjugate axis*, also the *lesser axis*.

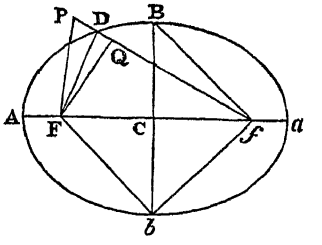
IX. Any straight line not passing through the centre, but terminated both ways by the ellipse, and bisected by a diameter, is called an *ordinate* to that diameter.

X. Each of the segments of a diameter intercepted between its vertices and an ordinate, is called an *absciss*.

XI. A straight line which meets the ellipse in one point only, and everywhere else falls without it, is said to *touch* the ellipse in that point, and is called a *tangent to the ellipse*.

PROP. I.

If from any point in an ellipse two straight lines be drawn to the foci, their sum is equal to the transverse axis.



Let AB*ab* be an ellipse, of which F, *f* are the foci, and A*a* the transverse axis; let D be any point in the curve, and DF, D*f* lines drawn to the foci; D*f* + DF = A*a*.

Because A, *a* are the points in the ellipse,

$$Af + AF = aF + af \text{ (Def. 1)},$$

therefore $Ff + 2AF = Ff + 2af$;

hence $2AF = 2af$, and $AF = af$,

and $Af + AF = Af + af = Aa$.

But D and A being points in the ellipse,

$$Df + DF = Af + AF,$$

therefore $Df + DF = Aa$.

COR. 1. The sum of two straight lines drawn from a point without the ellipse to the foci is greater than the transverse axis. And the sum of two straight lines drawn from a point within the ellipse to the foci is less than the transverse axis.

Let PF, P*f* be drawn from a point without the ellipse to the foci; let P*f* meet the ellipse in D; join FD; then P*f* + PF is greater than D*f* + DF (21, 1, E.), that is, than A*a*. Again, let QF, Q*f* be drawn from a point within the ellipse, let Q*f* meet the curve in D, and join FD; Q*f* + QF is less than D*f* + DF (21, 1, E.), that is, than A*a*.

COR. 2. A point is without or within the ellipse, according as the sum of two lines drawn from it to the foci is greater or less than the transverse axis.

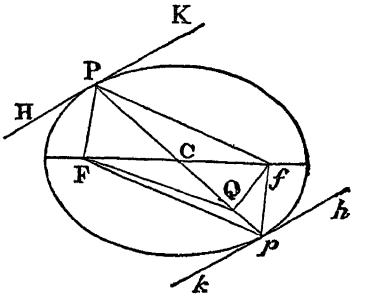
Cor. 3. The transverse axis is bisected in the centre. Let C be the centre, then CF=Cf (Def. 3), and FA=fa, therefore CA = Ca.

Cor. 4. The distance of either extremity of the conjugate axis from either of the foci is equal to half the transverse axis. Let Bb be the conjugate axis; join Fb, fb. Because CF = Cf, and Cb is common to the triangles CFb, Cfb, also the angles at C are right angles, these triangles are equal; hence Fb = fb, and since Fb + bf = Aa, Fb = AC.

Cor. 5. The conjugate axis is bisected in the centre. Join fb, fB. By the last corollary Bf = bf; therefore the angles fBC, fbC are equal; now fC is common to the triangles fCB, fCb, and the angles at C are right angles, therefore (26, 1, E.) CB = Cb.

Prop. II.

Every diameter of an ellipse is bisected in the centre.



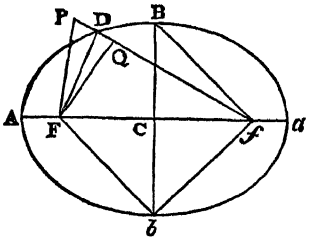
Let Pp be a diameter, it is bisected in C. For if Cp be not equal to CP, take CQ, equal to CP, and from the points P, p, Q, draw lines to F, f, the foci. The triangles FCP, fCQ having FC = Cf, PC = CQ, and the angles at C equal, are in all respects equal, therefore FP = fQ; in like manner it appears that fP = FQ, therefore FQ + fQ is equal to FP + fP, or (Def. 1) to Fp + fp, which is absurd (21, 1, E.); therefore CP = Cp.

Cor. 1. Every diameter meets the ellipse in two points only.

Cor. 2. Every diameter divides the ellipse into two parts, which are equal and similar, the like parts of the curve being at opposite extremities of the diameter.

Prop. III.

The square of half the conjugate axis of an ellipse is equal to the rectangle contained by the segments into which the transverse axis is divided by either focus.



Draw a straight line from f, either of the foci, to B, either of the extremities of the conjugate axis.

Then $BC^2 + Cf^2 = Bf^2 = Ca^2$ (4 Cor. 1).

But because Aa is bisected at C,

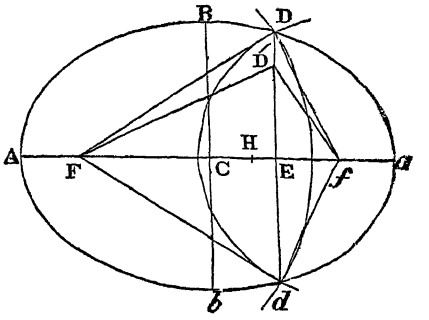
$$Ca^2 = Af \cdot fa + Cf^2;$$

therefore $BC^2 + Cf^2 = Af \cdot fa + Cf^2$,

and $BC^2 = Af \cdot fa$.

Prop. IV. Problem.

To find any number of points in an ellipse, having given the transverse axis and foci.



Let F, f be the foci, Aa the transverse axis, and C the centre. Suppose the problem resolved, and that D is a point in the ellipse; join DF, Df; take AH in the axis equal to DF; then aH will be equal to Df (1).

And HA — Ha = DF — Df;

But HA — Ha = HC + Ca — Ha = 2CH;

therefore DF — Df = 2CH.

Now DF < Ff + Df;

and hence DF — Df < Ff;

therefore 2CH < Ff and CH < Cf.

Thus it appears that the point H may be anywhere between the foci; but that it cannot be between the foci and the vertices.

Construction.—Take H, any point between the foci, and from F and f as centres, with the distances HA, Ha describe circles, which will cut each other in two points D, d, one on each side of the axis. These are points in the ellipse.

Join DF, Df, also dF, df. Because DF + Df = HA + Ha = Aa, therefore D is a point in the ellipse. In like manner, it appears that d is in the ellipse.

In this way, by taking different points H, may any number of points be found.

Cor. 1. Any perpendicular to the transverse axis between its extremities meets the ellipse in two points, and in no more. For, if the perpendicular Dd could meet the curve in two points D, D', on the same side of the axis, then DF, Df, also D'F, D'f, being drawn to the foci, DF + Df would be equal to D'F + D'f. Now, supposing D' to be the point nearer to the axis, DF will be greater than D'F, and Df greater than D'f (19, 1, E.), and DF + Df greater than D'F + D'f; therefore D and D' cannot both be points in the ellipse.

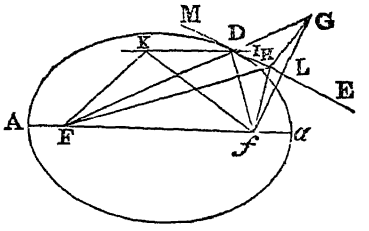
Cor. 2. Every chord Dd, in an ellipse, perpendicular to the transverse axis, is bisected by that axis, and therefore is an ordinate to it. For the chord Dd in the ellipse is also a chord in a circle, the centre of which is in the axis.

Cor. 3. Of all the straight lines that can be drawn from either focus to the curve, the longest is that which passes through the centre; and the shortest is the remainder of the transverse axis. And only two equal straight lines can be drawn from the focus to the curve, one on each side of the axis.

Scholium. From this proposition it appears that an ellipse is a curve, which returns into itself, thus inclosing a finite area; also, that the spaces between the curve and the axis on each side are alike in every way; so that if the ellipse were resolved into two portions, by cutting it along the axis, the space ABDa, if turned over, would coincide entirely with the space Abda. Now it has been shown that the same spaces will coincide if one of them be reversed (2 Cor. 2); and then the curve ABDa will coincide with adbA. Hence it follows that the two axes divide the whole ellipse into four portions exactly alike; and which, by superposition, may be applied on each other,

PROP. V.

The straight line which bisects the angle adjacent to that which is contained by two straight lines drawn from any point in the ellipse to the foci, is a tangent to the curve in that point.



Let D be any point in the curve; let DF, Df be straight lines drawn to the foci; the straight line DE which bisects the angle fDG adjacent to fDF, is a tangent to the curve at D.

Take H any other point in DE; take DG = Df, and join Hf, HF, HG, fG; let fG meet DE in L. Because Df = DG, and DL is common to the triangles DfL, DGL, and the angles fDL, GDL are equal, these triangles are equal, and fL = LG, and hence fH = HG (4, 1, E.), and FH + fH = FH + HG; but FH + HG is greater than FG, that is, greater than FD + fD or Aa, therefore FH + fH is greater than Aa; hence the point H is without the ellipse (2 Cor. 1); and therefore **DHE** is a tangent to the curve at D (Def. 11).

COR. 1. There cannot be more than one tangent at the same point; for D is such a point in the line DE, that the sum of DF, Df, the distances of that point from the foci, is evidently less than the sum of HF, Hf, the distances of H, any other point in that line; and if another line KDI be drawn through D, there is in like manner a point K in that line which will be different from D, such, that the sum of FK, fK is less than the sum of the distances of any other point in KI, and therefore less than FD + fD; therefore the point K will be within the ellipse (2 Cor. 1), and the line KI will cut the curve.

COR. 2. A perpendicular to the transverse axis at either of its extremities is a tangent to the curve. The demonstration is the same as for the proposition, if it be considered that when D falls at either extremity of the axis, the point L falls also at the extremity of the axis; and thus the tangent DE, which is always perpendicular to fL, is perpendicular to the axis.

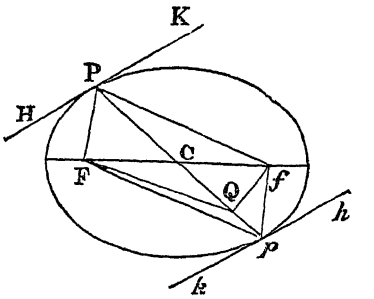
COR. 3. A perpendicular to the conjugate axis at either of its extremities is a tangent to the curve. For the perpendicular evidently bisects the angle adjacent to that which is contained by lines drawn from the extremity to the foci.

COR. 4. A tangent to the ellipse makes equal angles with straight lines drawn from the point of contact to the foci. For the angle fDE being equal to GDE, is also equal to FDM, which is vertical to GDE.

SCHOLIUM. From the property of the ellipse which forms this last corollary, the points F and f take the name of *Foci*. For writers on optics show that if a polished concave surface be formed, whose figure is that produced by the revolution of an ellipse about its transverse axis, rays of light which flow from one focus, and fall upon that surface, are reflected to the other focus; so that if a luminous point be placed in one focus, there is formed by reflection an image of it in the other focus.

PROP. VI.

The tangents at the vertices of any diameter of an ellipse are parallel.



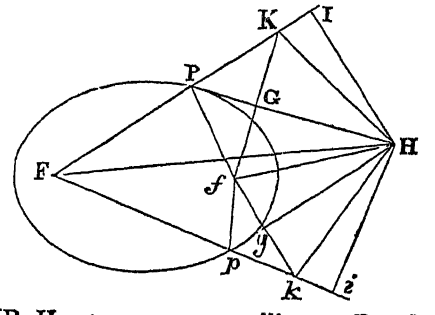
Let Pp be a diameter, and HPK, hpk tangents at its vertices; draw straight lines from P and p to F and f the foci. The triangles FCP, fCp, having FC = fC, CP = Cp (2), and the angles at C equal, are in all respects equal; and because the angle FPC is equal to Cpf, FP is parallel to fp (27, 1, E.); therefore Pf is equal and parallel to pF (33, 1, E.), thus FPfp is a parallelogram, of which the opposite angles P and p are equal (34, 1, E.). Now the angles FPH, fph are evidently half the supplements of these angles (4 Cor. 5), therefore the angles FPH, fph, are equal, and hence CPH, Cph are also equal, and consequently HP is parallel to hp.

COR. 1. If tangents be drawn to an ellipse at the vertices of a diameter; straight lines drawn from either focus to the points of contact make equal angles with these tangents. For the angle Fpk is equal to FPH.

COR. 2. The axes of an ellipse are the only diameters which are perpendicular to tangents at their vertices. For let Pp be any other diameter, then PF and pF are necessarily unequal, and therefore the angles FpP, FPp are also unequal; to these add the equal angles Fpk, FPH, and the angles Cpk, CPH are unequal; therefore neither of them can be a right angle (29, 1, E.).

PROP. VII.

If a straight line be drawn from either focus of an ellipse to the intersection of two tangents to the curve; it will make equal angles with straight lines drawn from the same focus to the points of contact.



Let HP, Hp, tangents to an ellipse at P and p, intersect each other at H; draw PF, pF, HF to F, either of the foci; the line HF makes equal angles with FP, Fp.

Draw Pf, pf, Hf, to f the other focus, and in FP, Fp produced take PK = Pf and pk = pf; join HK, Hk, and draw fK, fk, meeting the tangents in G and g.

The triangles HPK, HPf have PK = Pf, **PH** common to both, and the angles KPH, fPH equal **(5)**, therefore they are in every way equal (4, 1, E.), and have HK = Hf. In the same way it may be shown that the triangles Hpk, Hpf are in every way equal, and therefore that Hk = Hf.

The triangles HFK, HFk have HK = Hk (for each is equal to Hf), HF common to both, and FK = Fk, because each is equal to PF + Pf or pF + pf, that is, to the trans-

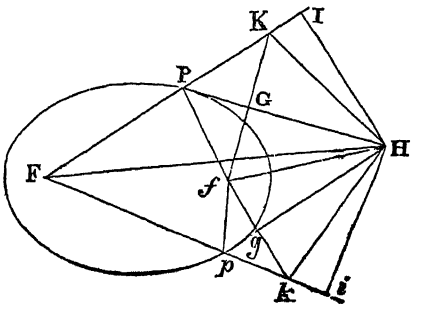
verse axis; therefore they are in all respects equal, and the angle HFK is equal to the angle HFk; wherefore HF makes equal angles with FP and Fp.

Cor. Perpendiculars drawn from the intersection of two tangents to straight lines drawn from either focus through the points of contact are equal.

Let HI, Hi be perpendiculars drawn from H, the intersection of the tangents PH, pH on the lines FP, Fp. The triangles HFI, HFi are in all respects equal (26, 1, E.), therefore HI = Hi.

Prop. VIII.

Straight lines drawn from the intersection of two tangents to the foci, make equal angles with the tangents.



Let F, f be the foci of an ellipse, and let straight lines HP, Hp, which intersect each other at H, touch the ellipse at P and p, also let HF, Hf be lines drawn to the foci; the angles PHF, pHf are equal.

The same construction being made as in Prop. VII., because the angles FHK, FHk are equal,

$$\text{and FHK} \begin{cases} = \text{FHP} + \text{PHK} \\ = \text{FHP} + \text{PH}f \\ = 2\text{FHP} + \text{FH}f, \end{cases}$$

and in like manner,

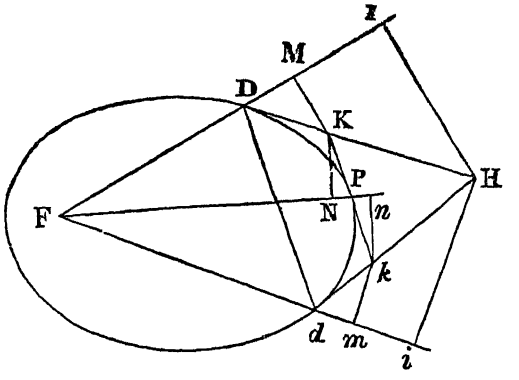
$$\text{FH}k \begin{cases} = \text{FH}p + p\text{H}k \\ = \text{FH}p + p\text{H}f \\ = 2f\text{H}p + \text{FH}f, \end{cases}$$

therefore $2\text{FHP} + \text{FH}f = 2f\text{H}p + \text{FH}f$,

and hence $2\text{FHP} = 2f\text{H}p$, and $\text{FHP} = f\text{H}p$.

Prop. IX.

If two tangents to an ellipse be at the extremities of a chord, and a third tangent be parallel to the chord; the part of this tangent intercepted by the other two is bisected at the point of contact.



Let HD, Hd be tangents at the extremities of the chord Dd, and KPk a tangent parallel to Dd, meeting the other tangents in K and k; the intercepted segment Kk is bisected at P, the point of contact.

From the points of contact D, P, d, draw lines to F, either of the foci, and from H, K, k, the intersections of the tangents, draw perpendiculars to the lines drawn from the points of contact to the foci, viz. HI, Hi perpendicular to DF, dF; and KM, KN perpendicular to FD, FP; and km, kn perpendicular to Fd, FP.

The triangles DHI, DKM are manifestly equiangular, also the triangles dHi, dkm;

therefore DH : DK = HI : KM (4, 6, E.),

and dH : dk = Hi : km;

but because Dd is parallel to Kk, a side of the triangle HKk,

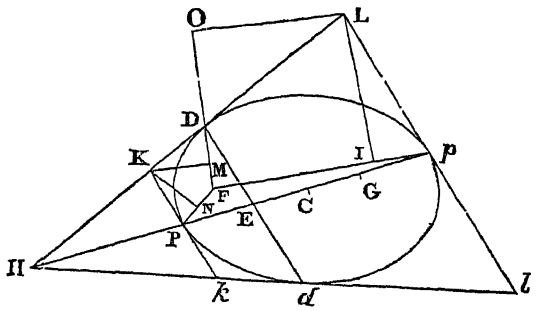
DH : DK = dH : dk (2, 6, E.),

therefore HI : KM = Hi : km.

Now HI = Hi (Cor. 7), therefore KM = km; but KM = KN and km = kn (Cor. 7), therefore KN = kn; and since from the similar triangles KPN, kPn, KN : kn = KP, kP, therefore KP is equal to kP.

Prop. X.

Any chord not passing through the centre, but parallel to a tangent, is bisected by the diameter that passes through the point of contact; or it is an ordinate to that diameter.



The chord DEd, which is parallel to Kk, a tangent at P, is bisected at E by the diameter PCp.

Draw Lpl, a tangent at p, the other end of the diameter, and DH, dH, tangents at D and d, the extremities of the chord, meeting the other tangents in K, k, and L, l: Then KPk and Lpl are bisected at P and p (9); therefore the diameter Pp, when produced, will pass through H, and bisect Dd, which is parallel to Kk or Ll, in E. (Lemma to Prop. 8, Part I.)

Cor. 1. Straight lines which touch an ellipse in the extremities of an ordinate to any diameter, intersect each other in that diameter.

Cor. 2. Every ordinate to a diameter is parallel to a tangent at its vertex: for if not, let a tangent be drawn parallel to the ordinate; then the diameter drawn through the point of contact would bisect the ordinate; and thus the same line would be bisected in two different points, which is absurd.

Cor. 3. All the ordinates to the same diameter are parallel to each other.

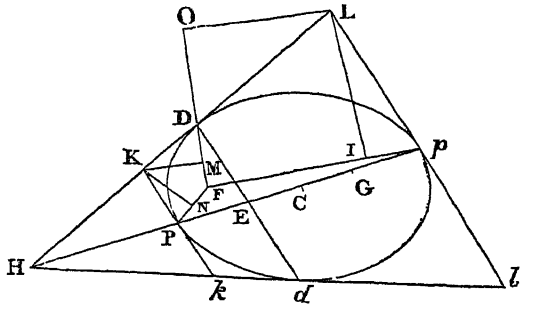
Cor. 4. A straight line that bisects two parallel chords, and terminates in the curve, is a diameter.

Cor. 5. The ordinates to either axis are perpendicular to that axis: and no other diameter is perpendicular to its ordinates.

Prop. XI.

If a tangent to an ellipse meet a diameter, and from the point of contact an ordinate be drawn to that diameter; the semidiameter will be a mean proportional between the segments of the diameter intercepted between the centre and the ordinate, and between the centre and the tangent.

Ellipse.



Let DH, a tangent to the ellipse at D, meet the diameter Pp produced in H, and let DEd be an ordinate to that diameter; CE : CP = CP : CH.

Through P and p, the vertices of the diameter, draw the tangents PK, pL, meeting DH in K and L; draw PF, pF, to either of the foci; join FD, and draw KM and KN perpendicular to FD and FP, also LO and LI perpendicular to FD and Fp.

The triangles PKN, pLI, are equiangular; for the angles at N and I are right angles, and the angles NPK, IpL are equal (1 Cor. 6); therefore

PK : pL = KN : LI (4, 6, E.) = KM : LO (Cor. 7).

But the triangles KDM, LDO, being manifestly equiangular,

KM : LO = KD : LD;

therefore PK : pL = KD : LD.

But because of the parallel lines PK, ED, pL, the triangles HPK, HpL, are equiangular; and the lines HL, Hp, are similarly divided in K, D, and in P, E (10, 6, E.), hence

PK : pL = HP : Hp, and KD : LD = PE : pE;

therefore HP : Hp = PE : pE.

Take CG = CE, and then PE = pG, and by conversion

HP : Pp = PE : EG;

and taking the halves of the consequents,

HP : PC = PE : EC;

and by composition, HC : PC = PC : EC.

Cor. 1. The rectangle PE · Ep is equal to the rectangle HE · EC.

For PC² = HC · CE (17, 6, E.)

= HE · EC + EC² (3, 2, E.);

also PC² = PE · Ep + EC² (5, 2, E.);

therefore HE · EC = PE · Ep.

Cor. 2. The rectangle PH · Hp is equal to the rectangle EH · HC.

For HC² = PH · Hp + CP² (6, 2, E.);

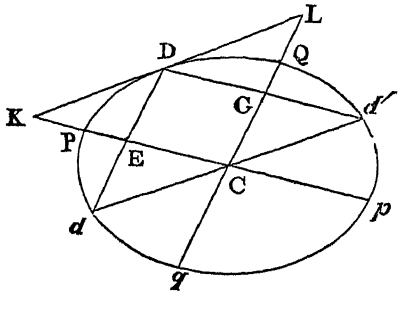
and HC² = EH · HC + EC · HC (1, 2, E.),

= EH · HC + CP² (by the Prop.);

therefore PH · Hp = EH · HC.

Prop. XII.

If a diameter of an ellipse be parallel to the ordinates to another diameter; the latter diameter is parallel to the ordinates to the former.



Let Qq, a diameter of an ellipse, be parallel to DEd, any ordinate to the diameter Pp; the diameter Pp shall be parallel to the ordinates to the diameter Qq.

Ellipse.

Draw the diameter dCd' through one extremity of the ordinate Dd, and join d' and D, the other extremity of the ordinate, meeting Qq in G. Because dd' is bisected in C (2) and CG is parallel to dD, the line Dd' is bisected at G (2, 6, E.); therefore Dd' is an ordinate to the diameter Qq (Def. 9), and because dd' and Dd are bisected at C and E, the diameter Pp is parallel to Dd' (2, 6, E.); therefore Pp is parallel to any ordinate to the diameter Qq.

Definitions.

XII. Two diameters are said to be *conjugate* to one another when each is parallel to the ordinates to the other diameter.

Cor. Diameters which are conjugate to one another are parallel to tangents at the vertices of each other.

XIII. A third proportional to any diameter and its conjugate is called the *Parameter*, also the *Latus Rectum of that diameter*.

Prop. XIII.

If an ordinate be drawn to any diameter of an ellipse; the rectangle contained by the segments of the diameter will be to the square of the semi-ordinate as the square of the diameter to the square of its conjugate.

(See Figure to Prop. XII.)

Let DEd be an ordinate to the diameter Pp, and let Qq be its conjugate,

PE · Ep : DE² = Pp² : Qq².

Let KDL, a tangent at D, meet the diameter in K, and its conjugate in L; draw DG parallel to Pp, meeting Qq in G. Because CP is a mean proportional between CE and CK (11),

CP² : CE² = CK : CE (2 Cor. 20, 6, E.),

and, by division, CP² : PE · Ep = CK : KE.

But because ED is parallel to CL,

CK : KE = CL : DE or CG,

and because CQ is a mean proportional between CG and CL (11),

CL : CG = CQ² : CG² or ED² (2 Cor. 20, 6, E.),

therefore CP² : PE · Ep = CQ² : DE²,

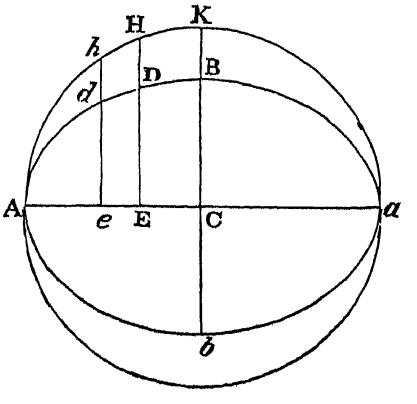
and, by inversion and alternation,

PE · Ep : DE² = CP² : CQ² = Pp² : Qq².

Cor. 1. The squares of semi-ordinates and of ordinates to any diameter of an ellipse are to one another as the rectangles contained by the corresponding abscisses.

Cor. 2. The ordinates to any diameter, which intercept equal segments of that diameter from the centre, are equal to one another; and, conversely, equal ordinates intercept equal segments of the diameter from the centre.

Cor. 3. If a circle be described upon Aa, either of the axes of an ellipse, as a diameter, and DE, de, any two semi-ordinates to the axes, meet the circle in H and h, DE shall be to de as HE to he.



Ellipse.

For $DE^2 : de^2 = AE \cdot Ea : Ae \cdot ea = HE^2 : he^2$,
therefore $DE : de = HE : he$.

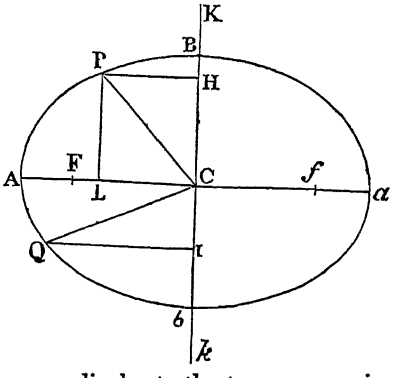
Cor. 4. If a circle be described on Aa the transverse axis as a diameter, and DE, any ordinate to the axis, be produced to meet the circle in H; HE shall be to DE as the transverse axis Aa to the conjugate axis $B\beta$. For, produce the conjugate axis to meet the circle in K, then, by last corollary,

$HE : DE = KC$, or $AC : BC = Aa : B\beta$.

Cor. 5. And if HE be divided at D, so that HE is to DE as the transverse axis to the conjugate axis, D is a point in the ellipse, and DE a semi-ordinate to the axis Aa.

Prop. XIV.

In $B\beta$, the conjugate axis of an ellipse, let there be taken on each side of the centre C, straight lines CK, Ck, each a fourth proportional to CF, the eccentricity, and CA, CB, half the transverse and conjugate axes: If then from P, a vertex of any diameter, there be drawn PH perpendicular to $B\beta$; the square of the semi-diameter PC will have to the rectangle contained by the segments KH, kH, the constant ratio of the square of CF to the square of CB.



Draw PL perpendicular to the transverse axis.

Because (13 of this, and 5, 2, E.)

$CA^2 : CB^2 = CA^2 - CL^2 : PL^2$,

and, by division,

$CA^2 - CB^2 : CB^2 = CA^2 - (CL^2 + PL^2) : PL^2$;

therefore (4 Cor. 1, and 47, 1, E.)

$CF^2 : CB^2 = CA^2 - PC^2 : PL^2$ or CH^2.

But, by hypothesis, $CF^2 : CB^2 = CA^2 : CK^2$;

therefore $CA^2 : CK^2 = CA^2 - PC^2 : CH^2$,

and hence (19, 5, E.)

$PC^2 : CK^2 - CH^2 = CA^2 : CK^2$,

and (5, 2, E.)

$PC^2 : KH \cdot Hk = CA^2 : CK^2 = CF^2 : CB^2$.

Cor. 1. Hence the squares of any semidiameters PC, QC, are to one another as the rectangles $KH \cdot Hk$, $KI \cdot Ik$, contained by the segments of the line Kk, between its extremities, and perpendiculars from the vertices of the diameters.

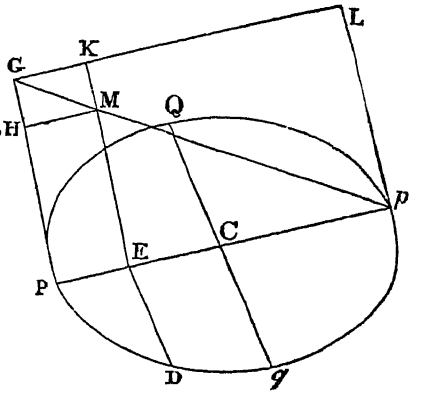
Cor. 2. The transverse axis is the greatest diameter, and the conjugate axis the least; and a diameter which is nearer to the transverse axis is greater than one more remote.

By hypothesis $CF : CA = CB : CK$, therefore CK is greater than CB, and the points K, k, are without the ellipse: Suppose now a semidiameter PC to turn about C, and that in every position PH is perpendicular to Kk: The rectangle $KH \cdot Hk$ will manifestly be greatest when PC coincides with AC, and least when it coincides with BC, and will decrease continually while PC passes from the position AC to BC; therefore the same will be true of the revolving semidiameter PC, which has a constant ratio to the rectangle $KH \cdot Hk$.

Cor. 3. Diameters which make equal angles with the transverse axis on opposite sides of it are equal; and only two equal diameters can be drawn, one on each side of the transverse axis. Ellipse.

Prop. XV.

If an ordinate be drawn to any diameter of an ellipse, the rectangle under the abscisses of the diameter is to the square of the semi-ordinate as the diameter to its parameter.



Let DE be a semi-ordinate to the diameter Pp, let PG be the parameter of the diameter, and Qq the conjugate diameter. By the definition of the parameter (Def. 13),

$Pp : Qq = Qq : PG$,

therefore $Pp : PG = Pp^2 : Qq^2$ (2 Cor. 20, 6, E.).

But $Pp^2 : Qq^2 = PE \cdot Ep : DE^2$ (13);

therefore $PE \cdot Ep : DE^2 = Pp : PG$.

Cor. Let the parameter PG be perpendicular to the diameter Pp; join pG, and from E draw EM parallel to PG, meeting pG in M. The square of DE, the semi-ordinate, is equal to the rectangle contained by PE and EM.

For $PE \cdot Ep : DE^2 = Pp : PG$,

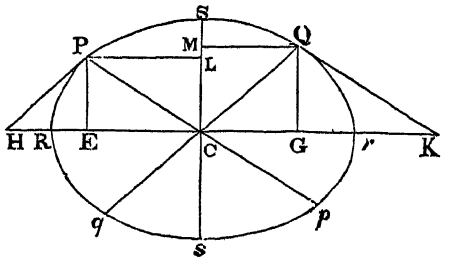
and $Pp : PG :: Ep : EM = PE \cdot Ep : PE \cdot EM$,

therefore $DE^2 = PE \cdot EM$.

Scholium. If the rectangles $PGL\not{p}$, HGKM, be completed, it will appear that the square of ED is equal to the rectangle MP, which rectangle is less than the rectangle KP, contained by the abscis PE and parameter PG, by a rectangle KH similar and similarly situated to LP, the rectangle contained by the diameter and parameter. It was on account of the deficiency of the square of the ordinate from the rectangle contained by the abscis and parameter that Apollonius called the curve line to which the property belonged an ellipse.

Prop. XVI.

If from the vertices of two conjugate diameters of an ellipse there be drawn ordinates to any third diameter; the square of the segment of that diameter intercepted between either ordinate and the centre is equal to the rectangle contained by the segments between the other ordinate and the vertices of the same diameter.



Ellipse.

Let Pp, Qq be two conjugate diameters, and PE, QG semi-ordinates to any third diameter Rr; $CG^2 = RE \cdot Er$, and $CE^2 = RG \cdot Gr$.

Draw the tangents PH, QK meeting Rr in H and K. The rectangles $HC \cdot CE$ and $KC \cdot CG$ are equal, for each is equal to CR^2 (11), therefore

$$HC : CK = CG : CE.$$

But the triangles HPC, CQK are evidently similar (Cor. Def. 12), and PE being parallel to QG, their bases CH, KC are similarly divided at E and G, therefore

$$HC : CK = HE : CG,$$

wherefore $CG : CE = HE : CG$, consequently $CG^2 = CE \cdot EH = (1\text{ Cor. }11)\ RE \cdot Er$. In like manner it may be shown that $CE^2 = RG \cdot Gr$.

Cor. 1. Let Ss be the diameter that is conjugate to Rr, then Rr is to Ss as CG to PE, or as CE to QG.

For $Rr^2 : Ss^2 = RE \cdot Er$, or $CG^2 : PE^2$;

therefore $Rr : Ss :: CG : PE$.

In like manner $Rr : Ss :: CE : QG$.

Cor. 2. The sum of the squares of CE, CG, the segments of the diameter to which the semi-ordinates PE, QG are drawn, is equal to the square of CR the semidiameter.

For $CE^2 + CG^2 = CE^2 + RE \cdot Er = CR^2$ (5, 2, E.)

Cor. 3. The sum of the squares of any two conjugate diameters is equal to the sum of the squares of the axes.

Let Rr, Ss be the axes, and Pp, Qq any two conjugate diameters; draw PE, QG perpendicular to Rr, and PL, QM perpendicular to Ss. Then

$$CE^2 + CG^2 = CR^2,$$

and $CM^2 + CL^2$, or $GQ^2 + PE^2 = CS^2$,

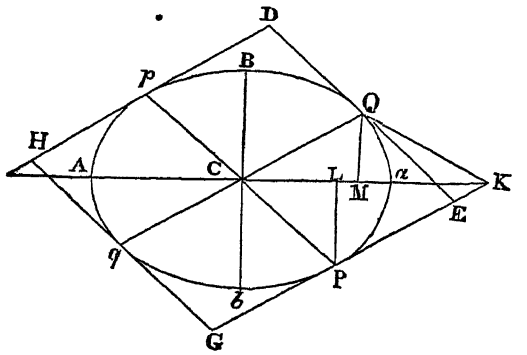
therefore $CE^2 + PE^2 + CG^2 + GQ^2 = CR^2 + CS^2$;

that is, (47, 1, E.) $CP^2 + CQ^2 = CR^2 + CS^2$,

therefore $Pp^2 + Qq^2 = Rr^2 + Ss^2$.

Prop. XVII.

If four straight lines be drawn touching an ellipse at the vertices of any two conjugate diameters; the parallelogram formed by these lines is equal to the rectangle contained by the transverse and conjugate axes.



Let Pp, Qq be any two conjugate diameters; a parallelogram DEGH formed by tangents to the curve at their vertices is equal to the rectangle contained by Aa, Bb, the two axes.

Produce Aa, one of the axes, to meet the tangent PE in K; join QK, and draw PL, QM perpendicular to Aa.

Because $CK : CA = CA : CL$ (11),

and $CA : CB = CL : QM$ (1 Cor. 16),

ex æq. $CK : CB = CA : QM$,

therefore $CK \cdot QM = CB \cdot CA$ (16, 6, E.).

But $CK \cdot QM$ = twice trian. CKQ = paral. CPEQ (41, 1, E.),

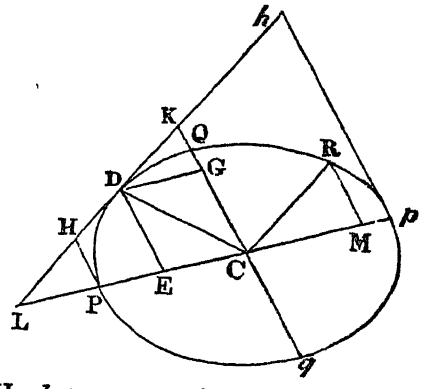
therefore the parallelogram $CPEQ = CB \cdot CA$,

and taking the quadruples of these, the parallelogram DEGH is equal to the rectangle contained by Aa and Bb.

Prop. XVIII.

Ellipse.

If two tangents at the vertices of any diameter of an ellipse meet a third tangent; the rectangle contained by their segments between the points of contact and the points of intersection is equal to the square of the semidiameter to which they are parallel. And the rectangle contained by the segments of the third tangent between its point of contact and the parallel tangents is equal to the square of the semidiameter to which it is parallel.



Let PH, ph, tangents at the vertices of a diameter Pp, meet HDh, a tangent to the curve at any point D, in H and h: let CQ be the semidiameter to which the tangents PH, ph are parallel, and CR that to which Hh is parallel;

$$PH \cdot ph = CQ^2, \text{ and } DH \cdot Dh = CR^2.$$

If the tangent HDh be parallel to Pp, the proposition is manifest. If it be not parallel, let it meet the semidiameters CP, CQ, in L and K. Draw DE, RM parallel to CQ, and DG parallel to CP.

Because $LP \cdot Lp = LE \cdot LC$ (2 Cor. 11),

$$LP : LE = LC : Lp;$$

hence, and because of the parallels PH, ED, CK, ph,

$$PH : ED = CK : ph,$$

wherefore $PH \cdot ph = ED \cdot CK$.

But $ED \cdot CK = CG \cdot CK = CQ^2$ (11),

therefore $PH \cdot ph = CQ^2$.

Again, the triangles LED, CMR are evidently similar, and LE, LD similarly divided at H and P, also at h and p,

therefore $PE : HD = (LE : LD =)\ CM : CR$,

also $pE : hD = (LE : LD =)\ CM : CR$;

hence, taking the rectangles of the corresponding terms,

$PE \cdot pE : HD \cdot hD :: CM^2 : CR^2$ (3 Cor. 20, 6, E.)

But if CD be joined, the points D and R are evidently the vertices of two conjugate diameters (Cor. Def. 12), and therefore $PE \cdot pE = CM^2$ (16);

therefore $HD \cdot hD = CR^2$.

Cor. The rectangle contained by LD and DK, the segments of a tangent intercepted between D, the point of contact, and Pp, Qq, any two conjugate diameters, is equal to the square of CR, the semidiameter to which the tangent is parallel.

Let the parallel tangents PH, ph meet LK in H and h, and draw DE a semi-ordinate to Pp. Because of the parallels PH, ED, CK, ph,

$$LE : LD = EP : DH,$$

and $EC : DK :: Ep : Dh$;

therefore $LE \cdot EC : LD \cdot DK :: EP \cdot Ep : DH \cdot Dh$.

But $LE \cdot EC = EP \cdot Ep$ (1 Cor. 11),

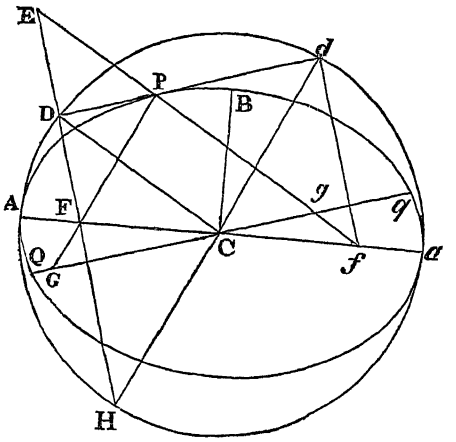
therefore $LD \cdot DK = DH \cdot Dh =$ (by this Prop.) CR^2.

Prop. XIX.

If two straight lines be drawn from the foci of an ellipse perpendicular to a tangent; straight lines drawn from

Ellipse.

the centre to the points in which they meet the tangent will each be equal to half the transverse axis.



Let DP*d* be a tangent to the curve at P, and FD, *fd* perpendiculars to the tangent from the foci; the straight lines joining the points C, D, and C, *d*, are each equal to AC, half the transverse axis.

Join FP, *f*P, and produce FD, *f*P till they intersect in E. The triangles FDP, EDP have the angles at D right angles, and the angles FPD, EPD equal (5), and the side DP common to both; they are therefore equal, and consequently have ED = DF, and EP = PF, therefore E*f* = FP + P*f* = A*a*. Now the straight lines FE, F*f*, being bisected at D and C, the line DC is parallel to E*f*, and thus the triangles F*f*E, FCD are similar;

therefore F*f* : *f*E or A*a* = FC : CD.

But FC is half of F*f*, therefore CD is half of A*a*. In like manner it may be shown that C*d* is half of A*a*.

Cor. If the diameter *Qq* be drawn parallel to the tangent D*d*, it will cut off from PF, P*f* the segments PG, P*g*, each equal to AC half the transverse axis. For C*d*PG, CDP*g*, are parallelograms, therefore PG = *d*C = AC, and P*g* = DC = AC.

Prop. XX.

The rectangle contained by perpendiculars drawn from the foci of an ellipse to a tangent is equal to the square of half the conjugate axis.

(See Figure to Prop. XIX.)

Let DP*d* be a tangent, and FD, *fd*, perpendiculars from the foci; the rectangle contained by FD and *fd* is equal to the square of CB half the conjugate axis.

It is evident from the last proposition that the points D, *d* are in the circumference of a circle whose centre is the centre of the ellipse, and radius CA half the transverse axis; now FD*d* being a right angle, if *d*C be joined, the lines DF, *d*C, when produced, will meet at H, a point in the circumference; and since FC=*f*C, and CH=C*d*, and the angles FCH, *f*C*d* are equal, FH is equal to *fd*; therefore

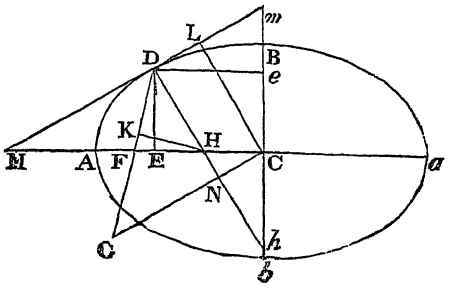
DF · *df*=DF · FH=AF · F*a* (35, 3, E.)=CB² (3).

Cor. If PF, P*f* be drawn from the point of contact to the foci, the square of FD is a fourth proportional to *f*P, FP and BC². For the lines *f*P, FP make equal angles with the tangent (4 Cor. 5), and *fd*P, FDP are right angles, therefore the triangles *f*P*d*, FPD are similar, and

*f*P : FP = *fd* : FD = *fd* · FD or CB² : FD².

Prop. XXI.

If from C the centre of an ellipse a straight line CL be drawn perpendicular to a tangent LD, and from D the point of contact a perpendicular be drawn to the tangent, meeting the transverse axis in H and the conjugate axis in *h*; the rectangle contained by CL and DH is equal to the square of CB, the semi-conjugate axis; and the rectangle contained by CL and D*h* is equal to the square of CA, the semi-transverse axis. Ellipse.



Produce the axes to meet the tangent in M and *m*, and from D draw the semi-ordinates DE, D*e*, which will be perpendicular to the axes.

The triangles DEH, CL*m* are evidently equiangular, therefore

DH : DE = C*m* : CL;

hence CL · DH=DE · C*m*.

But DE · C*m*, or C*e* · C*m*=BC² (11),

therefore CL · DH=BC².

In the same way it is shown that CL · D*h*=AC².

Cor. 1. If a perpendicular be drawn to a tangent at the point of contact, the segments intercepted between the point of contact and the axes are to each other reciprocally as the squares of the axes by which they are terminated.

For AC² : BC² : : CL · D*h* : CL · DH : : D*h* : DH.

Cor. 2. If DF be drawn to either focus, and HK be drawn perpendicular to DF, the straight line DK shall be equal to half the parameter of the transverse axis.

Draw CG parallel to the tangent at D, meeting DH in N, and DF in G. The triangles GDN, HDK are similar, therefore

GD : DN = HD : DK,

and hence GD · DK = HD · DN.

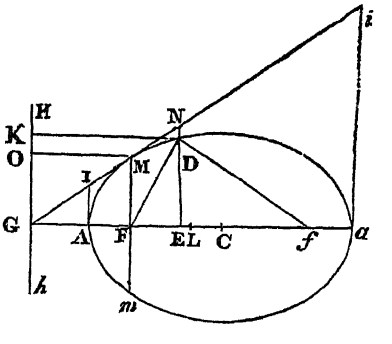
But GD = AC (Cor. 19), and ND = CL,

therefore AC · DK = HD · CL = (by the Prop.) CB²;

wherefore AC : BC = BC : DK;

hence DK is half the parameter of A*a* (Def. 13).

Definition.



XIV. If a point G be taken in the transverse axis of an ellipse produced, so that the distance of G from the centre may be a third proportional to CF the eccentricity, and CA the semi-transverse axis; a straight line HG*h*, drawn through G perpendicular to the axis, is called the *directrix of the ellipse.*

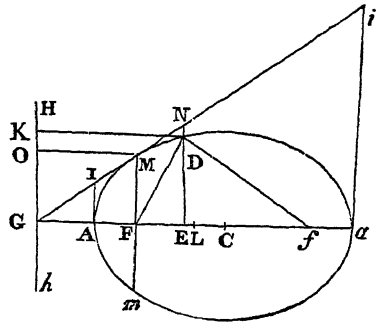
Cor. 1. If MF*m*, an ordinate to the axis, be drawn through the focus; tangents to the ellipse at the extremities of the ordinate will meet the axis at the point G (11).

Ellipse.

Cor. 2. The ellipse has two directrices, for the point G may be taken on either side of the centre.

Prop. XXII.

The distance of any point in an ellipse from either directrix is to its distance from the focus nearest that directrix in the constant ratio of the semitransverse axis to the eccentricity.



Let D be any point in the ellipse, let DK be drawn perpendicular to the directrix, and let DF be drawn to the focus nearest the directrix; DK is to DF as CA, half the transverse axis, to CF, the eccentricity.

Draw Df to the other focus, and DE perpendicular to Aa; take L a point in the axis, so that AL = FD, and consequently La = Df; then CL is evidently half the difference between AL and aL, or FD and fD, and CE half the difference between fE and FE; and because Df + DF : fF = fE — FE : Df — DF (K, and 16 of 6, E.).

By taking the halves of the terms of the proportion,

CA : CF = CE : CL.

But CA : CF = CG : CA (Def. 14),

therefore CG : CA = CE : CL;

hence (19, 5, E.) EG : AL = CG : CA = CA : CF,

that is, DK : DF = CA : CF.

Cor. 1. If the tangent GMN be drawn through M, the extremity of the ordinate passing through the focus, and ED be produced to meet GM in N, EN shall be equal to DF. For draw MO perpendicular to the directrix, then, because M and D are points in the ellipse,

FM : FD = MO : DK = FG : EG.

But the triangles GFM, GEN being similar,

FG : EG = FM : EN;

therefore FM : FD = FM : EN,

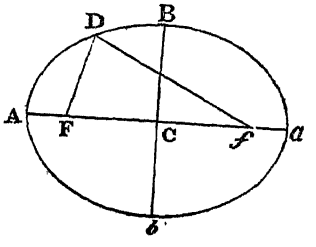
and hence FD = EN.

Cor. 2. If AI and ai be drawn perpendicular to the transverse axis at its extremities, meeting the tangent GM in I and i, then AI = AF and ai = aF.

For GA : AF = OM : MF = GF : MF = GA : AI, therefore AF = AI; and, in like manner, it may be shown that aF = ai.

Prop. XXIII. Problem.

Two unequal straight lines which bisect each other at right angles being given by position; to describe an ellipse of which these may be the two axes, by a mechanical construction.

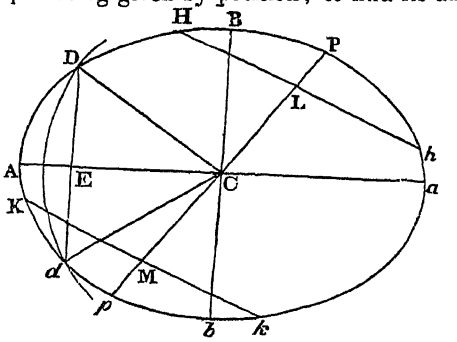


Let Aa be the transverse, and Bb the conjugate axes. About either extremity of the conjugate axis as a centre, with a radius equal to CA, half the transverse axis, describe arcs cutting that axis in F and f; these points will be the foci (4 Cor. 1). Let the ends of a string equal in length to Aa be fastened at the points F, f, and let the string be stretched by a pin at D, and while it is kept uniformly tense, let the point of the pin be carried along the plane about the centre C, till it return to the place from whence it set out. By this motion the point of the pin will trace on the plane a curve which will be the ellipse required, as is evident from the definition of the ellipse

Ellipse.

Prop. XXIV.

An ellipse being given by position; to find its axes.

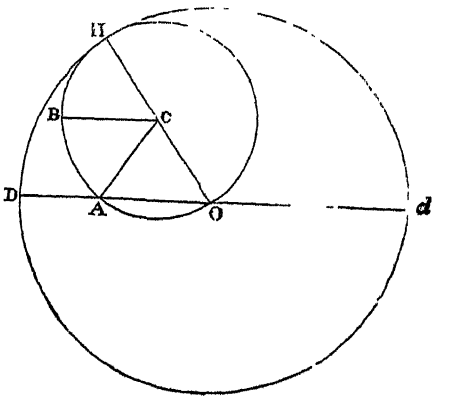


Let ABab be the given ellipse: draw two parallel chords Hh, Kk, and bisect them at L and M; join LM, and produce it to meet the ellipse in P and p, then Pp is a diameter (4 Cor. 10). Bisect Pp in C; the point C is the centre of the ellipse (2).

Take D any point in the ellipse, and on C as a centre, with the distance CD, describe a circle. If this circle be wholly without the curve, then CD must be half the transverse axis; but if it be wholly within the curve, then CD must be half the conjugate axis (14). If the circle neither be wholly without nor wholly within the ellipse, let the circle meet it again in d. Join Dd, and bisect Dd in E; join CE, and produce CE to meet the ellipse in A and a: then Aa will be one of the axes (5 Cor. 10); for it is perpendicular to the line Dd (3, 3, E.), which is an ordinate to Aa: the other axis Bb will be found by drawing a straight line through the centre perpendicular to Aa.

Prop. XXV.

If a moveable circle roll along the concave circumference of a fixed circle in the same plane, and the radius of the former be half that of the latter; any given point in its circumference will describe a diameter of the fixed circle.



Let ABHO a moveable circle (which may be called the *generating circle*), whose centre is C, roll along DHd a

Ellipse.

fixed circle, of which O is the centre, both being in the same plane, and let the radius CH be half of the radius OH; any given point A in the circumference of the generating circle will always be in D*d*, some diameter given in position of the other circle.

Let H be the point of contact of the circles: the points H, C, O are in a straight line (11, 3, E.); and because the diameter of the inner circle is half that of the outer circle, one of its extremities will always be at O, the centre of the fixed circle.

Suppose that at the beginning of the motion the point A was at D, a given point in the circumference of the fixed circle, and that by rolling along the arch DH, the generating circle has come to the position OAH: draw AC to its centre, and bisect the angle ACH, and consequently the arch AH, by the radius BC.

The arch DH is equal to the arch AH, because every element of the one has been applied to an equal corresponding element of the other: therefore the arch DH is double the arch BH, and the radius of the circle DH is by hypothesis double the radius of the circle BH. Now in different circles, equal angles at their centres stand on arches which have the same ratio as their circumferences or their radii, therefore an angle at O, the centre of the fixed circle, standing on the arch DH, will be equal to the angle BCH, that is, to the angle AOH (20, 3, E.), hence a straight line drawn through O and A will pass through the given point D; thus A will always be in the diameter DO*d*, which is given by position, and by the motion of the circle will describe that diameter.

Cor. 1. A diameter DO*d* drawn through the moving point A, in any one position, will be its *Locus* in every position.

Cor. 2. The generating circle will have made two complete revolutions about its centre C when its diameter has completed one revolution about the centre O.

Cor. 3. When the generating circle has made a complete revolution about O, every point in its circumference will have described a diameter, passing twice through the centre, and have returned to its first position.

Scholium. The refined notion of generating lines by supposing a curve to roll along a straight line or curve, is due to the moderns.

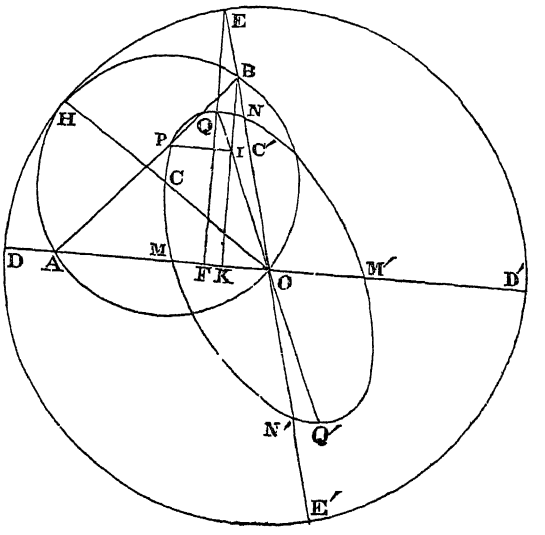
Galileo appears to have been the first who introduced it into geometry, and in this way he indicated the *cycloid*, the discussion of which by Mersenne, Descartes, Pascal, and others, was the beginning of that series of discoveries which has since gradually expanded into the modern geometry. The ancients, however, in some cases employed motion in the formation of geometrical figures. Euclid defined a sphere to be the solid figure described by the revolution of a semicircle about its diameter, which remains unmoved; and Archimedes defined his spiral by the uniform motion of a point along a straight line which at the same time turns with an uniform angular motion about one of its extremities. The preceding proposition, and the following, may be established by the ordinary method of geometrical reasoning; or instead of supposing one circle to roll on another, we might suppose the diameter of the generating circle to turn about the centre of the fixed circle with a uniform angular motion, while at the same time it turned uniformly about its own centre, so as to make two complete revolutions in the time its diameter makes one. It then might be easily shown, that the extremity of any radius of the revolving circle would describe a diameter of a fixed circle.

The property here demonstrated is elegant, and remarkable in having been applied in mechanics to the production of a reciprocating rectilinear motion by means of a rotatory motion.

Prop. XXVI.

Ellipse.

If a moveable or generating circle roll along the concave circumference of a fixed circle in the same plane, and the radius of the former be half that of the latter, as in the preceding proposition; any given point in the plane of the generating circle, within or without it, will describe an ellipse, of which conjugate diameters will be given in position.



Let DHED'E' be the fixed circle, O its centre, and AHBO the generating circle, which rolls along the concave circumference DHE: any given point P (the generating point) in the plane of this circle, within or without it, will describe an ellipse given in position.

Take a given point A anywhere in the circumference of the generating circle, and draw a straight line through A, and the generating point P, meeting the circumference in B: Thus A and B will be given points in the circle, and AP, PB lines given in magnitude. Draw OD, OE, radii of the fixed circle, through the points A and B: these will be lines given in position. (Preceding Prop.)

Let OCH be the revolving diameter of the generating circle, and C its centre. When OH has made a complete revolution about the centre O, the point A will have been twice at O, and BP, one of the segments of AB, will have coincided entirely with OM, OM', equal segments of the diameter DD', on opposite sides of the centre; therefore, if in DD there be taken OM and OM', each equal to the line BP, M and M' will be given points in which the locus of P cuts the line DD'.

For a like reason AP, the other segment of AB, will have coincided with segments of the diameter EE' in two opposite positions, viz. ON, ON'; therefore, if ON and ON' be taken each equal AP, N and N' will be also given points in which the locus of P intersects the line EE'.

By the motion of the generating circle, the point B, either of the extremities of the revolving chord AB, will in the course of a revolution have come to E, a point in the circumference of the fixed circle. The angle OAB will then be in a semicircle (of the generating circle), and AB will have the position of a perpendicular to OD. Let this be the line EF, which will be given in position, and also in magnitude, because it is equal to the chord BA. Take FQ = AP, therefore QE = PB; then Q will be a fifth given point in the locus of P. Join QO, and take OQ' = OQ: the line QQ', which is bisected at O, will be given in position and magnitude. Draw BK perpendicu-

Ellipse.

lar to OD, and PI parallel to it, meeting BK in I. The triangles BPI, BAK are similar (4, 6, E.), therefore

$$BI : IK = BP : PA = EQ : QF :$$

Because the lines BK, EF are similarly divided at Q and I, the points O, I, Q, are in a straight line (Lemma to Prop. 8, Part I.), so that I is in the line QOQ'.

Again, because EO : OB = QO : OI,

and that OB cannot exceed OE, therefore OI cannot be greater that OQ; and when AB is not perpendicular to DD', the point I will always be between Q and Q': in no case can it be beyond these limits.

The triangles OQE, OIB, are similar (4, 6, E.), therefore their sides are proportionals, and

$$OQ^2 : OI^2 = QE^2 \text{ or } BP^2 : BI^2,$$

and, by division, $OQ^2 : QI \cdot IQ' = BP^2 : PI^2$;

hence, by alternation, and observing that BP = OM,

$$OQ^2 : OM^2 = QI \cdot IQ' : PI^2 ;$$

therefore the point P is in an ellipse, of which QQ' and MM', lines given in magnitude and position, are conjugate diameters (converse of 13).

Cor. 1. The ellipse described by the generating point P depends entirely on the magnitude of the generating circle AOB, and the position of the point in its plane, that is, on OC the radius of the circle, and CP its distance from the centre; therefore, whatever be the position of the revolving chord AB, if it always pass through the same point P, the ellipse will be the same, and have the same position on the plane of the fixed circle.

Cor. 2. The position of DD', EE', the diameters of the fixed circle, which are the loci of the extremities of the revolving chord AB, and consequently the position of MM' NN', the diameters of the ellipse, depend entirely on the position of the chord in respect of the centre; they will be different for different chords, but for the same chord they will have a fixed position. This is evident from the last proposition.

Cor. 3. The semidiameters OM, ON of the ellipse in which (produced if necessary) the revolving chord terminates, are equal to the distances of the generating point P from the ends of the chord, viz. OM to PB, and ON to PA, and the angle which the diameters MM', NN' make at the centre is half the angle which the chord subtends at the centre of the generating circle; for in the course of a revolution of the generating circle about the centre Q, the segments PB, PA of the chord will have been applied upon the lines OM, ON, so as entirely to coincide with them: the rest is evident (20, 3, E.).

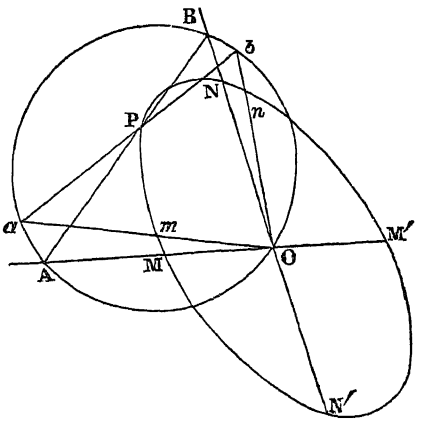
Cor. 4. When the revolving chord AB comes into the position EF, a perpendicular to MM', either of the diameters, which are the loci of its extremities, it then passes through Q, a vertex of the diameter QOQ', which is the conjugate of MM', and in this position it is a normal to the ellipse: for a tangent to the ellipse at Q is parallel to MM', and therefore perpendicular to EF.

Scholium. From this proposition it appears that if the ends of a straight line AB of a given length be carried along two straight lines DOD', EOE', given in position; any point P in AB (or in AB produced), at given distances from its extremities, will describe an ellipse, the centre of which will be at the intersection of the lines given in position. It is upon this principle that elliptic compasses and lathes for turning ovals are constructed. An instrument for describing ellipses will be described farther on.

Prop. XXVII.

Supposing the ellipse MPN, whose centre is O, to have been described according to the hypothesis of Prop. XXVI.; let AOB be the generating circle in any position on the plane of the fixed circle, and P the generating point, which is also a point in the ellipse; through P draw any chord APB; join OA and OB; take OM and OM' in contrary directions, each equal to PB, and ON and ON' in contrary directions, each equal to PA; then MM', NN' will be two diameters of the ellipse.

Ellipse.



Since A and B are points in the circumference of the generating circle, and O is the centre of the fixed circle, the lines AO, BO will have the same position in the ellipse for all positions of the chord AB, because they are the loci of the points A, B; therefore (3 Cor. 26) the semidiameters OM, ON will be respectively equal to PB and PA, the distances of P from the ends of the chord AB; hence if OM, ON be taken equal to PA and PB, the points MN will be the vertices of diameters of the ellipse.

Cor. And if other chords *ab*, &c. be drawn through P, and O*a*, O*b*, &c. be joined, and there be taken O*m* equal to *b*P, and O*n* equal to P*a*, &c. then *m*, *n*, &c. will be points in the ellipse; and in this way any number of points whatever may be found from a single position of the generating circle.

Prop. XXVIII.

Supposing an ellipse to be described according to the hypothesis of Prop. XXVI. if the generating point be within the generating circle (fig. 1), half the sum of its semiaxes is equal to the radius of the circle; and half their difference, to the distance of the generating point from its centre. But if the point be without the circle (fig. 2), then half the difference of the semiaxes is equal to its radius, and half their sum to the distance of the generating point from its centre.

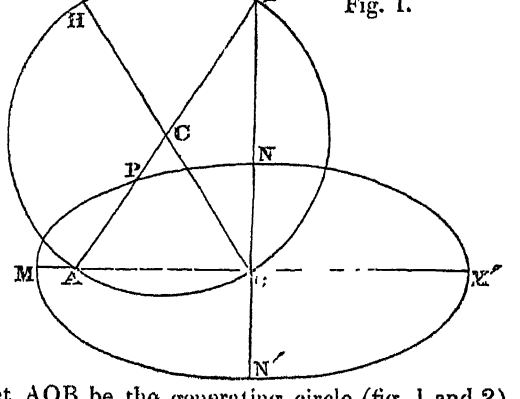
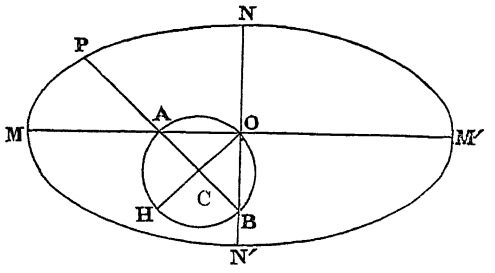


Fig. 1.

Let AOB be the generating circle (fig. 1 and 2), and P the generating point, at any point in the curve. It appears from Prop. XXVI. Cor. 4, that a chord in the circle passing through P and A, the intersection of the circle, and MM', one of the axes, will also pass through B, the point in which it meets the other axis NN'; and in this

Hyperbola. case the chord will pass through C the centre (31, 3, E.), because the axes form right angles at the centre of the ellipse. Therefore when the point P is within the circle AOB (fig. 1), the radius OC or AC is half the sum of BP and AP, that is, of OM and ON, the semiaxes (27); and CP, the distance of the generating point from the centre, is half the difference of PA and PB, or of OM and ON.

Fig. 2.

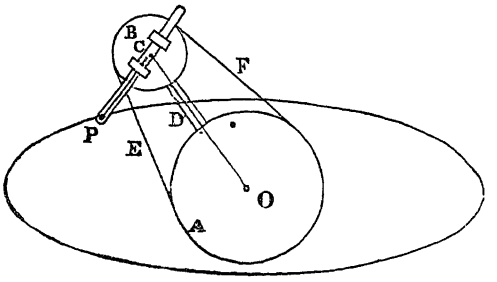


When the generating point P is without the circle AOB (fig. 2), then the radius OC or AC is manifestly half the difference of AP and BP; and CP, the distance of the generating point from the centre, is half the sum of AP and BP, that is, of OM and ON, the semiaxes.

Cor. 1. Hence it appears that the same ellipse may be described by two different generating circles (each rolling on its own fixed circle), viz. by one whose diameter is the sum of the semiaxes, and by another whose diameter is their difference; in the first way the generating point will be within the circle, and in the second without it.

Cor. 2. Also it appears that the chord of the generating circle, intercepted between the diameters of the ellipse that pass through its extremities (and which passes through the generating point), is equal to the sum of the semidiameters when the generating point is within the circle, but to their difference when the point is without the circle.

Scholium. The curves which may be generated by a point in the plane of a moveable circle which rolls along the circumference of a fixed circle, are called cycloids, also epicycloids. They are of two kinds, one generated by a circle rolling on the convex circumference, and another by its rolling on the concave. Some writers confine the name *epicycloids* to the first class, and call the second *hypocycloids*. It appears from this proposition that an ellipse is an hypocycloid. This property of the curve has not been observed, as far as we know, by any writer on the conic sections, although the extreme case, viz. that in Hyperbola which the ellipse, by the shortening of its lesser axis, degenerates into a straight line of a given length (Prop. 25), is always mentioned by writers on cycloids.

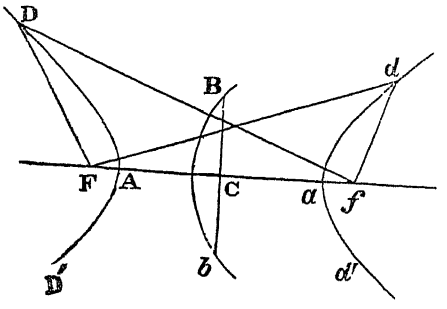


The property in question has suggested an instrument for generating an ellipse elegantly, by continued motion. A and B are two wheels, the axes of which turn in holes C, O, near the ends of the connecting bar D. One of the wheels B must be just half the diameter of the other A, which may be of any size, and a band EF goes round them, outside; an arm CP is attached to the wheel B, and admits of being lengthened or shortened by sliding along its surface in a socket which may be anywhere on the wheel. Suppose now that the wheel A is fixed or kept from turning, and that the bar D is turned round the centre O, carrying at its other extremity the wheel B; the action of the band EF will then turn this wheel B round its centre C, and while the bar makes one revolution round the centre of the fixed wheel, the other wheel will make two revolutions about its centre.

The use of the sliding arm CP is to give extension to the surface of the wheel, so that P, any point in the arm, may be regarded as a point in the plane of a circle turning about a moveable centre C, while that centre revolves about a fixed centre O. From this description it is easy to see that C, the centre of the wheel B, may be regarded as the centre of a circle which rolls on the inside of a circle whose centre is O; also that any point P in the plane which is the extension of the surface of the wheel, is just a point in the plane of the rolling circle; and since the circle of which C is the centre makes two turns in going round that of which O is the centre, the radius of the one circle must be double that of the other; and hence it follows from the proposition that the path of the point P in space is an ellipse.

PART III.—OF THE HYPERBOLA.

Definitions.



I. If two points F, *f* be given in a plane, and a point D be conceived to move in such a manner that D*f*—DF, the difference of its distances from them, is always the same; the point D will describe upon the plane a line DAD' called an *Hyperbola*. By assuming first one of the given points F, and then the other *f*, as that to which the moving point is nearest, the difference of the lines DF and D*f* in both cases being the same, there will be two hyperbolas DAD', *dad'* described, opposite to each other, which are therefore called *Opposite Hyperbolas*.

Cor. The lines DF, D*f* may become greater than any given line, therefore the hyperbolas extend to a greater distance from the given points F, *f* than any which can be assigned.

II. The given points F, *f* are called the *Foci of the hyperbola*.

III. The point C, which bisects the straight line between the foci, is called the *Centre*.

IV. The distance of either focus from the centre is called the *Eccentricity*.

V. A straight line passing through the centre, and terminated by the opposite hyperbolas, is called a *Transverse Diameter*. It is also sometimes called simply a *Diameter*.

VI. The extremities of a diameter are called its *Vertices*.

VII. The diameter which passes through the foci is called the *Transverse Axis*.

Hyperbola. COR. The vertices of the transverse axis lie between the foci. Let A be either of the vertices, then, because any side of a triangle is greater than the difference between the other two sides, Ff is greater than fD—DF, which is equal to fA—FA (Def. 1). Now this can only be true when A is between F and f.

VIII. A straight line Bb passing through the centre, perpendicular to the transverse axis, and limited at B and b by a circle described on one extremity of that axis, with a radius equal to the distance of either focus from the centre, is called the *Conjugate Axis*. It is also called the *Second Axis*.

COR. The conjugate axis is bisected in the centre. This appears from 3, 8, E.

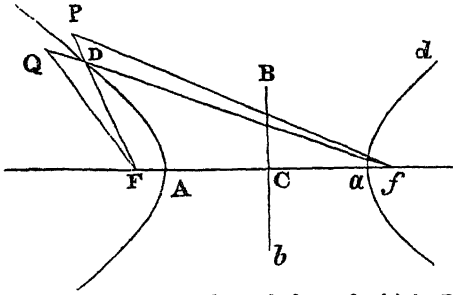
IX. Any straight line terminated both ways by the hyperbola, and bisected by a transverse diameter produced, is called an *Ordinate* to that diameter.

X. Each of the segments of a transverse diameter produced, intercepted by its vertices and an ordinate, is called an *Abscise*.

XI. A straight line which meets the hyperbola in one point only, and which everywhere else falls without the opposite hyperbolas, is said to *touch* the hyperbola in that point, and is called a *Tangent to the hyperbola*.

PROP. I.

If from any point in an hyperbola two straight lines be drawn to the foci; their difference is equal to the transverse axis.



Let DA, da be opposite hyperbolas, of which F, f are the foci and Aa the transverse axis; let D be any point in the curve, and DF, Df lines drawn to the foci;

Df — DF = Aa.

Because A and a are points in the hyperbola,

Af—AF = aF—af, (Def. 1),
therefore Ff—2AF = Ff—2af;
hence 2AF = 2af, and AF = af,
and Af—AF = Af—af = Aa.

But D and A being points in the hyperbola,
Df—DF = Af—AF, therefore Df—DF = Aa.

COR. 1. The difference of two straight lines drawn from a point without the opposite hyperbolas to the foci is less than the transverse axis, and the difference of two straight lines drawn from a point within either of them to the foci is greater than the transverse axis.

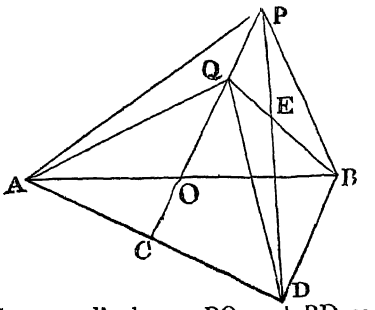
Let Pf, PF be lines drawn from a point without the hyperbolas, that is, between the curve and its conjugate axis. The line PF must necessarily meet the curve; let D be the point of intersection; Pf is less than PD + Df (20, 1, E.), therefore Pf — PF is less than (PD + Df) — PF, that is, less than Df — DF, or Aa. Again, let Qf, QF be lines drawn from a point within either of the hyperbolas, Qf must necessarily meet the curve; let D be the point of intersection, join FD; QF is less than QD + DF, and therefore Qf — QF is greater than Qf — (QD + DF), that is, greater than Df — DF or Aa.

COR. 2. A point is without or within the hyperbolas, according as the difference of two lines drawn from that point to the foci is less or greater than the transverse axis.

COR. 3. The transverse axis is bisected in the centre. Hyperbola. Let C be the centre; then CF = Cf (Def. 3), and FA = fa, therefore CA = Ca.

LEMMA I.

Let APB be a triangle, of which the side PA is greater than the side PB; draw a straight line from P, the vertex, to O, the middle of the base AB, and straight lines AQ, BQ, to any point in PO; the line QA will be greater than the line QB; and the excess of PA above PB will be greater than the excess of QA above QB.



Draw AC perpendicular to PO, and BD parallel to it, meeting AC in D, and join QD, PD, this last line meeting QB in E.

The triangles AOP, BOP have AO = BO, PO common to both, and PA greater than PB, therefore the angle AOQ is greater than the angle BOQ (25, 1, E.); and hence again, in the triangles AOQ, BOQ, the line AQ will be greater than BQ (24, 1, E.).

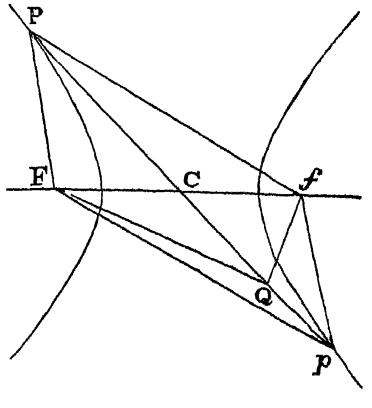
And because CO is parallel to DB, and AO = OB, therefore AC = CD (2, 6, E.). The triangles ACP, DCP have thus AC = DC, CP common, and the angle ACP equal to DCP, therefore PA = PD; and in the same way it appears that QA = QD.

And since PA is greater than PB, and QA than QB, therefore PD is greater than PB, and QD than QB.

Again, since DE + EQ > DQ,
therefore DE + EQ — QB > DQ — QB;
that is, DE — EB > AQ — QB;
also, since PB < PE + EB,
therefore DP — PB > DP — PE — EB;
that is, AP — PB > DE — EB.
Now it was shown that DE — EB > AQ — QB;
much more then is AP — PB > AQ — QB.

PROP. II.

Every transverse diameter of an hyperbola is bisected in the centre.



Let Pp be a transverse diameter; it is bisected in C; for if CP and Cp be unequal, take CQ equal to CP; from the points P, p, Q, draw straight lines to F and f the foci. The triangles PCF, QCf have PC equal to QC and CF

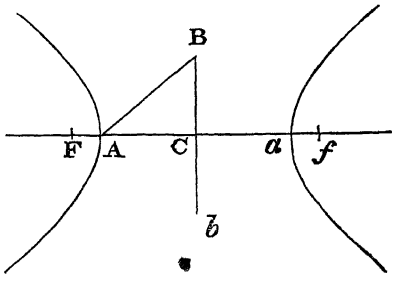
 equal to Cf (Def. 3), and the angles at C equal, therefore they are in every way equal, and PF is equal to Qf. In the same way, it appears that the triangles PCf, QCF are equal, and that Pf is equal to QF; therefore Pf—PF =QF—Qf; but because P and p are points in the hyperbola Pf—PF=pF—pf, therefore pF—pf=QF—Qf. But by the preceding Lemma pF—pf>QF—Qf; now this is impossible; therefore CP and Cp are not unequal, that is, they are equal.

Cor. 1. Every transverse diameter meets the hyperbola in two points only.

Cor. 2. Every transverse diameter divides the opposite hyperbolas into two parts which are equal and similar, the like parts being at opposite parts of the diameter.

Prop. III.

The square of half the conjugate axis of an hyperbola is equal to the rectangle contained by the straight lines between either focus and the extremities of the transverse axis.

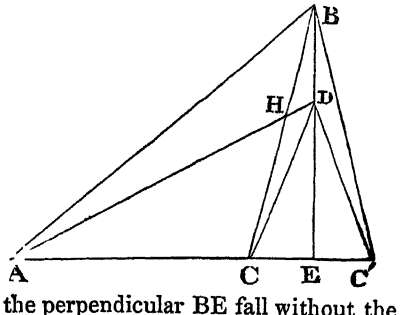


Draw a straight line from A, either of the extremities of the transverse axis, to B, either extremity of the conjugate axis. Then, $BC^2 + CA^2 = BA^2$ (47, 1, E.) = CF^2 (Def. 7). But because Aa is bisected at C and produced to F,

$$CF^2 = AF \cdot Fa + CA^2 \text{ (6, 2, E.)},$$
$$\text{therefore } BC^2 + CA^2 = AF \cdot Fa + CA^2;$$
$$\text{and } BC^2 = AF \cdot Fa.$$

Lemma II.

Let ABC be a triangle, of which the side BA is greater than the side BC; draw BE perpendicular to the side AC, and straight lines AD, CD to any point in BE; the line DA will be greater than the line DC; and the excess of DA above DC will be greater than the excess of BA above BC.



First, let the perpendicular BE fall without the triangle ABC, and let AD meet BC in H.

The angle DCA is greater than BCA; but BCA being an obtuse angle, is greater than BAC, which is acute; and again BAC is greater than DAC; much more then is DCA greater than DAC; therefore DA is greater than DC (19, 1, E.).

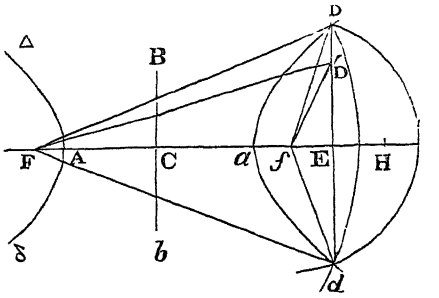
And since AH+HB>AB,
therefore AH+HB—BC>AB—BC;
that is, AH—HC>AB—BC.

Again, since CD<DH+CH,
therefore AD—CD>AD—DH—CH;
that is, AD—CD>AH—CH.
But it was shown that AH—CH>AB—BC;
much more then is AD—DC>AB—BC.

Next let the perpendicular fall within the triangle ABC′; take EC=EC′, and join BC, DC: then BC=BC′, and DC=DC′, therefore DA>DC′,
and BA—BC=BA—BC′,
also DA—DC=DA—DC′;
but DA—DC>BA—BC,
therefore DA—DC′>BA—BC′.

Prop. IV. Problem.

To find any number of points in an hyperbola, having given the transverse axis and foci.



Let F, f be the foci, Aa the transverse axis, and C the centre. Suppose the problem resolved, and that D is a point in the hyperbola. Join DF, Df. Take AH in the axis equal to DF; then aH will be equal to Df (Def. 1),
and HA+Ha=DF+Df;
but HA+Ha=HC+Ca+Ha=2CH,
therefore DF+Df=2CH.
Now DF+Df>Ff,
therefore 2CH>Ff and CH>Cf.

Thus it appears that the point H cannot be between the foci F, f, and that it may be anywhere in the line Ff, produced both ways.

Construction.—Take H, any point in the axis produced both ways, except between F and f the foci, and from F and f as centres, with the distances HA, Ha, describe circles which will cut each other in two points D, d, one on each side of the axis. These are points in the hyperbola.

Join DF, Df, also dF, df. Because DF—Df=HA —Ha=Aa, therefore D is a point in the hyperbola; and in like manner it appears that d is a point in the hyperbola.

In this way may any number of points in the hyperbola be found.

Cor. 1. Any perpendicular to the transverse axis which meets it produced either way, will cut the curve in two points, and in no more. For if the perpendicular Dd could meet the curve in two points D, D′, on the same side of the axis, then DF, Df, also D′F, D′f, being drawn to the foci, DF—Df would be equal to D′F—D′f, which is impossible (Lemma 2).

Cor. 2. Every chord Dd in an hyperbola, perpendicular to the transverse axis, is bisected by that axis, and therefore is an ordinate to it.

Cor. 3. Of all the straight lines which can be drawn from either focus to either of the opposite hyperbolas, the shortest is that which passes through the centre (being produced if necessary); and only two equal straight lines can be drawn from either focus to one of the opposite hyperbolas, viz. one line on each side of the centre.

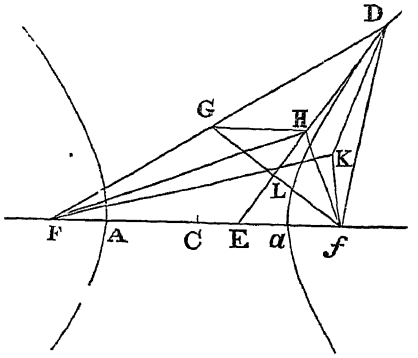
Scholium. From this proposition it appears that the opposite hyperbolas recede continually from the foci and from the axis, and that they are entirely separated from

Hyperbola

each other, their nearest approach being at the vertices of the transverse axis. Also, that if the space D*ad*, bounded by either, were resolved into two by cutting it along the axis CH, the portions on each side of the axis would entirely coincide if one were turned over on the other. Now it was shown that the opposite hyperbolas might be applied one upon the other, viz. the curve D*ad* on ∂AΔ (2 Cor. 2), therefore the transverse axis divides the opposite hyperbolas into four spaces, indefinite in extent, but which are exactly alike, and may be placed one on another, so as entirely to coincide.

Prop. V.

The straight line which bisects the angle contained by two straight lines drawn from any point in the hyperbola to the foci is a tangent to the curve at that point.



Let D be the point in the curve, let DF, D*f* be straight lines drawn to the foci; the straight line DE which bisects the angle *f*DF, is a tangent to the curve.

Take H any other point in DE, make DG = D*f*, and join H*f*, HF, HG, *f*G; let *f*G meet DE in L. Because D*f*=DG, and DL is common to the triangles D*f*L, DGL, and the angles *f*DL, GDL are equal, these triangles are equal, and *f*L = LG, and hence *f*H = HG (4, 1, E.); and FH — *f*H = FH — HG: but since FH is less than FG + GH, FH — HG is less than FG, that is, less than FD — *f*D or A*a*, therefore FH — *f*H is less than A*a*; hence the point H is without the hyperbola (2 Cor. 1), and consequently DHL is a tangent to the curve at D (Def. 11).

Cor. 1. There cannot be more than one tangent to the hyperbola at the same point. For D is such a point in the line DE, that the difference of the lines DF, D*f*, the distances of that point from the foci, is evidently greater than the difference of FH, *f*H, the distances of H, any other point in that line; and if another line KD be drawn through D, there is in like manner a point K in that line, which will be different from D, such that the difference of FK, *f*K is greater than the difference of the distances of any other point in KD, and therefore greater than FD — *f*D; therefore the point K will be within the hyperbola (2 Cor. 1), and the line KD will cut the curve.

Cor. 2. A perpendicular to the transverse axis at either of its extremities is a tangent to the curve. The demonstration is the same as for the proposition, if it be considered that when D falls at either extremity of the axis, the point L falls also at the extremity of the axis, and thus the tangent DE, which is always perpendicular to *f*L, is perpendicular to the axis.

Cor. 3. Every tangent to either of the opposite hyperbolas passes between that hyperbola and the centre. Let the tangent DL meet the axis in E. Because DE bisects the angle FD*f*,

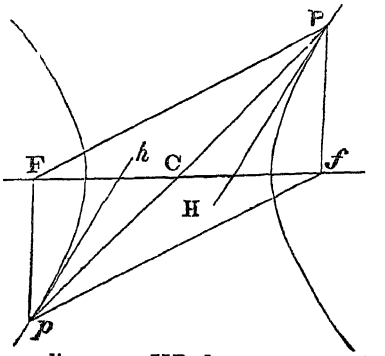
FD : *f*D :: FE : *f*E (3, 6, E.).

But FD is greater than *f*D (Def. 1), therefore FE is greater than *f*E, and hence E is between C and the vertex of the hyperbola to which DE is a tangent. Hyperbola

Scholium. From the property of the hyperbola which forms this proposition, the points F and *f* are called *foci*; for rays of light proceeding from one focus, and falling upon a polished surface whose figure is that formed by the revolution of the curve about the transverse axis, are reflected in lines passing through the other focus.

Prop. VI.

The tangents at the vertices of any transverse diameter of an hyperbola are parallel.



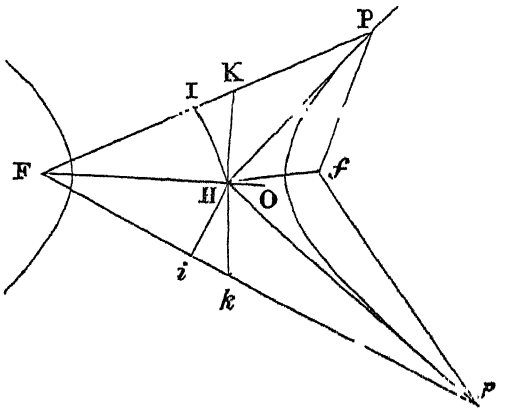
Let P*p* be a diameter, HP, *hp* tangents at its vertices; draw straight lines from P and *p* to F and *f*, the foci. The triangles FCP, *f*C*p*, having FC = *f*C, CP = C*p* (2), and the angles at C equal, are in all respects equal; and because the angle FPC is equal to C*pf*, FP is parallel to *fp* (27, 1, E.), therefore P*f* is equal and parallel to *p*F (33, 1, E.): thus FP*fp* is a parallelogram of which the opposite angles P and *p* are equal (34, 1, E.). Now the angles FPH, *fph* are the halves of these angles (4), therefore the angles FPH, *fph*, and hence CPH, C*ph*, are also equal, and consequently HP is parallel to *hp*.

Cor. 1. If tangents be drawn to an hyperbola at the vertices of a transverse diameter, straight lines drawn from either focus to the points of contact make equal angles with these tangents; for the angle F*ph* is equal to FPH.

Cor. 2. The transverse axis is the only diameter which is perpendicular to tangents at its vertices. For let P*p* be any other diameter. The angle CPH is less than FPH, that is, less than the half of FP*f*, therefore CPH is less than a right angle.

Prop. VII.

If a straight line be drawn from either focus of an hyperbola to the intersection of two tangents to the curve, it will make equal angles with straight lines drawn from the same focus to the points of contact.



Let HP, Hp, tangents to an hyperbola at P and p, intersect each other at H; draw PF, pF, HF, to F, either of the foci; the line HF makes equal angles with FP, Fp.

Draw Pf, pf, Hf, to f, the other focus, and in FP, Fp take PK = Pf and $pk = pf$; join HK, Hk.

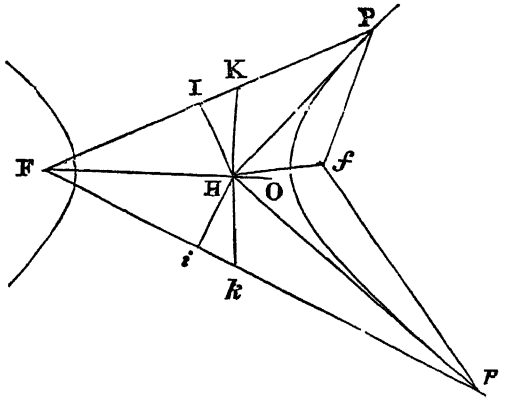
The triangles HPK, HPf have PK = Pf, PH common to both, and the angles KPH, fPH equal (5); therefore they are in every way equal, and have HK = Hf. In the same way it may be shown, that the triangles Hpk, Hpf are in every way equal, and therefore that Hk = Hf.

The triangles HFK, HFk have HK = Hk (for each is equal to Hf), HF common to both, and FK = Fk, because each is equal to PF—Pf, or pF—pf, that is, to the transverse axis; therefore they are in all respects equal; and the angle HFK is equal to the angle HFk; wherefore HF makes equal angles with FP and Fp.

Cor. Perpendiculars drawn from the intersection of two tangents to straight lines drawn from either focus through the points of contact are equal. Let HI, Hi be perpendiculars drawn from H, the intersection of the tangents PH, pH on the lines FP, Fp. The triangles HFI, HFi are in all respects equal (26, 1, E.); therefore HI=Hi.

Prop. VIII.

Straight lines drawn from the intersection of two tangents to the foci, make equal angles with the tangents.



Let F, f be the foci of an hyperbola, and let straight lines HP, Hp, which intersect each other at H, touch the hyperbola at P and p; also let HF, Hf be lines drawn to the foci; and let FH be produced to any distance O, the angles PHO, pHf are equal.

The same construction being made as in Prop. 7, because the angles FHK, FHk are equal, the angles KHO, kHO are equal.

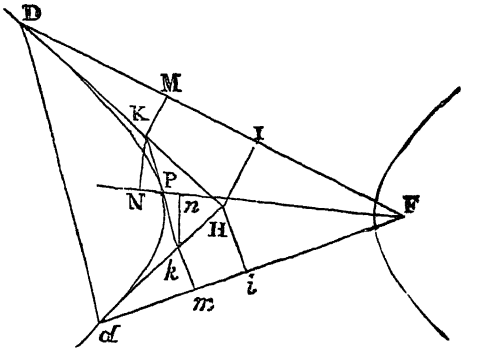
$$\text{Now KHO} \begin{cases} = \text{KH}f + f\text{HO}, \\ = 2\text{PH}f + f\text{HO}, \\ = 2\text{PHO} - f\text{HO}, \end{cases}$$

$$\text{and } k\text{HO} \begin{cases} = k\text{H}f - f\text{HO}, \\ = 2p\text{H}f - f\text{HO} \end{cases}$$

therefore 2PHO = 2pHf, and PHO = pHf.

Prop. IX.

If two tangents to an hyperbola be at the extremities of a chord, and a third tangent be parallel to the chord, the part of this tangent intercepted by the other two is bisected at the point of contact.



Let HD, Hd be tangents at the extremities of the chord Dd; and let Kk, a tangent parallel to Dd, meet the other two tangents in K and k. The intercepted segment Kk is bisected at P, the point of contact.

From the points of contact D, P, d, draw lines to F, either of the foci; and from H, K, k, the intersections of the tangents, draw perpendiculars to the lines drawn from the points of contact to the foci, viz. HI, Hi perpendicular to DF, dF, and KM, KN perpendicular to FD, FP, and km, kn perpendicular to Fd, FP.

The triangles DHI, DKM are manifestly equiangular, also the triangles dHi, dkm;

therefore DH : DK = HI : KM (4, 6, E.),

and dH : dk = Hi : km.

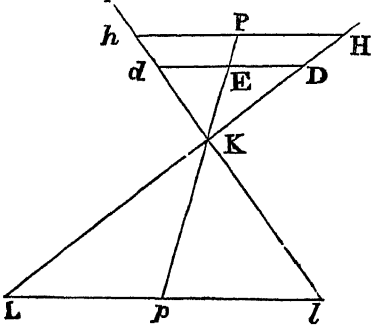
But because Dd is parallel to Kk, a side of the triangle HKk, DH : DK = dH : dk (2, 6, E.),

therefore HI : KM = Hi, km.

Now HI = Hi (Cor. 7), therefore KM = km; but KM = KN, and km = kn (Cor. 7), therefore KN = kn; and since from the similar triangles KPN, kPn, KN : kn = KP : kP, therefore KP is equal to kP.

Lemma III.

Let KLl be a triangle, having its base Ll bisected at p, and let Hh, any straight line parallel to the base, and terminated by the sides produced, be bisected at P, then P, p, the points of bisection, and K, the vertex of the triangle, are in the same straight line, and that line bisects Dd any other line parallel to the base.



Join KP, Kp; the triangles KHh, KLl being similar, and Hh, Ll similarly divided at P, p,

KH : KL = (Hh : Ll) HP : Lp.

Now the angles at H and L are equal, therefore the triangles KHP, KLp are similar, and the angle PKH is equal to pKL; to both add the angle HKp, and the angles PKH, HKp are equal to pKL, HKp, that is, to two right angles; therefore KP, Kp lie in the same straight line (14, 1, E.)

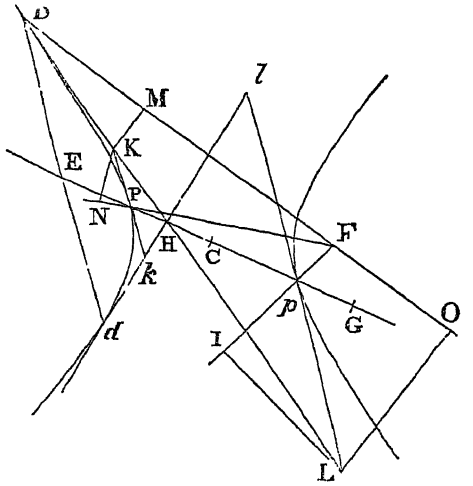
Next let Dd meet KP in E, then

HP : DE (= PK : EK) = Ph : Ed, and DE = Ed.

Prop. X.

Any chord not passing through the centre, but parallel to a tangent, is bisected by the diameter which passes

Hyperbola. through the point of contact; or it is an ordinate to that diameter.



The chord DE*d*, which is parallel to K*k*, a tangent at P, is bisected at E by the diameter PC*p*.

Draw L*p*, a tangent at *p*, the other end of the diameter, and DH, *d*H tangents at D and *d*, the extremities of the chord meeting the other tangents in K, *k* and L, *l*. Then KP*k* and L*pl* are bisected at P and *p* (9), therefore the diameter P*p*, when produced, will pass through H, and bisect D*d*, which is parallel to K*k* or L*l* in E. (Lemma.)

Cor. 1. Straight lines which touch an hyperbola in the extremities of an ordinate to any diameter, intersect each other in that diameter.

Cor. 2. Every ordinate to a diameter is parallel to a tangent at its vertex; for if not, let a tangent be drawn parallel to the ordinate; then the diameter drawn through the point of contact would bisect the ordinate, and thus the same ordinate would be bisected in two different points, which is absurd.

Cor. 3. All the ordinates to the same diameter are parallel to each other.

Cor. 4. A straight line that bisects two parallel chords, and terminates in the curve, is a diameter.

Cor. 5. The ordinates to either axis are perpendicular to that axis, and no other diameter is perpendicular to its ordinates.

Prop. XI.

If a tangent to an hyperbola meet a transverse diameter, and from the point of contact an ordinate be drawn to that diameter, the semidiameter will be a mean proportional between the segments of the diameter intercepted between the centre and the ordinate, and between the centre and the tangent.

(See Figure to Prop. X.)

Let DH, a tangent to the hyperbola at D, meet a transverse diameter P*p* produced in H, and let DE*d* be an ordinate to that diameter: CE : CP = CP : CH.

Through P and *p*, the vertices of the diameter, draw the tangents PK, *p*L, meeting DH in K and L; draw PF, *p*F to either of the foci, and draw KM and KN perpendicular to FD and FP, and also LO and LI perpendicular to FD and F*p*.

The triangles PKN, *p*LI are equiangular, for the angles at N and I are right angles, and the angles NPK, I*p*L are equal (1 Cor. 6); therefore

PK : *p*L = KN : LI (4, 6, E.) = KM : LO : (Cor. 7).

But the triangles KDM, LDO being manifestly equiangular, KM : LO = KD : LD;

therefore PK : *p*L = KD : LD.

But because of the parallel lines PK, ED, *p*L, the triangles HPK, H*p*L are equiangular, and the lines HL, H*p* are similarly divided in K, D, and in P, E (10, 6, E.); hence Hyperbola.

PK : *p*L = HP : H*p*, and KD : LD = PE : *p*E;

therefore HP : H*p* = PE : *p*E.

Take CG = CE, and then PE = *p*G, and, by composition,

HP : P*p* = PE : EG;

and taking the halves of the consequents,

HP : PC = PE : EC,

and, by division, HC : PC = PC : EC.

Cor. 1. The rectangle PE · E*p* is equal to the rectangle HE · EC.

For PC² = HC · CE (17, 6, E.) = EC² — HE · EC (1, 2, E.),

also PC² = EC² — PE · E*p* (6, 2, E.);

therefore HE · EC = PE · E*p*.

Cor. 2. The rectangle PH · H*p* is equal to the rectangle HE · HC.

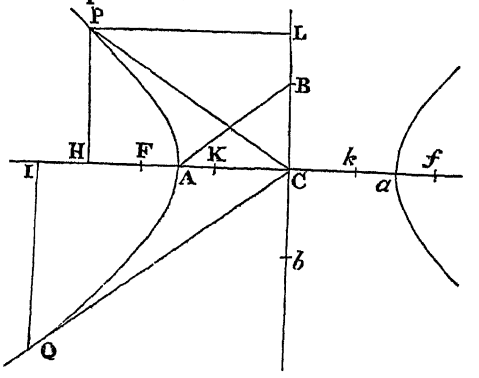
For HC² = CP² — PH · H*p* (6, 2, E.),

and HC² = EC · HC — EH · HC (1, 2, E.) = CP² — EH · HC (by the Prop.);

therefore PH · H*p* = EH · HC.

Prop. XII.[1]

In A*a*, the transverse axis of an hyperbola, let there be taken on each side of the centre straight lines CK, C*k*, each a fourth proportional to CF the eccentricity, and CA, CB, half the transverse and conjugate axes: if then from P, a vertex of any diameter, there be drawn PH perpendicular to A*a*; the square of the semidiameter PC, will have to the rectangle contained by the segments KH, *k*H the constant ratio of the square of CF to the square of CA.



Draw PL perpendicular to the conjugate axis.

Because CB² : CA² = CB² + CL² : PL² (1 Cor. 22), by composition, CB² + CA² : CA² = CB² + CL² + PL² : PL²,

therefore (47, 1, E. and Def. 8) CF² : CA² = CB² + PC² + PL² or CH²;

but, by hypothesis, CF² : CA² = CB² : CK²,

therefore CB² : CK² = CB² + PC² : CH²;

and hence (19, 5, E.) PC² : CH² — CK² = CB² : CK²,

and (6, 2, E.) PC² : KH · H*k* = CF² : CA².

Cor. 1. Hence the squares of any semidiameters PC, QC are to one another as the rectangles KH · H*k*, KI · I*k*, contained by the segments of the line K*k* between its extremities, and perpendiculars from the vertices of the diameters.

Cor. 2. The transverse axis is the least of all the diameters, and a diameter which is nearer to the transverse axis is less than one more remote, and a semidiameter may be found greater than any given line.

By hypothesis CF or AB : CA = CB : CK: Now AB is greater than CB (19, 1, E.), therefore CA is greater than CK, and the points K, *k* are between A, *a*, the vertices of the transverse axis. Suppose now a semidiameter PC to

[1] This proposition was misplaced by accident. It ought to have followed Proposition XXII.

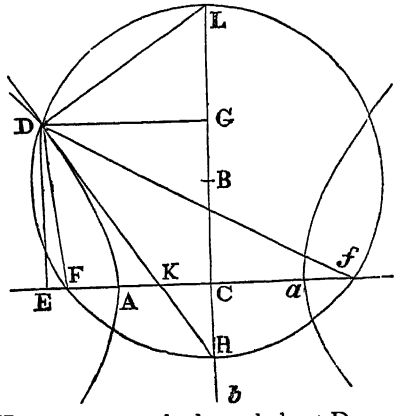
Hyperbola.

turn about C, and that in every position PH is perpendicular to Kk produced both ways; the rectangle KH · Hk, and the square of PC, to which the rectangle has a constant ratio, will manifestly be least when PC coincides with AC, and both will increase as H recedes from C; and, as the rectangle may exceed any given space, the semidiameter may become greater than any given line.

Cor. 3. Diameters which make equal angles with the transverse axis on opposite sides of it are equal; and only two equal diameters can be drawn, one on each side of the transverse axis.

Prop. XIII.

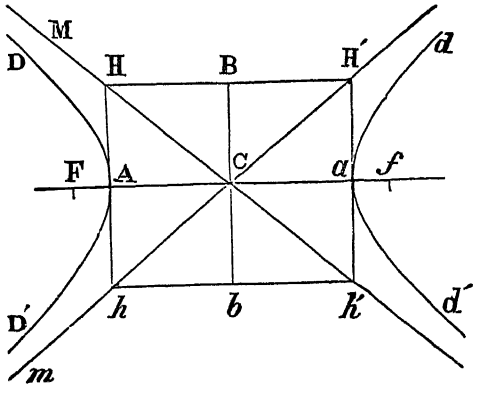
If a tangent to an hyperbola meet the conjugate axis, and from the point of contact a perpendicular be drawn to that axis, the semiaxis will be a mean proportional between the segments of the axis intercepted between the centre and the perpendicular, and between the centre and the tangent.



Let DH, a tangent to the hyperbola at D, meet the conjugate axis Bb in H, and let DG be perpendicular to that axis, then CG : CB=CB : CH.

Let DH meet the transverse axis in K; draw DE perpendicular to that axis, draw DF, Df to the foci, and describe a circle about the triangle DfF; the conjugate axis will evidently pass through the centre of the circle; and because the angle FDf is bisected by the tangent DK, the line DK will pass through H the intersection of the conjugate axis with the circumference; therefore the circle passes through H. Draw DL to the other extremity of the diameter. The triangles LGD, KCH are similar, for each is similar to the right-angled triangle LDH, therefore

LG : GD (or CE) = CK : CH;
hence LG · CH = CE · CK = CA² (11.)
Now LC · CH = CF² (35, 3, E.),
therefore LC · CH — LG · CH = CF² — CA²;
that is, CG · CH = CB² (Def. 8),
wherefore CG : CB = CB : CH.



Definition.

Hyperbola.

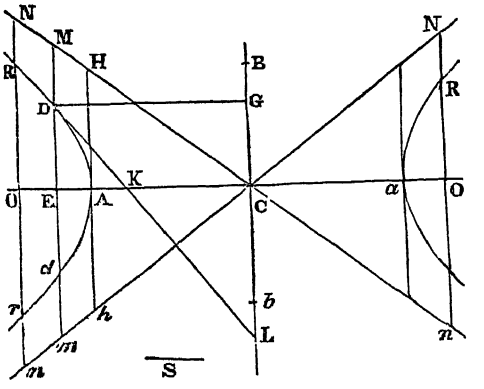
XII. If through A, one of the vertices of the transverse axis, a straight line HAk be drawn, equal and parallel to Bb the conjugate axis, and bisected at A by the transverse axis; the straight lines CHM, Chm drawn through the centre, and the extremities of that parallel, are called *Asymptotes.*

Cor. 1. The asymptotes of two opposite hyperbolas are common to both. Through a, the other extremity of the axis, draw H'ah', parallel to Bb, and meeting the asymptotes of the hyperbola DAD' in H' and h'. Because aC is equal to AC, aH' is equal to Ah, and ah' to AH.

Cor. 2. The asymptotes are diagonals of a rectangle formed by drawing perpendiculars to the axes at their vertices; for the lines AH, CB, aH', being equal and parallel, the points H, B, H' are in a straight line parallel to Aa; the same is true of the points h, b, h'.

Prop. XIV.

The asymptotes do not meet the hyperbola; and if from any point in the curve a straight line be drawn parallel to the conjugate axis, and terminated by the asymptotes, the rectangle contained by its segments between that point and the asymptotes is equal to the square of half the conjugate axis.



Through D, any point in the hyperbola, draw a straight line parallel to the conjugate axis, meeting the transverse axis in E, and the asymptotes in M and m; the points M and m shall be without the hyperbola, and the rectangle MD · Dm equal to the square of BC.

Draw DG perpendicular to Bb the conjugate axis; let a tangent to the curve at D meet the transverse axis in K, and the conjugate axis in L, and let a perpendicular at the vertex A meet the asymptote in H. Because DK is a tangent, and DE an ordinate to the axis, CA is a mean proportional between CK and CE (11); and therefore

CK : CE=CA² : CE² (2 Cor. 20, 6, E.).
But CK : CE=LC : LG,
and CA² : CE² :: AH² : EM²,
therefore LC : LG :: AH² : EM².

Again, CB being a mean proportional between CL and CG (13),

LC : CG=CB² : CG²,
and therefore, by composition,
LC : LG = CB² : CB²+CG², or CB²+ED²;
wherefore AH² : EM²=CB² : CB²+ED².
Now AH²=CB² (Def. 12),
therefore EM²=CB²+ED²,

consequently EM² is greater than ED², and EM greater than ED, therefore M is without the hyperbola. In like manner it appears that m is without the hyperbola, therefore every point in both the asymptotes is without the hy-

Hyperbola. perbola. Again, the straight line Mm, terminated by the asymptotes, being manifestly bisected by the axis at E,

$$ME^2 = MD \cdot Dm + DE^2;$$

but it has been shown that

$$ME^2 = BC^2 + DE^2,$$

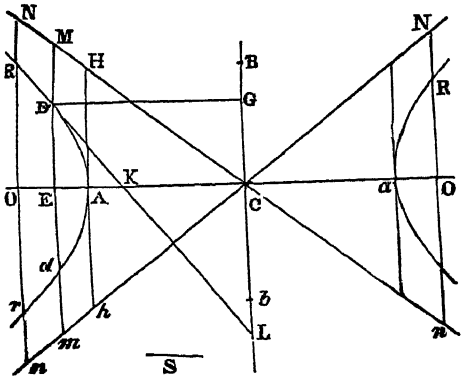
therefore $MD \cdot Dm = BC^2$.

Cor. 1. Hence, if in a straight line Mm, terminated by the asymptotes, and parallel to the conjugate axis, there be taken a point D such that the rectangle MD · Dm is equal to the square of that axis, the point D is in the hyperbola.

Cor. 2. If straight lines MDm, NRn, be drawn through D and R, any points in the hyperbola, or opposite hyperbolas, parallel to the conjugate axis, and meeting the asymptotes in M, m, and N, n, the rectangles MD · Dm, NR · Rn are equal.

Prop. XV.

The hyperbola and its asymptote, when produced, continually approach to each other, and the distance between them becomes less than any given line.



Take two points E and O in the transverse axis produced, and through these points draw straight lines parallel to the conjugate axis, meeting the hyperbola in D, R, and the asymptotes in M, m and N, n.

Because $NO^2 > ME^2$

and $NR \cdot Rn = MD \cdot Dm$ (2 Cor. 14),

therefore $NO^2 - NR \cdot Rn > ME^2 - MD \cdot Dm$;

that is, $RO^2 > DE^2$,

and $RO > DE$.

Now $On > Em$,

therefore $Rn > Dm$;

and since $Rn : Dm = DM : RN$ (2 Cor. 14),

$DM > RN$,

therefore the point R is nearer to the asymptote than D, that is, the hyperbola when produced approaches to the asymptote.

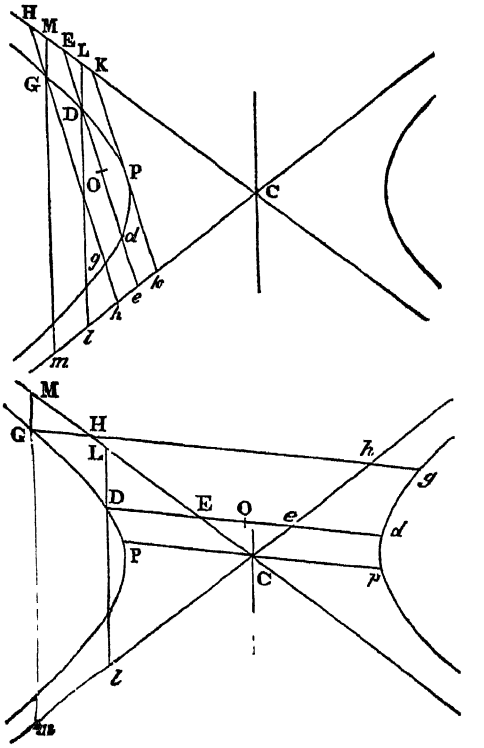
Let S be any line less than half the conjugate axis; then, because Dm, a straight line drawn from a point in the hyperbola, parallel to the conjugate axis, and terminated by the asymptote on the other side of the transverse axis, may evidently be of any magnitude greater than Ah, which is equal to half the conjugate axis, Dm may be a third proportional to S and BC; and since Dm is also a third proportional to DM (the segment between D and the other asymptote) and BC, DM may be equal to S; but the distance of D from the asymptote is less than DM, therefore that distance may become less than S, and consequently less than any given line.

Cor. Every straight line passing through the centre within the angles contained by the asymptotes through which the transverse axis passes, meets the hyperbola, and therefore is a transverse diameter; and every straight Hyperbola. line passing through the centre within the adjacent angles falls entirely without the hyperbola.

Scholium. The name *asymptotes* (*non concurrentes*) has been given to the lines CH, Ch, because of the property they have of continually approaching to the hyperbola without meeting it, as has been proved in this proposition.

Prop. XVI.

If from two points in an hyperbola, or opposite hyperbolas, two parallel straight lines be drawn to meet the asymptotes, the rectangles contained by their segments between the points and the asymptotes are equal.



Let D and G be two points in the hyperbola, or opposite hyperbolas; let parallel lines EDe, HGh be drawn to meet the asymptotes in E, e, and H, h; the rectangles ED · De, HG · Gh are equal.

Through D and G draw straight lines parallel to the conjugate axis, meeting the asymptotes in the points L, l, and M, m. The triangles HGM, EDL are similar, as also the triangles hGm, eDl,

therefore $DL : DE = GM : GH$,

and $Dl : De = Gm : Gh$;

hence, taking the rectangles of the corresponding terms of the proportions,

$LD \cdot Dl : ED \cdot De = MG \cdot Gm : HG \cdot Gh$;

but $LD \cdot Dl = MG \cdot Gm$ (2 Cor. 14),

therefore $ED \cdot De = HG \cdot Gh$.

Cor. 1. If a straight line be drawn through D, d, two points in the same or opposite hyperbolas, the segments DE, de between those points and the asymptotes are equal. For in the same manner that the rectangles ED · De, HG · Gh have been proved to be equal, it may be shown that the rectangles Ed · de, HG · Gh are equal, therefore ED · De = Ed · de. Let Ee be bisected in O, then ED · De = $EO^2 - OD^2$, and Ed · de = $EO^2 - Od^2$, therefore $EO^2 - OD^2 = EO^2 - Od^2$; hence OD = O$d$, and ED = ed.

Cor. 2. When the points D and d are in the same hyperbola, by supposing them to approach till they coincide at P, the line Ee will thus become a tangent to the curve at P. Therefore any tangent KPk, which is terminated by the asymptotes, is bisected at P, the point of contact.

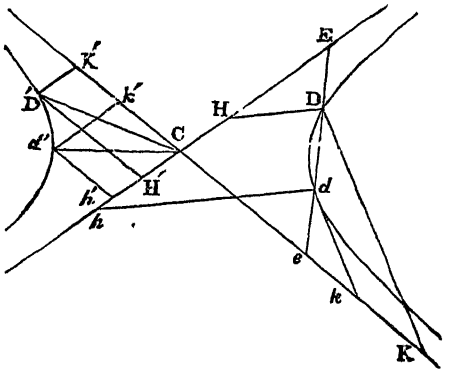
Cor. 3. And if any straight line KPk, limited by the asymptotes, be bisected at P, a point in the curve, that line is a tangent at P. For it is evident that only one line can be drawn through P, which shall be limited by the asymptotes, and bisected at P.

Cor. 4. If a straight line be drawn through D, any point in the hyperbola, parallel to a tangent KPk, and terminated by the asymptotes at E and e, the rectangle ED · De is equal to the square of PK, the segment of the tangent between the point of contact and either asymptote. The demonstration is the same as in the proposition.

Cor. 5. If from any point D in an hyperbola a straight line be drawn parallel to Pp, any diameter, meeting the asymptotes in E and e, the rectangle ED · De is equal to the square of half that diameter. The demonstration is the same as in the proposition.

Prop. XVII.

If two straight lines be drawn from any point in an hyperbola to the asymptotes, and from any other point in the same or opposite hyperbolas two other lines parallel to the former be drawn to meet the same asymptotes; the rectangle contained by the first two lines will be equal to the rectangle contained by the other two lines.



From D, any point in the hyperbola, draw DH and DK to the asymptotes, and from any other point d draw dh and dk parallel to DH and DK. The rectangles HD · DK, hd · dk are equal.

Join D, d, cutting the asymptotes in E, e. From similar triangles

$$ED : DH = E\delta : dh,$$
$$\text{and } eD : DK = e\delta : dk;$$

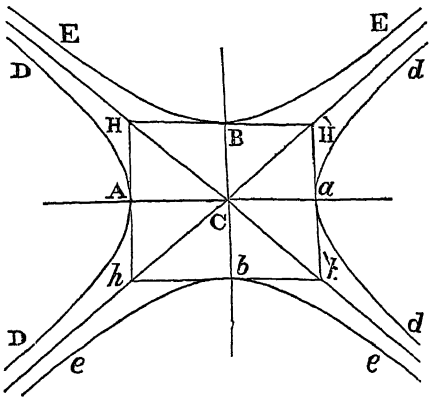
therefore, taking the rectangles of corresponding terms,

$$ED \cdot De : HD \cdot DK = E\delta \cdot de : hd \cdot dk;$$
$$\text{but } ED \cdot De = E\delta \cdot de \text{ (1 Cor. 16)},$$
$$\text{therefore } HD \cdot DK = hd \cdot dk.$$

Cor. 1. If the lines D'K', D'H', $d'k'$, $d'h'$, be parallel to the asymptotes, and thus form the parallelograms D'K'CH', $d'k'$ Ch', these are equal to one another (16, and 14, 6, E.). And if D'C, d'C be joined, the halves of the parallelograms, or the triangles D'K'C, $d'k'$C are also equal.

Cor. 2. If from D', d', any two points in an hyperbola, straight lines D'K', $d'k'$ be drawn parallel to one asymptote, meeting the other in K' and k', these lines are to each other reciprocally as their distances from the centre, or D'K' : $d'k'$ :: Ck' : CK'. This appears from last corollary, and 14, 6, E.

Definitions.



XIII. If Aa be the transverse axis and Bb the conjugate axis of two opposite hyperbolas DAD, *dad*, and if Bb be the transverse axis and Aa the conjugate axis of other two opposite hyperbolas EBE, *ebe*, these hyperbolas are said to be *conjugate to the former*. When all the four hyperbolas are mentioned they are called *conjugate hyperbolas*.

Cor. The asymptotes of the hyperbolas DAD, *dad* are also the asymptotes of the hyperbolas EBE, *ebe*. This is evident from Cor. 2 to Definition 12.

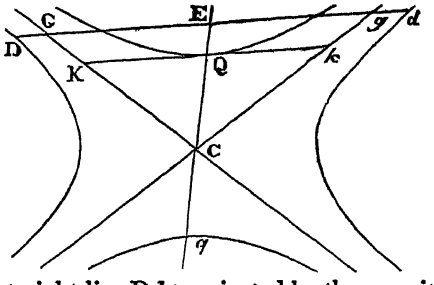
XIV. Any diameter of the conjugate hyperbolas is called a *second diameter of the other hyperbolas*.

Cor. Every straight line passing through the centre, within the angle through which the conjugate or second axis passes, is a second diameter of the hyperbola.

XV. Any straight line not passing through the centre, but terminated both ways by the opposite hyperbolas, and bisected by a second diameter, is called an *ordinate to that diameter*.

Prop. XVIII.

Any straight line not passing through the centre, but terminated by the opposite hyperbolas, and parallel to a tangent to either of the conjugate hyperbolas, is bisected by the second diameter that passes through the point of contact, or is an ordinate to that diameter.



The straight line Dd terminated by the opposite hyperbolas, and parallel to the tangent KQk, is bisected at E by Qq, the diameter that passes through the point of contact.

Let Dd meet the asymptotes in G and g, and let the tangent meet them in K and k. The straight lines Gg, Kk are evidently similarly divided at E and Q, and since KQ = Qk (2 Cor. 16), therefore GE = Eg; now DG = gd (1 Cor. 16), therefore DE = Ed.

Cor. 1. Every ordinate to a second diameter is parallel to a tangent at its vertex. The demonstration is the same as in Cor. 2, Prop. 10.

Cor. 2. All the ordinates to the same second diameter are parallel to each other.

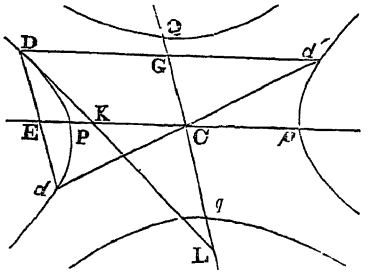
Cor. 3. A straight line that bisects two parallel straight lines which terminate in the opposite hyperbolas is a second diameter.

Hyperbola. Cor. 4. The ordinates to the conjugate or second axis are perpendicular to it, and no other second diameter is perpendicular to its ordinates.

Cor. 5. The opposite hyperbolas are similar to one another, and like portions of them are in all respects equal.

Prop. XIX.

If a transverse diameter of an hyperbola be parallel to the ordinates to a second diameter; the latter shall be parallel to the ordinates to the former.



Let Pp, a transverse diameter of an hyperbola, be parallel to DGd', any ordinate to the second diameter Qq; the second diameter Qq shall be parallel to the ordinates to the diameter Pp.

Draw the diameter d'Cd through one extremity of the ordinate d'D, and join d and D, the other extremity, meeting Pp in E. Because dd' is bisected at C, and CE is parallel to d'D, the line Dd is bisected at E, therefore Dd is an ordinate to the diameter Pp. And because Dd' and dd' are bisected at G and C, the diameter Qq is parallel to Dd (2, 6, E.); therefore Qq is parallel to any ordinate to the diameter Pp.

Definitions.

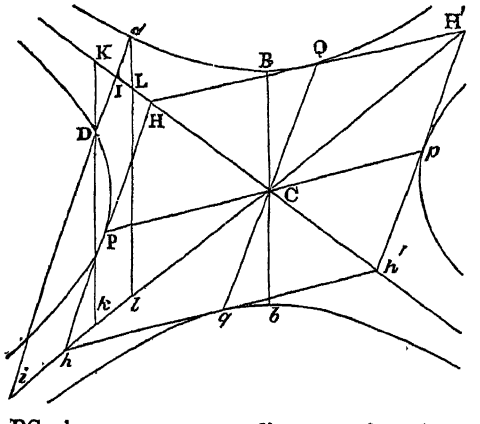
XVI. Two diameters are said to be *conjugate to one another* when each is parallel to the ordinates to the other diameter.

Cor. Diameters which are conjugate to one another are parallel to tangents at the vertices of each other.

XVII. A third proportional to any diameter and its conjugate is called the *Parameter*, also the *Latus rectum of that diameter.*

Prop. XX.

The tangent at the vertex of any transverse diameter of an hyperbola, which is terminated by the asymptotes, is equal to the diameter that is conjugate to that diameter.



Let PCp be any transverse diameter of an hyperbola, HPh a tangent at its vertex, meeting the asymptotes in H and h, and Qq the diameter which is conjugate to Pp; the tangent Hh is equal to the diameter Qq.

Hyperbola. Through D, any point in the hyperbola, draw a straight line parallel to the tangent and diameter, cutting either of the conjugate hyperbolas in d, and the asymptotes in I and i, and through D and d draw lines parallel to Bb, the conjugate axis, meeting the asymptotes in the points K, k, and L, l. The triangles DIK, dIL are similar, as also iDk, $id$$l$, therefore

$$\text{KD} : \text{DI} :: \text{L}d : d\text{I},$$
$$\text{and } k\text{D} : \text{D}i :: l\,d : di;$$

therefore, taking the rectangles of the corresponding terms,

$$\text{KD} \cdot \text{D}k : \text{ID} \cdot \text{D}i :: \text{L}d \cdot dl : \text{I}d \cdot di.$$

But $\text{KD} \cdot \text{D}k = \text{BC}^2$ (14), and $\text{BC}^2 = \text{L}d \cdot dl$ (5 Cor. 16), therefore $\text{ID} \cdot \text{D}i = \text{I}d \cdot di$.

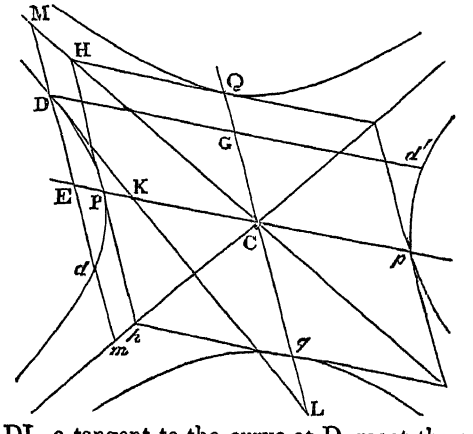
Now $\text{ID} \cdot \text{D}i = \text{HP}^2$ (4 Cor. 16),
and $\text{I}d \cdot di = \text{QC}^2$ (5 Cor. 16);
therefore $\text{HP}^2 = \text{QC}^2$, and HP = QC,
and consequently Hh = Qq.

Cor. 1. If another tangent be drawn to the curve at p, meeting the asymptotes in H' and h', the straight lines which join the points H, H', also h, h', are tangents to the conjugate hyperbolas at Q and q. For pH', as well as PH, is equal and parallel to CQ; therefore the points H, Q, H', are in a straight line parallel to Pp, and HQ = H'Q (34, 1, E.), therefore HQH' is a tangent to the curve at Q. In like manner it appears that hqh' is a tangent at q.

Cor. 2. If tangents be drawn at the vertices of two conjugate diameters, they will meet in the asymptotes, and form a parallelogram, of which the asymptotes are diagonals.

Prop. XXI.

If a tangent to an hyperbola meet a second diameter, and from the point of contact an ordinate be drawn to that diameter; half the second diameter will be a mean proportional between the segments of the diameter intercepted between the centre and the ordinate and between the centre and the tangent.



Let DL, a tangent to the curve at D, meet the second diameter Qq in L, and let DGd' be an ordinate to that diameter; then

$$\text{CG} : \text{CQ} = \text{CQ} : \text{CL}.$$

Let Pp be the diameter that is conjugate to Qq, let HPh be a tangent at the vertex, terminated by the asymptotes; through D draw the ordinate DEd to the diameter Pp, meeting the asymptotes in M and m; let K be the intersection of DL and Pp. Because DK is a tangent at D, and DEd an ordinate to Pp, CP is a mean proportional between CE and CK (11), and therefore

$$\text{CE}^2 : \text{CP}^2 :: \text{CE} : \text{CK}.$$

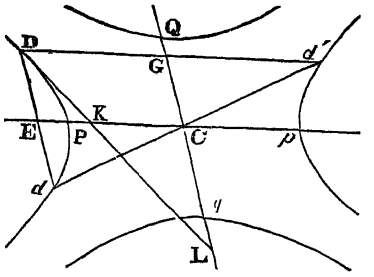
Now, the lines CQ, PH, EM, being parallel (2 Cor. 10, and Def. 16), from similar triangles,

Hyperbola.

$$CE^2 : CP^2 = EM^2 : PH^2,$$
and CE or DG : CK = LG : LC;
therefore $EM^2 : PH^2 = LG : LC$,
and, by division, &c.
$$EM^2 - PH^2 : PH^2 = CG : LC = CG^2 : CG \cdot LC.$$
But since $PH^2 = MD \cdot Dm$ (4 Cor. 16),
$$EM^2 - PH^2 = ED^2 = CG^2 \text{ (5, 2, E.)};$$
therefore $PH^2 = CG \cdot LC$;
hence, and since PH = CQ (20),
$$CG : CQ = CQ : CL.$$

PROP. XXII.

If an ordinate be drawn to any transverse diameter of an hyperbola; the rectangle under the abscisses of the diameter will be to the square of the semi-ordinate as the square of the diameter to the square of its conjugate.



Let DEd be an ordinate to the transverse diameter Pp, and let Qq be its conjugate diameter;
$$PE \cdot Ep : DE^2 = Pp^2 : Qq^2.$$
Let DKL, a tangent at D, meet the diameter in K, and its conjugate in L. Draw DG parallel to Pp, meeting Qq in G. Because CP is a mean proportional between CE and CK (11),
$$CP^2 : CE^2 = CK : CE,$$
and, by division, and (5, 2, E.) $CP^2 : PE \cdot Ep = CK : KE$.
But, because ED is parallel to CL,
$$CK : KE = CL : DE, \text{ or } CG;$$
and because CQ is a mean proportional between CG and CL (21),
$$CL : CG = CQ^2 : CG^2, \text{ or } DE^2,$$
therefore $CP^2 : PE \cdot Ep : CQ^2 : DE^2$,
and, by inversion and alternation,
$$PE \cdot Ep : DE^2 = CP^2 : CQ^2 = Pp^2 : Qq^2.$$

COR. 1. If an ordinate be drawn to any second diameter of an hyperbola, the sum of the squares of half the second diameter and its segment, intercepted between the ordinate and the centre, is to the square of the semi-ordinate as the square of the second diameter to the square of its conjugate.

Let DG be a semi-ordinate to the second diameter Qq. It has been shown that
$$CG^2 : CQ^2 = PE \cdot Ep : CP^2;$$
therefore, by composition,
$$CQ^2 + CG^2 : CQ^2 = CE^2 \text{ or } DG^2 : CP^2,$$
and by alternation,
$$CQ^2 + CG^2 : DG^2 = CQ^2 : CP^2 = Qq^2 : Pp^2.$$

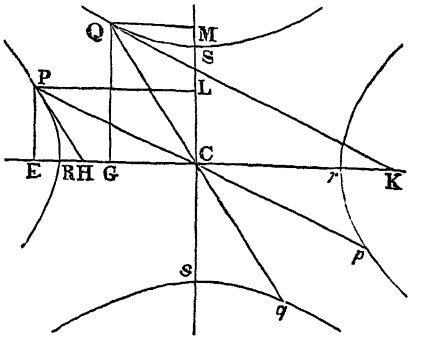
COR. 2. The squares of semi-ordinates, and of ordinates to any transverse diameter, are to one another as the rectangles contained by the corresponding abscisses; and the squares of semi-ordinates, and of ordinates to any second diameter, are to one another as the sums of the squares of half that diameter, and the segments intercepted between the ordinate and the centre.

COR. 3. The ordinates to any transverse diameter, which intercept equal segments of that diameter from the centre, are equal to one another, and, conversely, equal ordinates intercept equal segments of the diameter from the centre.

PROP. XXIII.

Hyperbola.

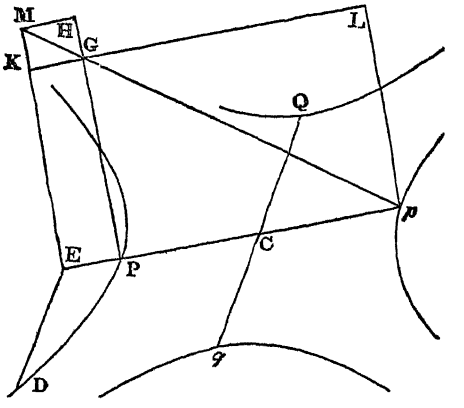
The transverse axis of an hyperbola is the least of all its transverse diameters, and the conjugate axis is the least of all its second diameters.



Let Rr be the transverse axis, Pp any other transverse diameter; draw PE perpendicular to Rr; then CE being greater than CR, and CP greater than CE, much more is CP greater than CR, therefore Pp is greater than Rr. In like manner it is shown, that if Ss be the conjugate axis, and Qq any other second diameter, Qq is greater than Ss.

PROP. XXIV.

If an ordinate be drawn to any transverse diameter of an hyperbola, the rectangle under the abscisses of the diameter is to the square of the semi-ordinate as the diameter to its parameter.



Let DE be a semi-ordinate to the transverse diameter Pp; let PG be the parameter of the diameter, and Qq the conjugate diameter. By the definition of the parameter (Def. 16), $Pp : Qq = Qq : PG$,
therefore $Pp : PG = Pp^2 : Qq^2$ (2 Cor. 20, 6, E.).
But $Pp^2 : Qq^2 = PE \cdot Ep : DE^2$ (22);
therefore $PE \cdot Ep : DE^2 = Pp : PG$.

COR. Let the parameter PG be perpendicular to the diameter Pp; join pG, and from E draw EM parallel to PG, meeting pG in M. The square of DE, the semi-ordinate, is equal to the rectangle contained by PE and EM.
For $PE \cdot Ep : DE^2 = Pp : PG$,
and $Pp : PG = Ep : EM = PE \cdot Ep : PE \cdot EM$,
therefore $DE^2 = PE \cdot EM$.

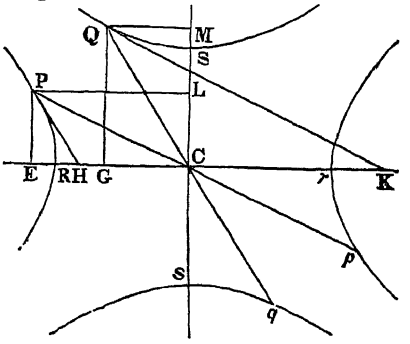
SCHOLIUM.

If the rectangles PGLp, HGKM be completed, it will appear that the square of ED is equal to the rectangle MP, which rectangle is greater than the rectangle KP, contained by the abscis PE, and the parameter GP, by a rectangle KH similar and similarly situated to LP, the rectangle contained by the parameter and diameter. It

Hyperbola. was on account of the excess of the square of the ordinate above the rectangle contained by the absciss and parameter that Apollonius gave the curve to which the property belonged the name of Hyperbola.

PROP. XXV.

If from the vertices of two conjugate diameters of an hyperbola there be drawn ordinates to any third transverse diameter; the square of the segment of that diameter, intercepted between the ordinate from the vertex of the second diameter and the centre, is equal to the rectangle contained by the segments between the other ordinate and the vertices of the third transverse diameter. And the square of the segment intercepted between the ordinate from the vertex of the transverse diameter and the centre is equal to the square of the segment between the other ordinate and the centre, together with the square of half the third transverse diameter.



Let Pp, Qq be two conjugate diameters, of which Pp is a transverse and Qq a second diameter; let PE, QG be semi-ordinates to any third transverse diameter Rr; then $CG^2 = RE \cdot Er$, and $CE^2 = CG^2 + CR^2$.

Draw the tangents PH, QK, meeting Rr in H and K. The rectangles $HC \cdot CE$ and $KC \cdot CG$ are equal, for each is equal to CR^2 (11), therefore

$$HC : CK = CG : CE.$$

But the triangles HPC, CQK are evidently similar (Cor. Def. 16); and since PE, QG are parallel, their bases CH, KC are similarly divided at E and G, therefore

$$HC : CK = HE : CG,$$

wherefore $CG : CE = HE : CG$,

consequently $CG^2 = CE \cdot EH =$ (1 Cor. 11), $RE \cdot Er$.

Again, from the similar triangles HPC, CQK,

$$HC : CK = CE : KG.$$

Now, it was shown that $HC : CK = CG : CE$,

therefore $CG : CE = CE : KG$,

consequently

$CE^2 = CG \cdot GK =$ (3, 2, E.), $CG^2 + GC \cdot CK$;

but $GC \cdot CK = CR^2$ (21),

therefore $CE^2 = CG^2 + CR^2$.

COR. 1. Let Ss be the diameter that is conjugate to Rr, then Rr is to Ss as CG to PE, or as CE to QG.

For $Rr^2 : Ss^2 = RE \cdot Er$, or $CG^2 : PE^2$ (22),

therefore $Rr : Ss = CG : PE$.

In like manner $Rr : Ss = CE : QG$.

COR. 2. The difference between the squares of CE, CG, the segments of the transverse diameter to which the semi-ordinates PE, QG are drawn, is equal to the square of CR the semi-diameter. For it has been shown that

$$CE^2 = CG^2 + CR^2,$$

therefore $CE^2 - CG^2 = CR^2$.

COR. 3. The difference of the squares of any two conjugate diameters is equal to the difference of the squares of the axes. Let Rr, Ss be the axes, and Pp, Qq any two conjugate diameters; draw PE, QG perpendicular to Rr, and PL, QM perpendicular to Ss. Then

$$CE^2 - CG^2 = CR^2,$$

and $CM^2 - CL^2$, or $GQ^2 - PE^2 = CS^2$;

therefore $CE^2 + PE^2 - (CG^2 + GQ^2) = CR^2 - CS^2$;

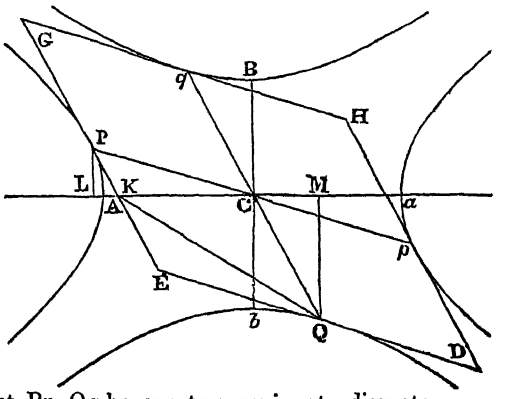
that is (47, 1, E.), $CP^2 - CQ^2 = CR^2 - CS^2$,

therefore $Pp^2 - Qq^2 = Rr^2 - Ss^2$.

Hyperbola.

PROP. XXVI.

If four straight lines be drawn touching conjugate hyperbolas at the vertices of any two conjugate diameters; the parallelogram formed by these lines is equal to the rectangle contained by the transverse and conjugate axes.



Let Pp, Qq be any two conjugate diameters, a parallelogram DEGH formed by tangents to the conjugate hyperbolas at their vertices is equal to the rectangle contained by Aa, Bb, the two axes.

Let Aa, one of the axes, meet the tangent PE in K; join QK, and draw PL, QM perpendicular to Aa.

Because $CK : CA = CA : CL$ (11),

and $CA : CB = CL : QM$ (1 Cor. 25),

ex. æq. $CK : CB = CA : QM$,

therefore $CK \cdot QM = CB \cdot CA$.

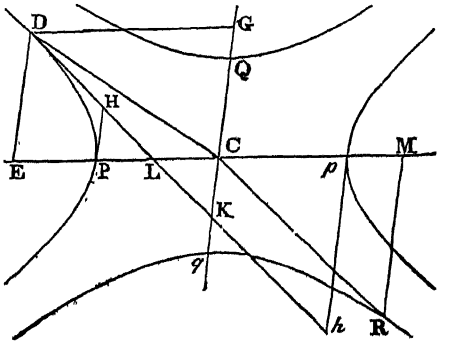
But $CK \cdot QM =$ twice trian. $CKQ =$ paral. CPEQ,

therefore the parallelogram $CPEQ = CB \cdot CA$;

and, taking the quadruples of these, the parallelogram DEGH is equal to the rectangle contained by Aa and Bb.

PROP. XXVII.

If two tangents at the vertices of any transverse diameter of an hyperbola meet a third tangent; the rectangle contained by their segments between the points of contact and the points of intersection is equal to the square of the semidiameter to which they are parallel. And the rectangle contained by the segments of the third tangent between its point of contact and the parallel tangents, is equal to the square of the semidiameter to which it is parallel.



Let PH, ph, tangents at the vertices of a transverse diameter Pp, meet DHh, a tangent to the curve at any point D, in H and h; let CQ be the semidiameter to which

Hyperbola. the tangents PH, ph are parallel, and CR that to which Dh is parallel; then

$$PH \cdot ph = CQ^2 \text{ and } DH \cdot Dh = CR^2,$$

Let Hh meet the semidiameters CP, CQ in L and K. Draw DE, RM parallel to CQ, and DG parallel to CP.

Because $LP \cdot Lp = LE \cdot LC$ (2 Cor. 11),

$$LP : LE = LC : Lp;$$

hence, and because of the parallels PH, ED, CK, ph,

$$PH : ED = CK : ph,$$

wherefore $PH \cdot ph = ED \cdot CK$.

But $ED \cdot CK = CG \cdot CK = CQ^2$ (21),

therefore $PH \cdot ph = CQ^2$.

Again, the triangles LED, CMR are evidently similar, and LE, LD are similarly divided at P and H, also at p and h;

therefore $PE : HD = (LE : LD =)\ CM : CR$,

also $pE : hD = (LE : LD =)\ CM : CR$;

hence, taking the rectangles of the corresponding terms,

$$PE \cdot pE : HD \cdot hD = CM^2 : CR^2.$$

But if CD be joined, the points D and R are evidently the vertices of two conjugate diameters (Cor. Def. 16), and therefore $PE \cdot pE = CM^2$ (25);

therefore $HD \cdot hD = CR^2$.

Cor. The rectangle contained by LD and DK, the segments of a tangent intercepted between D the point of contact, and Pp, Qq, any two conjugate diameters, is equal to the square of CR, the semidiameter to which the tangent is parallel.

Let the parallel tangents PH, ph meet LK in H and h, and draw DE, a semi-ordinate to Pp. Because of the parallels ED, PH, CK, ph,

$$LE : LD = EP : DH,$$

and $EC : DK = Ep : Dh$,

therefore

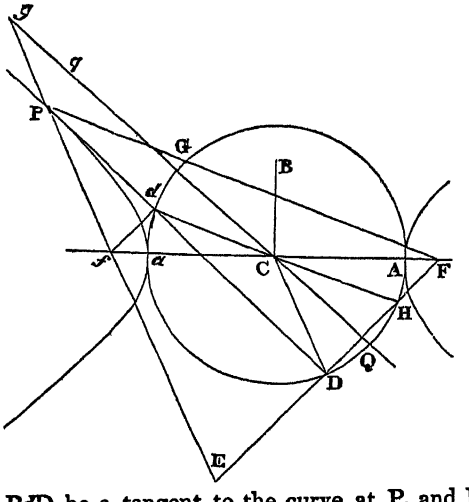
$$LE \cdot EC : LD \cdot DK = EP \cdot Ep : DH \cdot Dh.$$

But $LE \cdot EC = EP \cdot Ep$ (1 Cor. 11),

therefore $LD \cdot DK = DH \cdot Dh =$ (by this Prop.) CR^2.

Prop. XXVIII.

If two straight lines be drawn from the foci of an hyperbola perpendicular to a tangent; straight lines drawn from the centre, to the points in which they meet the tangent, will each be equal to half the transverse axis.



Let PdD be a tangent to the curve at P, and FD, fd perpendiculars to the tangent from the foci; the straight lines joining the points C, D and C, d are each equal to AC, half the transverse axis.

Join FP, fP, and produce FD, Pf till they intersect in E. The triangles FDP, EDP have the angles at D right angles, and the angles FPD, EPD equal (5), and the side DP common to both; they are therefore equal, and consequently have ED = DF, and EP = PF; wherefore Hyperbola. Ef = FP — Pf = Aa. Now the straight lines FE, Ff being bisected at D and C, the line DC is parallel to Ef, and thus the triangles FfE, FCD, are similar,

therefore $Ff : fE$, or $Aa = FC : CD$;

but FC is half Ff, therefore CD is half of Aa.

Cor. If a straight line Qq be drawn through the centre parallel to the tangent Dd, it will cut off from PF, Pf the segments PG, Pg, each equal to AC half the transverse axis. For CdPG, CDPg are parallelograms, therefore PG = dC = AC, and Pg = DC = AC.

Prop. XXIX.

The rectangle contained by perpendiculars drawn from the foci of an hyperbola to a tangent is equal to the square of half the conjugate axis.

(See Figure to Prop. XXVIII.)

Let PdD be a tangent, and FD, fd perpendiculars from the foci, the rectangle contained by FD and fd is equal to the square of BC half the conjugate axis.

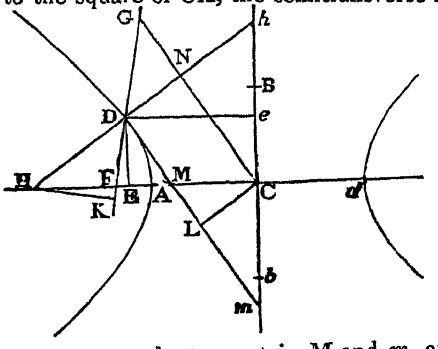
It is evident from last proposition that the points D, d, are in the circumference of a circle, whose centre is the centre of the hyperbola, and radius CA half the transverse axis; now FDd being a right angle, if dC be joined and produced, it will meet DF in H, a point in the circumference; and since FC = fC, and CH = Cd, and the angles FCH, fCd are equal, FH is equal to fd, therefore $DF \cdot df = DF \cdot FH = AF \cdot aF$ (36, 3, E.) = CB^2 (3).

Cor. If PF, Pf, be drawn from the point of contact to the foci; the square of FD is a fourth proportional to fP, FP, and CB^2. For the angles fPd, FPD are equal (5), and FDP, fdP are right angles, therefore the triangles FDP, fdP are similar, and

fP : FP = fd : FD = $fd \cdot$ FD or $BC^2 : FD^2$.

Prop. XXX.

If from C the centre of an hyperbola a straight line CL be drawn perpendicular to a tangent LD, and from D the point of contact a perpendicular be drawn to the tangent, meeting the transverse axis in H and the conjugate axis in h; the rectangle contained by CL and DH is equal to the square of CB, the semiconjugate axis; and the rectangle contained by CL and Dh is equal to the square of CA, the semitransverse axis.



Let the axes meet the tangent in M and m, and from D draw the semi-ordinates DE, De, which will be perpendicular to the axes.

The triangles DEH, CLm, are evidently equiangular,

therefore $DH : DE = Cm : CL$,

hence $CL \cdot DH = DE \cdot Cm$;

but $DE \cdot Cm$ or $Ce \cdot Cm = BC^2$ (12),

therefore $CL \cdot DH = BC^2$.

In the same way it may be shown that $CL \cdot Dh = AC^2$.

Cor. 1. If a perpendicular be drawn to a tangent at the point of contact; the segments intercepted between the point of contact and the axes are to each other recipro-

Hyperbola. cally as the squares of the axes by which they are terminated.

For $AC^2 : BC^2 = CL \cdot Dh : CL \cdot DH = Dh : DH$.

Cor. 2. If DF be drawn to either focus, and HK be drawn perpendicular to DF; the straight line DK shall be equal to half the parameter of the transverse axis.

Draw CG parallel to the tangent at D, meeting DH in N, and DF in G. The triangles GDN, HDK, are similar,

therefore GD : DN = HD : DK;

and hence GD · DK = HD · DN.

But GD = AC (Cor. 28) and ND = CL,

therefore AC · DK = HD · CL = (by the Prop.) CB^2,

wherefore AC : BC = BC : DK;

hence DK is half the parameter of Aa (Def. 17).

Definition.

(See Figure to next Prop.)

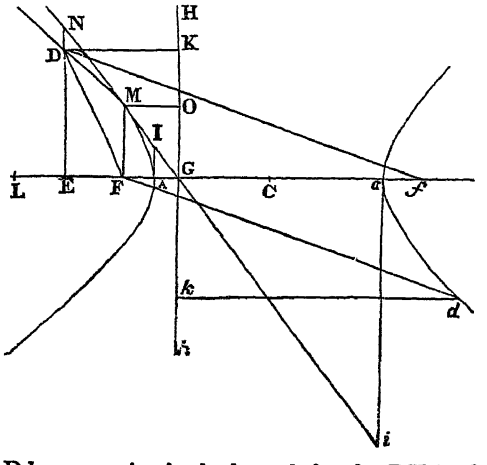
XVIII. If a point G be taken in the transverse axis of an hyperbola, so that the distance of G from the centre may be a third proportional to CF, the distance of either focus from the centre, and CA the semitransverse axis; a straight line HGh drawn through G, perpendicular to the axis, is called the *directrix* of the hyperbola.

Cor. 1. If an ordinate to the axis be drawn through the focus; tangents to the hyperbola at the extremities of the ordinate will meet the axis at the point G (11).

Cor. 2. The hyperbola has two directrices, for the point G may be taken on either side of the centre.

Prop. XXXI.

The distance of any point in an hyperbola from either directrix is to its distance from the focus nearest that directrix, in the constant ratio of the semitransverse axis to the distance of the focus from the centre.



Let D be any point in the hyperbola; let DK be drawn perpendicular to the directrix, and DF to the focus nearest the directrix; DK is to DF as CA, half the transverse axis, to CF, the distance of the focus from the centre.

Draw Df to the other focus, and DE perpendicular to Aa; take L a point in the axis so that AL = FD, and consequently La = Df; then CL is evidently half the sum of AL and aL, or of FD and fD, and CE half the sum of FE and fE; and because

$Df - DF : Ff = fE + FE : Df + DF$ (K, 6, E.),

by taking the halves of the terms of the proportion,

CA : CF = CE : CL.

But CA : CF = CG : CA (Def. 18),

therefore CG : CA = CE : CL;

hence (19, 5, E.) EG : AL = CG : CA = CA : CF,

that is, DK : DF = CA : CF.

Cor. 1. If the tangent GMN be drawn through M, the extremity of the ordinate passing through the focus, and ED be produced to meet GM in N; EN shall be equal to DF. For draw MO perpendicular to the directrix, then, because M and D are points in the hyperbola, and from similar triangles, Hyperbola.

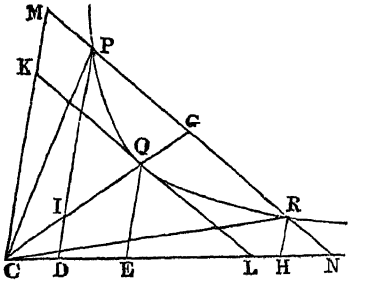
FM : FD = MO : DK = GF : GE = MF : EN,

therefore FD = EN.

Cor. 2. If AI and ai be drawn perpendicular to the transverse axis at its extremities, meeting the tangent GM in I and i, then AI = AF and $ai = aF$.

Prop. XXXII.

If through P and Q the vertices of two semidiameters of an hyperbola there be drawn straight lines PD, QE parallel to one of the asymptotes CM, meeting the other asymptote in D and E; the hyperbolic sector PCQ is equal to the hyperbolic trapezium PDEQ.



Let CQ meet PD in I. The triangles CDP, CEQ are equal (1 Cor. 17); therefore, taking the triangle CDI from both, the triangle CIP is equal to the quadrilateral DEQI. To these add the figure PIQ, and the hyperbolic sector PCQ is equal to the hyperbolic trapezium PDEQ.

Prop. XXXIII.

If from the centre of an hyperbola the segments CD, CE, CH be taken in continued proportion in one of the asymptotes, and the straight lines DP, EQ, HR be drawn parallel to the other asymptote, meeting the hyperbola in P, Q, R; the hyperbolic areas PDEQ, QEHR are equal.

(See Figure to preceding Prop.)

Through Q draw a tangent to the curve, meeting the asymptotes in K and L: join PR, meeting the asymptotes in M and N; draw the semidiameters CP, CQ, CR; let CQ meet PR in G.

Because QE is parallel to CM, and KQ is equal to QL (2 Cor. 16), CE is equal to EL; and because MC, PD, RH, are parallel, and MP is equal to RN (1 Cor. 16), CD is equal to HN. Now, by hypothesis,

CD : CE = CE : CH,

therefore NH : LE = CE : CH;

but CE : CH = HR : EQ (2 Cor. 17),

therefore NH : LE = HR : EQ,

and, by alternation, NH : HR = LE : EQ.

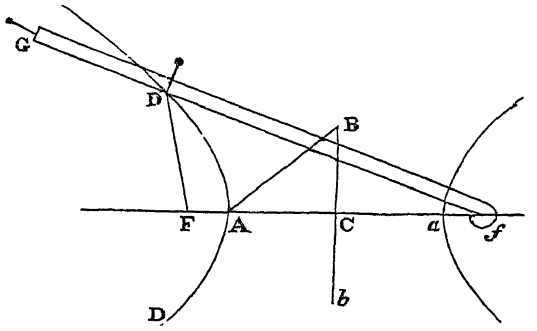
Now the angles at H and E are equal, therefore the triangles NHR, LEQ are equiangular, and NR is parallel to LQ; consequently RP is an ordinate to the diameter CQ (10), and is bisected by it at G; and as CQ bisects all lines which are parallel to KL, and are terminated by the hyperbola, it will bisect the area PQR. Let the equal areas PQG, RQG be taken from the equal triangles PCG, RCG, and there will remain the hyperbolic sectors PCQ, RCQ equal to each other. Therefore (32) the areas DPQE, EQRH are also equal.

Cor. Hence if CD, CE, CH, &c. any number of segments of the asymptote, be taken in continued proportion, the areas DPQE, DPQRH, &c. reckoned from the first line DP, will be in arithmetical progression.

Cone.

PROP. XXXIV. PROBLEM.

Two straight lines Aa, Bb, which bisect each other at right angles in C, being given by position; to describe an hyperbola, of which Aa shall be the transverse and Bb the conjugate axes.



Join AB, and in Aa produced take CF, Cf each equal to AB; the points F, f will be the foci of the hyperbola.

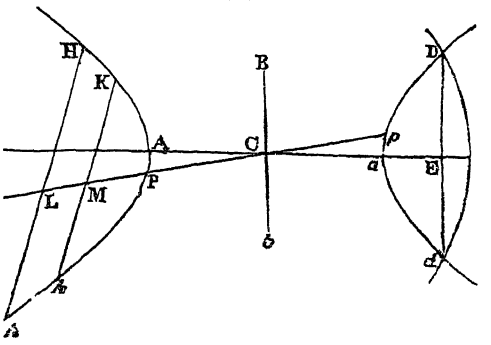
Let one end of a string be fastened at F, and the other to G the extremity of a ruler fDG, and let the difference between the length of the ruler and the string be equal to Aa. Let the other end of the ruler be fixed to the point f, and let the ruler be made to revolve about f as a centre in the plane in which the axes are situated, while the string is stretched by means of a pin D, so that the part of it between G and D is applied close to the edge of the ruler; the point of the pin will by its motion trace a curve line DAD upon the plane, which is one of the hyperbolas required.

If the ruler be made to revolve about the other focus F, while the end of the string is fastened to f, the opposite hyperbola will be described by the moving point D; for in either case $Gf - (GD + DF)$, that is, $Df - DF$ is by hypothesis equal to Aa the transverse axis.

PROP. XXXV. PROBLEM.

Cone.

An hyperbola being given by position; to find its axes.

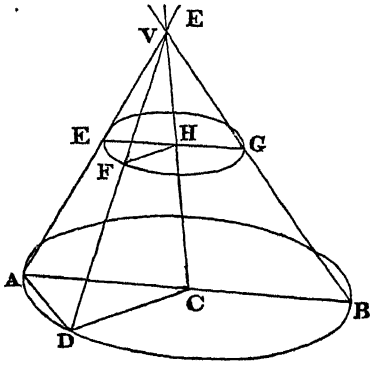


Let HAh be the given hyperbola. Draw two parallel straight lines Hh, Kk, terminating in either of the opposite hyperbolas, and bisect them at L and M; join LM, and produce it to meet the hyperbola in P; then LP will be a transverse diameter (4 Cor. 10). Let p be the point in which it meets the opposite hyperbola, bisect Pp in C, the point C is the centre (2). Take D any point in the hyperbola, and on C as a centre with the distance CD describe a circle; if this circle lie wholly without the opposite hyperbolas, then CD must be half the transverse axis (23); but if not, let the circle meet the hyperbola again in d; join Dd, and bisect it in E; join CE, meeting the opposite hyperbolas in A and a, then Aa will be the transverse axis (5 Cor. 10); for it is perpendicular to Dd (3, 3, E.), which is an ordinate to Aa. The other axis will be found by drawing Bb a straight line through the centre perpendicular to Aa, and taking CB so that CB^2 may be a fourth proportional to the rectangle $AE \cdot Ea$, and the squares of DE and CA; thus CB is half the conjugate axis (22).

PART IV.

SECT. I.—OF THE CONE AND ITS SECTIONS.

DEFINITIONS.



I. If through the point V, without the plane of the circle ADB, a straight line AVE be drawn, and produced indefinitely both ways, and if the point V remain fixed while the straight line AVE is moved round the whole circumference of the circle; two superficies will be generated by its motion, each of which is called a *Conical Superficies*, and these mentioned together are called *Opposite Conical Superficies*.

II. The solid contained by the conical superficies and the circle ADB, is called a *Cone*.

III. The fixed point V is called the *Vertex of the cone*.

IV. The circle ADB is called the *Base of the cone*.

V. Any straight line drawn from the vertex to the circumference of the base is called a *Side of the cone*.

VI. A straight line VC drawn through the vertex of the cone, and the centre of the base, is called the *Axis of the cone*.

VII. If the axis of the cone be perpendicular to the base, it is called a *Right cone*.

VIII. If the axis of the cone be not perpendicular to the base, it is called a *Scalene cone*.

PROP. I.

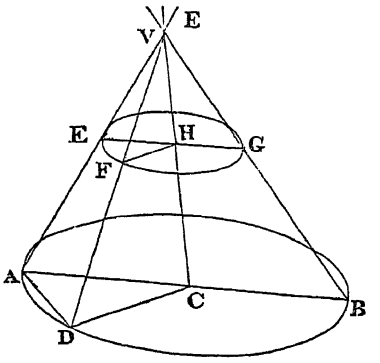
If a cone be cut by a plane passing through the vertex; the section will be a triangle.

Let ADBV be a cone of which VC is the axis; let AD be the common section of the base of the cone and the cutting plane; join VA, VD. When the generating line comes to the points A and D, it is evident that it will coincide with the straight lines VA, VD; they are therefore in the surface of the cone, and they are in the plane which passes through the points V, A, D, therefore the triangle VAD is the common section of the cone and the plane which passes through its vertex.

PROP. II.

If a cone be cut by a plane parallel to its base; the section will be a circle, the centre of which is in the axis.

Cone.



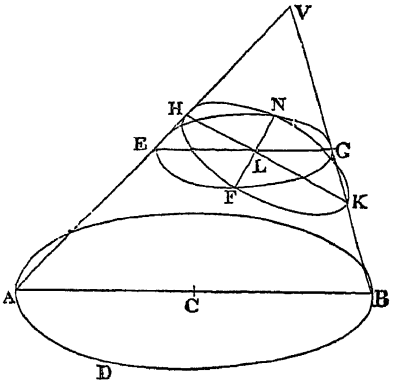
Let EFG be the section made by a plane parallel to the base of the cone, and VAB, VCD two sections of the cone made by any two planes passing through the axis VC; let EG, HF be the common sections of the plane EFG, and the planes VAB, VCD. Because the planes EFG, ADB are parallel, HE, HF will be parallel to CA, CD, and

$$AC : EH = (VC : VH =)\ CD : HF;$$

but $AC = CD$, therefore $EH = HF$. For the same reason $GH = HF$, therefore EFG is a circle of which H is the centre and EG the diameter.

PROP. III.

If a scalene cone ADBV be cut through the axis by a plane perpendicular to the base, making the triangle VAB, and from any point H in the straight line AV a straight line HK be drawn in the plane of the triangle VAB, so that the angle VHK may be equal to the angle VBA, and the cone be cut by another plane passing through HK perpendicular to the plane of the triangle ABV, the common section HFKN of this plane and the cone will be a circle.



Take any point L in the straight line HK, and through L draw EG parallel to AB, and let EFGN be a section parallel to the base, passing through EG; then the two planes HFKN, EFGN being perpendicular to the plane VAB, their common section FLN is perpendicular to ELG, and since EFGN is a circle (by last Prop.), and EG its diameter, the square of FL is equal to the rectangle contained by EL and LG (35, 3, E.); but since the angle VHK is equal to VBA or VGE, the angles EHK, EGK are equal, therefore the points E, H, G, K, are in the circumference of a circle (21, 3, E.), and $HL \cdot LK = EL \cdot LG$ (35, 3, E.) $= FL^2$, therefore the section HFKN is a circle of which HLK is a diameter (35, 3, E.)

This section is called a *Subcontrary Section.*

PROP. IV.

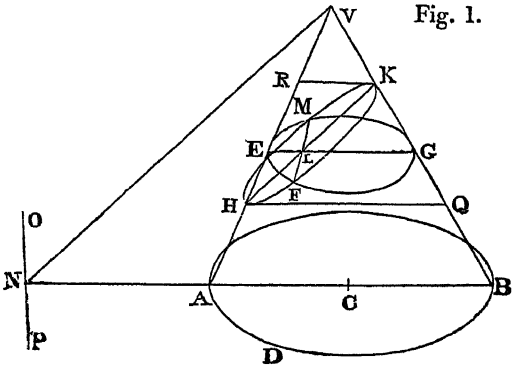
If a cone be cut by a plane which does not pass through the vertex, and which is neither parallel to the base nor to the plane of a subcontrary section: the common section of the plane and the surface of the cone will be an ellipse, a parabola, or an hyperbola, according as the plane passing through the vertex parallel to the cutting plane falls without the cone, touches it, or falls within it. Cone.

Let ADBV be any cone, and let ONP be the common section of a plane passing through its vertex and the plane of the base, which will either fall without the base, or touch it, or fall within it.

Let FKM be a section of the cone parallel to VPO; through C the centre of the base draw CN perpendicular to OP, meeting the circumference of the base in A and B; let a plane pass through V, A, and B, meeting the plane OVP in the line NV, the surface of the cone in VA, VB, and the plane of the section FKM in LK; then, because the planes OVP, MKF are parallel, KL will be parallel to VN, and will meet VB one side of the cone in K; it will meet VA the other side in H, fig. 1, within the cone; it will be parallel to VA in fig. 2, and it will meet VA, produced beyond the vertex, in H, fig. 3.

Let EFGM be a section of the cone parallel to the base, meeting the plane VAB in EG, and the plane FKM in FM, and let L be the intersection of EG and FM; then EG will be parallel to BN, and FM will be parallel to PO, and therefore will make the same angle with LK, wherever the lines FM, LK cut each other; and since BN is perpendicular to PO, EG is perpendicular to FM. Now the section EFGM is a circle of which EG is the diameter (2), therefore FM is bisected at L, and $FL^2 = EL \cdot LG$.

Fig. 1.



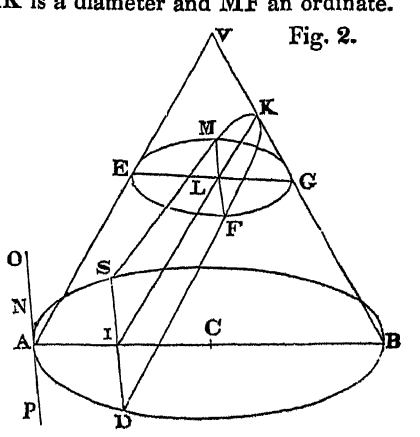
CASE I. Let the line PNO be without the base of the cone. Through K and H draw KR and HQ parallel to AB. The triangles KLG, KHQ are similar, as also HLE, HKR; therefore

$$KL : LG = KH : HQ,$$

and $$HL : LE = KH : KR;$$

therefore $KL \cdot HL : LG \cdot LE$ or $LF^2 :: KH^2 : HQ \cdot KR$. Now the ratio of KH^2 to $HQ \cdot KR$ is the same wherever the sections HFKM, EFGM intersect each other; therefore $KL \cdot HL$ has a constant ratio to LF^2, consequently (1 Cor. 13, Part II.) the section HFKM is an ellipse, of which HK is a diameter and MF an ordinate.

Fig. 2.



Curvature. CASE 2. Next, suppose the line ONP to touch the circumference of the base in A. Let DIS be the common section of the base and the plane FKM; the line DIS is evidently parallel to FLM, and perpendicular to AB, therefore $DI^2 = AI \cdot IB$,

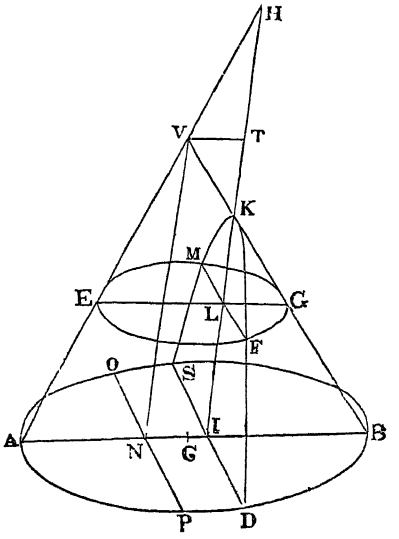
hence $DI^2 : FL^2 = AI \cdot IB : EL \cdot LG$.

But since EG is parallel to AB, and IK parallel to AV, AI is equal to EL, and

$$IB : LG = KI : KL,$$

therefore $DI^2 : FL^2 = KI : KL$.

Hence it appears (Cor. 11, Part I.), that the section DFKMS is a parabola, of which KLI is a diameter, and DIS, FLM ordinates to that diameter.



CASE 3. Lastly, let the line PNO fall within the base; draw VT through the vertex parallel to EG. The triangles HVT, HEL are similar, as also the triangles KVT, KGL, therefore

$$HT : TV = HL : LE,$$

and $KT : TV = KL : LG$;

therefore $HT \cdot KT = TV^2 = HL \cdot LK : LE \cdot LG$ or LF^2. Hence it appears that $HL \cdot LK$ has to LF^2 a constant ratio, therefore the section DFKMS is an hyperbola, of which KH is a transverse diameter, and FM an ordinate to that diameter (2 Cor. 22, Part III.).

SCHOLIUM. From the four preceding propositions it appears, that the only lines which can be formed by the common section of a plane and the surface of a cone, are these five: 1. A straight line, or rather two straight lines intersecting each other in the vertex of the cone, and forming with the straight line which joins the points in which they meet the base, a triangle; 2. A circle; 3. An ellipse; 4. A parabola; 5. An hyperbola. The first two of these, however, viz. the triangle and circle, may be referred to the hyperbola and the ellipse; for if the axes of an hyperbola be supposed to retain a constant ratio to each other, and, at the same time, to diminish continually, till at last the vertices coincide; the opposite hyperbolas will evidently become two straight lines intersecting each other in a point; and a circle may be considered as an ellipse, whose axes are equal, or whose foci coincide with the centre; so that the only three sections which require to be separately considered are the *ellipse*, the *parabola*, and the *hyperbola*.

SECT. II.—OF THE CURVATURE OF THE CONIC SECTIONS.

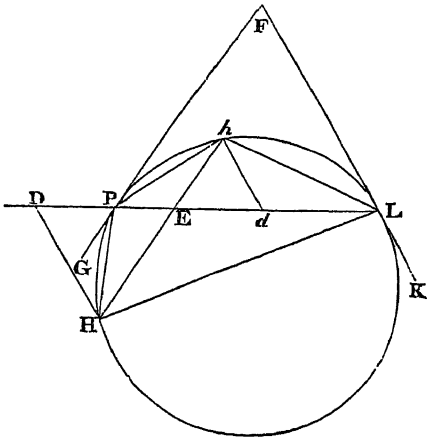
DEFINITIONS.

I. A circle is said to *touch* a conic section in any point when the circle and conic section have a common tangent at that point. Curvature.

II. If a circle touch a conic section in any point, so that no other circle touching it in the same point can pass between it and the conic section on either side of the point of contact, it is said to have the *same curvature* with the conic section in the point of contact, and it is called the *Circle of Curvature*.

LEMMA.

If straight lines be drawn touching a circle at the extremities of any chord, and from any point in the circumference straight lines be drawn parallel to the tangents, to terminate in the chord; these lines will be equal; and the square of each will be equal to the rectangle contained by the segments of the chord between each line and the point of contact of the tangent to which it is parallel.



Let PL be any chord in a circle, and FPG, FLK tangents at P and L; if from any point H in the circumference there be drawn HE, HD parallel to FG, FL respectively, meeting the chord in E and D; the lines HE, HD are equal; and the square of each is equal to the rectangle $LD \cdot PE$.

The sides of the triangle HDE being parallel to those of the triangle FLP, viz. HD to FL and HE to FP, the triangles are equiangular (29, 1, E.); now the angles FPL, FLP of the latter are equal (32, 3, E.), therefore the corresponding angles HED, HDE of the former are equal, and HD = HE.

And because the angle DHL is equal to HLK (29, 1, E.), and this last is equal to EPH (32, 3, E.); also, because the angle HLD is equal to HPG (32, 3, E.), which again is equal to PHE (29, 1, E.); the triangles DHL, EPH are equiangular. Therefore

$$LD : DH = HE : EP,$$

and (16, 6, E.) $LD \cdot EP = DH \cdot HE = HD^2 = HE^2$.

If the point h be in the arc of the opposite segment, and hd be drawn parallel to FL, and hE to PF, it will in like manner appear that

$$Ld \cdot EP = hd^2 = hE^2.$$

COR. 1. The points D and d being determined as directed in the proposition,

$$LP : LD = LH^2 : LD^2,$$

and $LP : Ld = Lh^2 : Ld^2$.

The triangles DLH, HLP have the angle at L common to both, and the angles DHL, HPL equal, because each is equal to the angle HLK (29, 1, E. and 32, 3, E.), therefore they are equiangular; hence

$$LP : LH = LH : LD \text{ (4, 6, E.)},$$

and $LP : LD (= LP^2 : LH^2) = LH^2 : LD^2$ (Cor. 19, 6, E.).

In the same way it may be proved that

$$LP : Ld = Lh^2 : Ld^2.$$

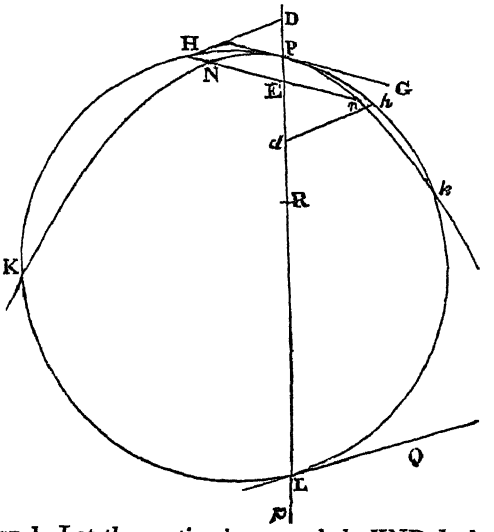
Curvature. Cor. 2. If E, the intersection of the chords Hh, PL, be between P and L, the points D, d will be on opposite sides of the point P. For in this case the chord LH will be greater than the chord LP, and the chord Lh will be less; therefore LH^2 will be greater than LP^2, and Lh^2 less; consequently (from Cor. 1) LD will be greater than LP, and Ld less than LP.

Cor. 3. If the chord Hh, which is parallel to the tangent PF, be supposed to approach continually towards that tangent; the points D, d, and E will continually approach to P, and may come nearer to it than any assignable distance.

Prop. I.

If a circle be described touching a conic section, and cutting off from the diameter that passes through the point of contact a segment greater than the parameter of that diameter; a part of the circumference on each side of the point of contact will be wholly without the conic section; but if it cut off a segment less than the parameter, a part of the circumference on each side of the point of contact will be wholly within the conic section.

Fig. 1.



Case 1. Let the section be a parabola KNPnk; let Pp be any diameter, and PG a tangent at P its vertex. Let a circle KHPhk touch the parabola and tangent at P, and cut off from the diameter a segment PL either greater or less than its parameter (fig. 1, 2). An arc HPh of the circle, extending to each side of the vertex P, will be wholly without the parabola or wholly within it.

First let PL be greater than RL, a segment of the diameter equal to the parameter (fig. 1); draw LQ touching the circle at L; let Nn, an ordinate to the diameter Pp, meet the circle in H and h, and draw HD, hd parallel to LQ, meeting the diameter in D and d.

Because NE^2 = nE^2 = PE · LR (12, Part I.),

and HE^2 = PE · LD
also hE^2 = PE · Ld } (Lemma);

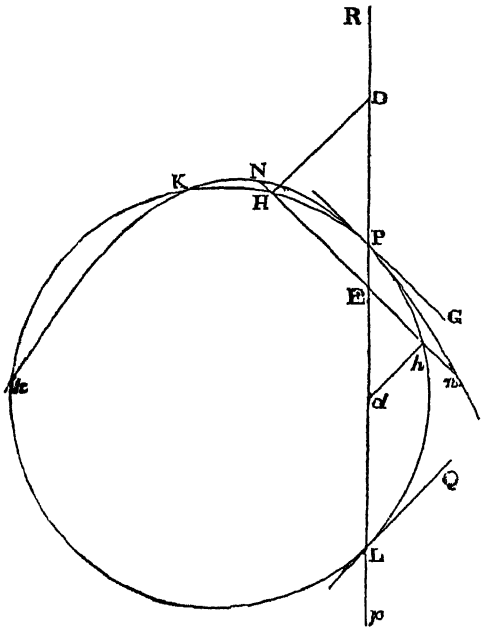
therefore NE^2 : HE^2 = LR : LD,

and nE^2 : hE^2 = LR : Ld.

Now since Pd may be less than any given line (Cor. 3 to Lemma), let it be less than PR; then LD and Ld will both be greater than LR, and consequently HE will be greater than NE, and hE greater than nE; therefore the arc of the circle HPh will be wholly without the parabola.

Fig. 2.

Curvature.



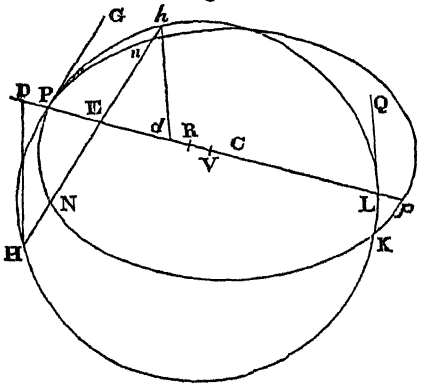
Next let PL, the segment of the diameter cut off by the circle, be less than LR the parameter; as before, let Nn an ordinate to the diameter Pp meet the circle in H and h, and let HD, hd be parallel to the tangent LQ; then, as in the preceding case,

NE^2 : HE^2 = LR : LD,

and nE^2 : hE^2 = LR : Ld.

Suppose now PD to be less than PR (Cor. 3, Lemma), then LD and Ld will each be less than LR, and therefore HE will be less than NE, and hE less than nE; hence the arc HPh of the circle will be within the parabola.

Fig. 3.



Case 2. Now let the curve be an ellipse or hyperbola (fig. 3 and 4).[1] First let the circle, which has a common tangent PG with the curve at the vertex of the diameter, cut off from it a segment PL greater than LR, a segment of the chord equal to its parameter. Let Nn, an ordinate to Pp, meet the circle in H and h: draw LQ touching the circle at L, and draw HD, hd parallel to LQ. Take a point V in Pp, such that

Pp : pE = LR : LV;

then Pp : LR = Ep : LV.

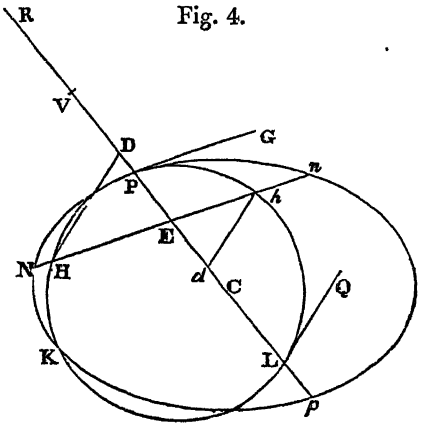
Now PE · Ep : NE^2 = Pp : LR = Ep : LV (15, Part II., and 21, Part III.);

[1] The reasoning in the case of the hyperbola is exactly like that for the ellipse; therefore, to avoid multiplying figures, those for the hyperbola are omitted.

Curvature. hence also $PE \cdot Ep : NE^2 = PE \cdot Ep : PE \cdot LV$ (1, 6, E.),
therefore $NE^2 = nE^2 = PE \cdot LV$.
Now $HE^2 = PE \cdot LD$, and $hE^2 = PE \cdot Ld$,
therefore $NE^2 : HE^2 = LV : LD$,
and $nE^2 : hE^2 = LV : Ld$.

Let the chord Hh of the circle have such a position that Pd is less than PR (Cor. 3 to Lemma); then pd and pD will both be greater than pR, and consequently greater than pV, which is less than pR. In this position of the chord, and in every other nearer to the tangent, NE will be less than HE, and nE less than hE; therefore the arc HPh of the circle will be entirely without the ellipse or hyperbola on each side of their common point P.

Fig. 4.



Lastly, suppose that the segment LP of the diameter cut off by the circle is less than LR its parameter; then the same construction being made as in the other case, we shall have $NE^2 : HE^2 = LV : LD$,
$nE^2 : hE^2 = LV : Ld$.
Now, when the ordinate Nn approaches toward the tangent PG, the point D will approach to P, and the point V to R; therefore there will be a position of the ordinate in which LD and Ld will be both less than LV; and the same will be true for all positions nearer to the tangent. In these, NE will be greater than HE, and nE greater than hE; thus it appears that the arc HPh will be within the curve, to a certain extent, on each side of the point P.

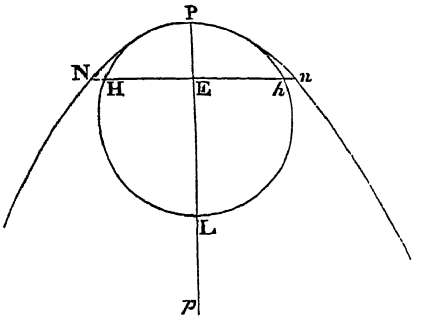
Cor. 1. If a circle touch a conic section, and cut off from the diameter that passes through the point of contact a segment equal to its parameter, it will have the same curvature with the conic section in the point of contact.

For if a greater circle be described, it will cut off a segment greater than its parameter, therefore a part of its circumference on each side of the point of contact will be wholly without the conic section; and as it will also be without the former circle, it will not pass between that circle and the conic section at the point of contact. If, on the other hand, a less circle be described, it will cut off from the diameter a less segment than its parameter, therefore a part of the circumference on each side of the point of contact will fall within the conic section; and as it will be within the former circle, it will not pass between that circle and the conic section at the point of contact. Hence (Def. 2), the circle which cuts off a segment equal to the parameter is the circle of equal curvature.

Prop. II.

The circle of curvature at the vertex of the axis of a parabola, or at the vertex of the transverse axis of an ellipse or hyperbola, falls wholly within the conic section; but the circle of curvature at the vertex of the conjugate axis of an ellipse falls wholly without the conic section. Curvature.

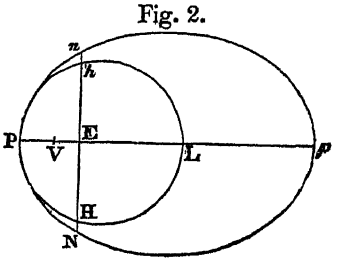
Fig. 1.



Let Pp be the axis of a parabola, and $PHLh$ the circle of curvature at its vertex, which therefore (Cor. 1) cuts off from the axis a segment PL equal to the parameter of the axis; if a tangent were drawn to the parabola at its vertex, it would also be a tangent to the circle at that point, therefore the centre of the circle is in Pp. Let NEn, an ordinate to the axis, meet the circle in H and h. It may be shown, as in the preceding proposition, that $NE^2 : HE^2 = LP : LE$.
Now, in every position of the ordinate, LP is greater than LE; therefore NE^2 is always greater than HE^2, and nE^2 is greater than hE^2; therefore the circle is wholly within the parabola.

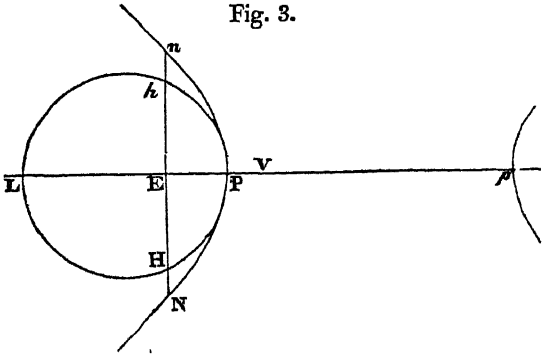
Next, let Pp be the transverse axis of an ellipse (fig. 2), or hyperbola (fig. 3), or the conjugate axis of an ellipse (fig. 4), and $PHLh$ the circle of curvature; then, as in the parabola, the centre of the circle will be in the axis. In each case draw Nn, an ordinate to the axis meeting the circle in H and h, and take a point V in PL, so that
$pP : pE = LP : LV$;
then it will appear, as in the last Proposition, that
$NE^2 : HE^2 = LV : LE$.

Fig. 2.



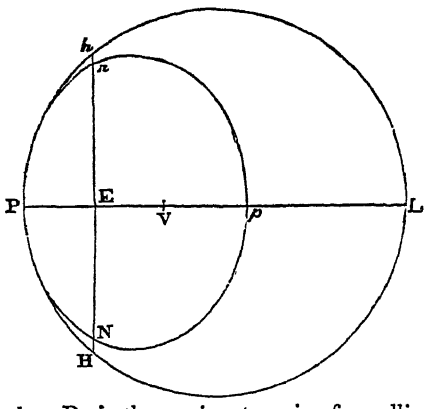
Now, when Pp is the transverse axis of an ellipse (fig. 2), since Pp is greater than LP and $Pp : PL = PE : PV$, therefore PE is greater than PV; and hence LV is always greater than LE; therefore NE^2 is greater than HE^2, also nE^2 is greater than hE^2; hence the circle falls wholly within the ellipse.

Fig. 3.



Curvature. Again, when Pp is the transverse axis of an hyperbola (fig. 3), pE is greater than pP, and therefore LV is greater than LP, and consequently greater also than LE; hence NE^2 is greater than HE^2, and nE^2 greater than hE^2, and the circle is wholly within the hyperbola.

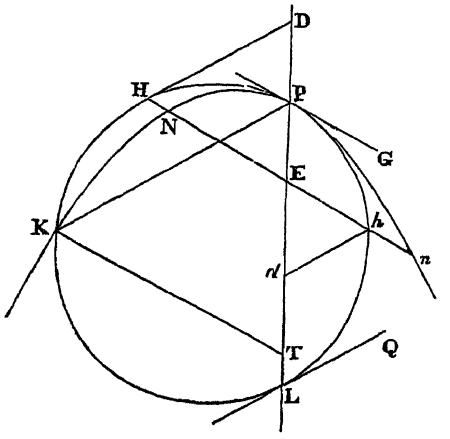
Fig. 4.



Lastly, when Pp is the conjugate axis of an ellipse (fig. 4), since pP is in this case less than LP, and pP : LP = PE : PV, therefore PE is less than PV; hence LV is less than LE, and consequently NE^2 is less than HE^2, and nE^2 less than hE^2; therefore the circle is wholly without the ellipse.

PROP. III.

The circle of curvature at the vertex of any diameter of a conic section which is not an axis, meets the conic section again in one point only; and between that point and the vertex of the diameter the circle falls wholly within the conic section on the one side, and wholly without it on the other.



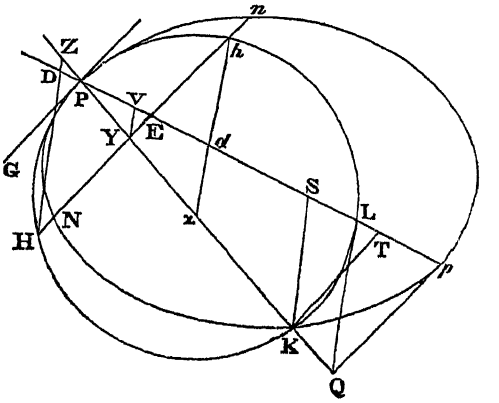
CASE 1. Let the conic section be a parabola, of which PL is a diameter, and let PLK be the circle of curvature at its vertex; cutting off from the diameter a segment PL equal to its parameter; draw PG touching the circle and parabola at P, and LQ touching the circle in L; also draw PK parallel to LQ, meeting the circle in K, and KT parallel to PG, meeting the axis in T. The lines KP, KT will be equal, and

KT^2 = PT · LP (Lemma);

therefore KT is a semi-ordinate to the diameter PL (12, Part I.), and K is a point in the parabola. And since only one line PK can be drawn parallel to the tangent LQ, only one such point K can be found; therefore the circle of curvature cuts the parabola in one point, besides the vertex of the diameter, and in no more. Between P and T draw NEn any ordinate to the diameter PL, meeting the circle in H and h, and draw HD, hd parallel to the tangents LQ, HD, meeting the axis in D and d; and because

NE^2 also nE^2 = PE · PL (12, Part I.)
and HE^2 = PE · LD
and hE^2 = PE · Ld (Lemma),
therefore NE^2 : HE^2 = PL : LD,
and nE^2 : hE^2 = PL : Ld.

Now PL is less than LD; therefore NE is less than HE, and the circular arc PHK is without the parabola from the vertex to the intersection K. If the ordinate be more remote from the vertex than the position KT, then D and d will be both on the same side of the vertex, and therefore PL will be greater than LD, also greater than Ld, and consequently NE will be greater than HE, also nE than hE; hence it follows that the arc PLK falls wholly within the parabola.



CASE 2. Let the conic section be either an ellipse or a hyperbola, of which Pp is a diameter, and PLK the circle of equal curvature at its vertex, cutting off a segment PL equal to its parameter. Draw LQ touching the circle, and pQ touching the curve; and because this line is parallel to the line PG, which touches the circle and ellipse at P, the lines LQ, pQ make equal acute or obtuse angles (but in opposite directions) with pL; therefore they will meet at a point Q. Join PQ; and because Q is without the circle, and P is in the circumference, the line PQ, which cannot be a tangent, must cut the circle in one other point K, and in no more. Draw KS and KT parallel to QL and Qp, meeting Pp in S and T.

Because of the parallels,

Pp : pT = PQ : QK = PL : LS (2, 6, E.);
therefore (by alt.) Pp : PL = pT : LS = pT · TP : LS · TP.
But LS · PT = KT^2 (Lemma),
therefore Pp : PL = pT · TP : KT^2.

Hence KT is a semi-ordinate to the diameter Pp, and K is a point in the ellipse or hyperbola (15 of Part II. and 24 of Part III.)

Draw NEn, any ordinate to the diameter, so as to meet the equicurve circle in H and h, and the line PQ in Y. Draw HDZ, hdz parallel to LQ, meeting Pp, PQ in D, Z and in d, z; also draw YV parallel to LQ, meeting Pp in V.

Because of the parallel lines,

Pp : Ep = PQ : YQ = PL : VL,
hence Pp : PL (= Ep : VL) = PE · Ep : PE · VL.
But Pp : PL = PE · Ep : NE^2 or nE^2,
therefore NE^2 = nE^2 = PE · VL.
But HE^2 = PE · LD
and hE^2 = PE · Ld (Lemma),

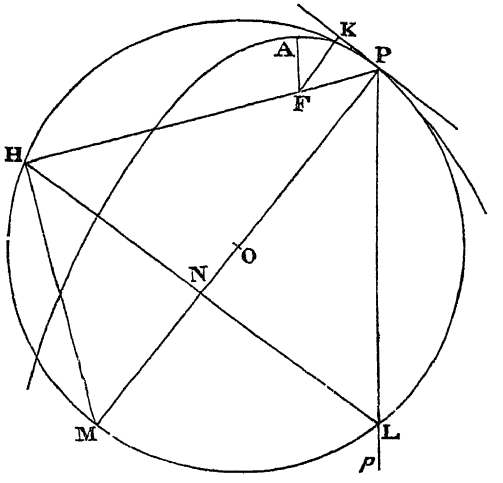
Curvature.

therefore $NE^2 : HE^2 = VL : LD = YQ : QZ$,
and $nE^2 : hE^2 = VL : Ld = YQ : Qz$.

Now wherever the point H be taken in the arc PHK, it is manifest that YQ will be less than QZ, therefore also NE is less than HE; thus the arc PHK falls wholly without the conic section. Again, since YQ always exceeds Qz, therefore nE always exceeds hE; hence the arc PhK falls wholly within the section.

Prop. IV.

The chord of the circle of curvature which is drawn from the point of contact through the focus of a parabola is equal to that which is cut off from the diameter; and half the radius of the circle is a third proportional to the perpendicular from the focus upon the tangent, and the distance of the point of contact from the focus.



Let PL be the chord cut off from the diameter, and PFH the chord passing through F the focus; draw PM the diameter of the circle; join HL, HM, and draw FK perpendicular to the tangent at P. Because the lines PFH, PL make equal angles with the tangent at P (3 Cor. 3, Part I.), the angles PHL, PLH are equal (32, 3, E.); hence PH = PL. Secondly, the triangles FKP, PHM being manifestly similar,

FK : FP = PH, or 4 PF : PM,
hence FK : FP = FP : $\frac{1}{4}$ PM, or $\frac{1}{2}$ the radius.

Cor. 1. Hence the radius is equal to $\frac{2FP^2}{FK}$.

Cor. 2. The radius is also equal to $\frac{2FK^3}{AF^2}$, where AF is the distance of the focus from the vertex of the parabola; for $FP = \frac{FK^2}{AF}$ (14, Part I.).

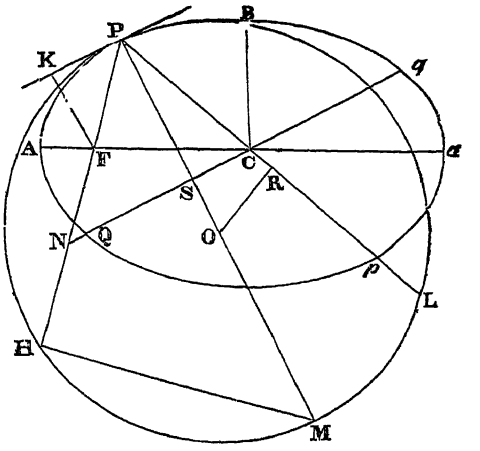
Cor. 3. Hence also the radius is equal to $\frac{\frac{1}{2}L \cdot FP^3}{FK^3}$, where L denotes the parameter of the axis; for

$$\frac{2FP^2}{FK} = \frac{2AF \cdot FP^3}{AF \cdot FP \cdot FK} = \frac{\frac{1}{2}L \cdot FP^3}{FK^3}.$$

Prop. V.

The radius of the circle of curvature at the vertex of any diameter of an ellipse or hyperbola is a third proportional to the perpendicular drawn from the centre upon the tangent and half the conjugate diameter; and the chord which is drawn from the point of contact through the focus is a third proportional to the transverse axis and conjugate diameter.

Areas.



Let PL be the chord cut off from the diameter, and PFH the chord passing through F the focus; draw PM the diameter of the circle, and from the centre O draw OR perpendicular to PL, which will bisect PL in R; join HM, and draw the conjugate diameter QCq meeting PH in N and PM in S, then PS is equal to the perpendicular from the centre C upon the tangent. The triangles PSC, PRO are similar; therefore

PS : PC = PR : PO;
but PC : CQ = CQ : PR (Def. of param.),
therefore PS : CQ = CQ : PO.

Secondly, the triangles PSN, PHM are similar,
therefore PN : PS = PM : PH.
But PS : CQ = (CQ : PO =) Qq : PM,
therefore PN : CQ = Qq : PH,
or, since PN = AC (Cor. to 19, Part II. and to 28, Part III.) $A\alpha : Qq = Qq$: PH.

Cor. 1. Hence the radius of curvature is equal to $\frac{CQ^2}{PS}$; and the chord passing through the focus is equal to $\frac{2CQ^2}{AC}$.

Cor. 2. The radius of curvature is also equal to $\frac{CQ^3}{AC \cdot BC}$; for $PS = \frac{AC \cdot BC}{QC}$ (17, Part II. and 26, Part III.)

Cor. 3. Draw FK from the focus perpendicular to the tangent, and let L denote the parameter of the transverse axis; the radius of curvature is also equal to $\frac{\frac{1}{2}L \times FP^3}{FK^3}$.

For the triangles PFK, NPS are manifestly similar; therefore FK : FP = PS : PN, or AC = BC : CQ;

$$\text{hence } CQ = \frac{FP}{FK} \times BC, \text{ and}$$

$$\frac{CQ^3}{AC \cdot BC} = \frac{FP^3}{FK^3} \times \frac{BC^2}{AC} = \frac{FP^3}{FK^3} \times \tfrac{1}{2}L.$$

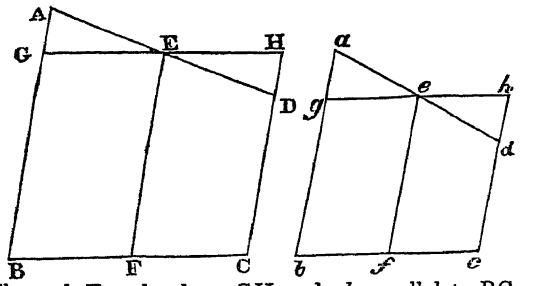
This expression for the radius of curvature is the same for all the three conic sections.

Sect. III.—Areas of the Conic Sections.

Lemma.

Let ABCD, *abcd*, two trapeziums, have each two parallel sides, and let the angles which the parallel sides AB, DC of the one figure make with its side BC be equal to the angles which *ab*, *dc*, the parallel sides of the other figure, make with its side *bc*; also, in the one figure, let

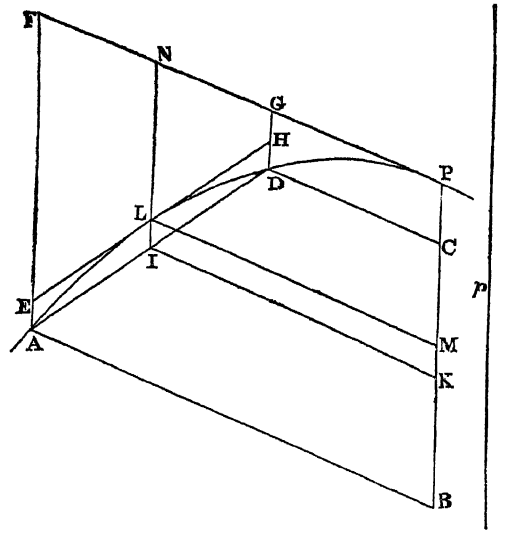
Areas. EF, which is parallel to AB and DC, bisect the opposite sides BC, AD in F and E, and in the other figure let *ef*, a parallel to *ab* and *dc*, bisect *bc* and *ad* in *f* and *e*; the trapezium ABCD is to the trapezium *abcd* as the rectangle BC·EF to the rectangle *bc*·*ef*.



Through E and *e* draw GH and *gh* parallel to BC and *bc*, forming the parallelograms GC, *gc*. The triangles AEG, DEH are manifestly equal (26, 1, E.); therefore the trapezium ABCD is equal to the parallelogram GBCH. In the same way it appears that the trapezium *abcd* is equal to the parallelogram *gbch*. Now the parallelogram GC has to the parallelogram *gc* the ratio compounded of the ratios of BG to *bg*, and of BC to *bc* (23, 6, E.); and the rectangle BC·BG has to the rectangle *bc*·*bg* the ratio which is compounded of the same ratios; therefore trap. ABCD : trap. *abcd* = BC·BG : *bc*·*bg* = BC·EF : *bc*·*ef*.

PROP. I.

In a parabola, let ABCD be a trapezium formed by PB, any diameter, AB, CD semi-ordinates to that diameter, and AD a chord in the curve; and let EFGH be another trapezium formed by PF, a tangent at the vertex of the diameter PB, by AF, DG, diameters produced at A, D, and EH a tangent parallel to the chord: the trapezium ABCD is double the trapezium EFGH.



Let L be the point of contact of the tangent EH; draw a diameter through L, meeting the chord AD in I, and the tangent PF in N; draw LM a semi-ordinate to the diameter PB, and IK parallel to LM. Let p be the parameter of the diameter PB. And because AD is bisected in I, and BK : KC = AI : ID = FN : NG, therefore BC is bisected in K and FG in N.

And because $p \cdot PB = AB^2 = PF^2$,
and $p \cdot PC = DC^2 = PG^2$;
therefore $p \cdot BC = PF^2 - PG^2$
$= (PF + PG)(PF - PG)$,
that is, $p \cdot BC = 2PN \cdot FG = 2LM \cdot FG$. Areas.

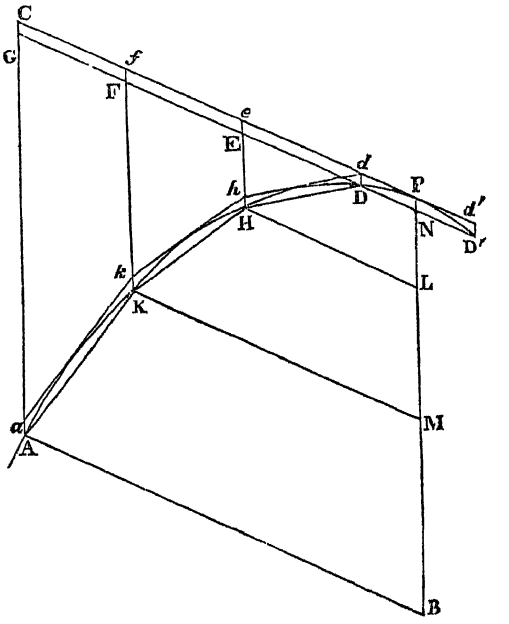
Now $p \cdot PM = p \cdot LN = LM^2$,
therefore $p \cdot BC : p \cdot LN = 2LM \cdot FG : LM^2$,
and $BC : LN = 2FG : LM$ or IK,
and hence $BC \cdot IK = 2FG \cdot LN$.

Now, by the premised lemma, the trapezium ABCD is to the trapezium EFGH as the rectangle BC · IK to the rectangle FG · LN; therefore the trapezium ABCD is double the trapezium EFGH.

SCHOLIUM. Since GH may be of any magnitude, the proposition will still be true when the points H and G coincide in the line PF.

PROP. II.

Let AB be a semi-ordinate to PB, any diameter of a parabola; complete the parallelogram ABPC, by drawing PC a tangent at the vertex, and AC parallel to PB: the space comprehended by PA, the arc of the parabola, and PB, AB, the abscis and ordinate, is two thirds of the parallelogram PBAC.



Divide PC into any odd number of equal parts, seven for example; let P*d* be one, P*e* three, and P*f* five of these; take P*d'* equal to P*d*, and draw *d'*D', *d*D, *e*H, *f*K parallel to PB, meeting the curve in D' D, H, K; these lines, when produced, will be diameters; and they will be equidistant, because they divide the line C*d'* into equal parts. Because P*d* = P*d'*, therefore *d*D = *d'*D' (11, 1, of this). Join DD', which will be parallel to *dd'* (33, 1, E.); let it meet PB in N; produce it to meet the other diameters in E, F, G. Draw HL, KM parallel to PC, also the chords DH, HK, KA, and, parallel to them, the tangents *dh*, *hk*, *ka*. And because the diameters whose vertices are D', D, H, are equidistant, the tangents *dd'*, *hd* will intersect each other at *d*, a point in the diameter passing through D (3 Cor. 15, 1); for a like reason the tangents *hd*, *hk* will intersect in H*e*, and *hk*, *ak* in FK.

The triangles HED, *hed* are in all respects equal, for DH = *dh* (34, 1, E.) DE = *de*; and since H*h* = D*d* = E*e*, therefore HE = *he*. The trapeziums KHEF, *hhef* are also equal; for HE, a side of the one, is equal to *he*, a side of the other, and HK, EF are equal to *hk*, *ef* respectively, and make equal angles with the equal sides HE, *he* between them; therefore if the trapeziums be applied, one on the other, so that the equal sides HE, *he* coincide, the

Areas.

sides HK, *hk* will coincide, also EF, *ef* and the trapeziums will entirely coincide. In like manner, the trapeziums AKFG, *akf*C are proved to be equal; and because the trapezium LHDN is double the triangle *hde* or its equal HDE (preceding Prop.), and the trapezium MKHL double the trapezium *fhke*, or its equal FKHE, and the trapezium BAKM double *aCfk*, that is, double AGFK, the polygon NDHKAB will be double the polygon DHKAG; but these together make up the parallelogram ABNG; therefore the polygon NDHKAB, inscribed in the parabola, is two thirds of the parallelogram ABNG. Now the space bounded by the arc PA, the abscss PB, and semiordinate AB, exceeds the inscribed polygon; therefore it also is greater than two thirds of the parallelogram ABNG, or two thirds of the parallelogram ABPC, diminished by two thirds of the parallelogram PCGN.

The parallelograms HD*dh*, ED*de* are equal (35, 1, E.), so also are K*h*, *ef*F, and AK*ka*, GF*f*C (36, 1, E.) Therefore the sum of the four parallelograms A*k*, K*h*, H*d*, DP is equal to the parallelogram GNPC. Now if the polygon inscribed in the parabola be increased by these four parallelograms, there will be formed the polygon P*dhka*B, which exceeds the parabolic area; therefore that area is less than two thirds of the parallelogram ABNG increased by the whole parallelogram GNPC, and consequently less than two thirds of the parallelogram ABPC increased by one third of the parallelogram GNPC.

Let the parabolic space PAB be denoted by S, the parallelogram PCAB by R, and the parallelogram PNGC by V.

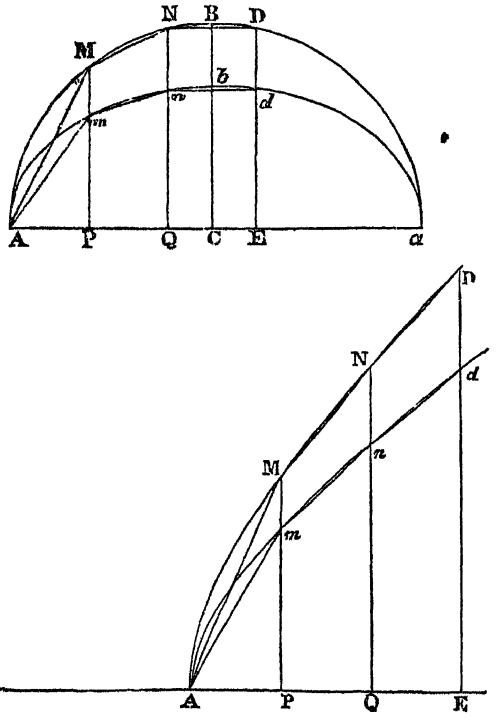
It has been proved that $S > \frac{2}{3}R - \frac{2}{3}V$,

and that $S < \frac{2}{3}R + \frac{1}{3}V$.

This is true whatever may be the magnitude of V; but the line P*d* may be taken such that V may be less than any assignable space; therefore S can be equal to no assignable space that is either greater or less than two thirds of the space R, and consequently is exactly equal to two thirds of the space R.

Definition.

If the axes of a hyperbola be equal, it is called an *Equilateral* hyperbola.



Prop. III.

If two ellipses, or two hyperbolas, have a common transverse axis, and if from the same point in the axis there be drawn a semiordinate to each; the areas contained by the common abscss, the ordinates, and the curves, will be to each other as their conjugate axes.

Let AMB*a*, A*mba* be two ellipses, and AMD, A*md* two hyperbolas, which have each pair a common transverse axis A*a*; and let BC, *b*C be their conjugate axes, and DE, *d*E semiordinates at the same point E in the common axis; the area AMDE is to the area A*md*E as the axis BC to the axis *b*C.

Let the common abscss in both curves be divided into any number of equal parts AP, PQ, QE; draw semiordinates P*m*M, Q*n*N, and the chords AM, MN, ND, *Am*, *mn*, *nd*.

In the case of two ellipses,

$$\left.\begin{array}{l} MP^2 : AP \cdot Pa = BC^2 : AC^2; \\ \text{and } AP \cdot Pa : mP^2 = AC^2 : bC^2; \end{array}\right\} \quad (13.\ 2.)$$

therefore, *ex. æq.* $MP^2 : mP^2 = BC^2 : bC^2$,

and $MP : mP = BC : bC$.

In the same way, in the two hyperbolas it may be proved that

$$MP : mP = NQ : nQ = DE : dE = BC : bC.$$

Now, in both curves (by 1, 6, E.),

triangle APM : triangle AP*m* = PM : P*m* = BC : *b*C;

and since MP : NQ = *m*P : *n*Q,

therefore, by composition and alternation,

$$MP + NQ : mP + nQ = NQ : nQ = BC : bC.$$

But MP + NQ : *m*P + *n*Q = trap. MPQN : trap. *m*PQ*n*

therefore, trap MPQN : trap. *m*PQ*n* = BC : *b*C.

In the same way it appears that the trapezium NQED is to the trapezium *n*Q*E*d as BC to *b*C; therefore (12, 5, E.), polygon AMNDE : polygon A*mnd*E = BC : *b*C.

This must be true, however great may be the number of sides of the polygon AMNDE, A*mnd*E inscribed in the curvilinear spaces; but by a known principle in geometry, the limits of the polygons (which are the curvilinear spaces) must have the same ratio as the polygons themselves; therefore the curvilinear spaces AND, A*nd* have the same ratio as the semiconjugate axes BC, *b*C.

Cor. 1. Hence it appears that the area of an ellipse is to that of its circumscribing circle as the conjugate axis to the transverse axis.

Cor. 2. It also appears, that the area of any segment of an ellipse may be found from that of a corresponding segment of a circle; and the area of a segment of any hyperbola from the corresponding segment of an equilateral hyperbola.

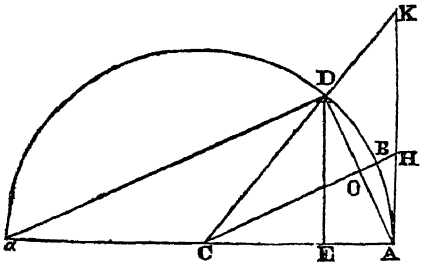
The quadrature of the parabola was perfectly accomplished by Archimedes: but it has been found impossible to find rectilinear spaces exactly equal to elliptic and hyperbolic areas; these can only be exhibited numerically by infinite series. In what follows, series will be investigated from principles as elementary as the nature of the subject will admit of; but it will be convenient to employ the symbols of algebra in the reasoning: and we shall confine the investigation to sectors of a circle and an equilateral hyperbola, from which sectors of any ellipse and hyperbola may be found.

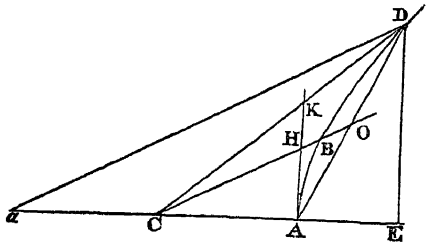
Prop. IV.

Let C be the centre of a circle, or of an equilateral hyperbola, and CA the semitransverse axis; let ACB, BCD be two equal sectors of the circle or hyperbola, and let AHK, a tangent at the vertex A, meet the semidiameters CB, CD in H and K.

Areas.

In the circle $2CA : AK = CA^2 - AH^2 : CA \cdot AH$.
In the hyperbola $2CA : AK = CA^2 + AH^2 : CA \cdot AH$.





In each curve draw DA, Da to the extremities of the axis; let the chord AD meet the semidiameter CB in O, and draw DE perpendicular to the axis.

Because AO = OD (3, 3, E. and Prop. 33, Part III.), and AC = Ca; the lines CH, aD are parallel (2, 6, E.), therefore the triangles CAH, aED are similar.

Now $ED^2 = AE \cdot Ea$ (35, 3, E. and 22 of Sect. III.),
therefore $AE : ED = ED : Ea$ (16, 6, E.);
hence the triangles DEA, aED are similar (6, 6, E.), and each is similar to CAH, therefore

$$aE : ED = AC : AH = AC^2 : AC \cdot AH.$$
$$AE : ED = AH : AC = AH^2 : AC \cdot AH.$$

Hence, in the circle,

$$aE - AE \text{ or } 2CE : ED = AC^2 - AH^2 : AC \cdot AH,$$

and in the hyperbola (24, 5, E.),

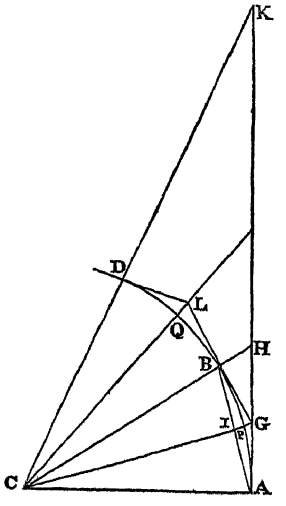
$$aE + AE \text{ or } 2CE : ED = AC^2 + AH^2 : AC \cdot AH;$$

But $2CE : ED = 2CA : AK$;

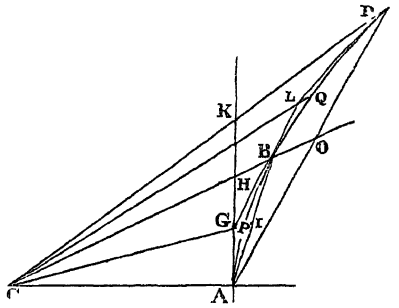
therefore, in the circle, $2CA : AK = AC^2 - AH^2 : AC \cdot AH$;
and, in the hyperbola, $2CA : AK = AC^2 + AH^2 : AC \cdot AH$.

Prop. V. Problem.

To investigate a formula that shall express the area of any sector of a circle, or of an equilateral hyperbola.



Area.



Let ACD be a sector of a circle or hyperbola, and AC the radius of the circle, or semitransverse axis of the hyperbola; let the sector be bisected by the semidiameter CB, and again each of the sectors ACB, BCD by the semidiameters CP, CQ, and so on; thus dividing the sector ACB first into two equal sectors, then into four, then into eight, and so on. Draw tangents to the curves at the alternate points A, B, D, and because, from the nature of the curves, the chords which join these points are ordinates to the semidiameters CP, CQ which pass between them, the tangents will intersect each other at G and L, points in the semidiameters (1 Cor. Prop. 10, Sect. III.). Join A, B, any two contiguous points, and let the chord AB meet CP in I; and because the triangles ACI, BCI are equal (38, 1, E.), and also the triangles AGI, BGI, the triangles CAG, CBG are equal. In the same way it appears that the triangles DCL, BCL are equal.

Again, because the semidiameter CB bisects the chord which joins the points P, Q, it will bisect GL, the tangent parallel to the chord; therefore the triangles GCB, LCB are equal. Hence it appears that the triangles ACG, GCB, BCL, LCD are all equal; and this will be true whatever be their number.

Let AK, a tangent at the vertex A, meet the semidiameters CP, CB, CD in G, H, K. Put a to denote CA, the radius of the circle or semiaxis of the hyperbola, and let the lines AK, AH, AG, &c. be denoted by t, t', t'', &c. These lines in the circle are the tangents of the arcs AD, AB, AP, &c. We shall, by analogy, consider them as *tangents* corresponding to the sectors DCA, BCA, PCA in the two curves.

And because

$$2a : t = a^2 \mp t^2 : at' \text{ (Prop. 4 of this Sect.)},$$

the upper sign applying to the circles, and the lower to the hyperbola, therefore

$$\frac{a^2}{t} = \frac{a^2}{2t'} \mp \frac{t'}{2},$$

$$\text{and similarly, } \frac{a^2}{t'} = \frac{a^2}{2t''} \mp \frac{t''}{2};$$

Let the value of $\frac{a^2}{2t'}$, found from this second formula be substituted instead of it in the first, and there is obtained

$$\frac{a^2}{t} = \frac{a^2}{4t''} \mp \left(\frac{t'}{2} + \frac{t''}{4}\right),$$

$$\text{and hence again, } \frac{a^3}{4at''} = \frac{a^2}{t} \pm \left(\frac{t'}{2} + \frac{t''}{4}\right).$$

Now $4at''$ or $4CA \cdot AG$ is eight times the triangle ACG, that is, double the polygon CAGLD. Let s' denote this polygon, and then we have

$$\frac{a^3}{2s'} = \frac{a^2}{t} \pm \left(\frac{t'}{2} + \frac{t''}{4}\right).$$

By carrying on the process of bisecting the sector ACD continually, so as to divide it next into 8, then into 16, then into 32 equal parts, and so on, putting t''' for the tan-

Areas. gent corresponding to its 8th part; t''' for that corresponding to its 16th, &c. there is obtained

$$\frac{a^3}{2s'} = \frac{a^2}{t} \pm \left(\frac{t'}{2} + \frac{t''}{4} + \frac{t'''}{8} + \frac{t''''}{16} +, \text{ &c.}\right).$$

Now the polygon CAGLD manifestly approaches continually to the area of the sector in either curve, as the number of its sides is increased, and at last may differ from it by less any than assignable quantity; therefore, putting now s for the area of the sector ACB, and considering that s is the limit of the polygon, we have

$$\frac{a^3}{2s} = \frac{a^2}{t} \pm \left(\frac{t'}{2} + \frac{t''}{4} + \frac{t'''}{8} + \frac{t''''}{16} +, \text{ &c.}\right);$$

the series in the parenthesis being carried on *ad infinitum*; and hence, putting

$$c = \frac{t'}{2} + \frac{t''}{4} + \frac{t'''}{8} + \frac{t''''}{16}, \text{ &c.}$$

we have $2s = \dfrac{a^3}{\frac{a^2}{t} \pm c}$.

This is the formula which was to be investigated, and in its application the upper part of the sign $\pm$ applies to the circle, and the lower to the hyperbola.

Scholium. In computing the area of a sector of a circle, or hyperbola, the values of the tangents AH, AG, &c. that is, t', t'', &c. must be found from the first t, and from each other. In the circle

$$2a : t = a^2 - t^2 : at' \text{ (Prop. 4)};$$

hence $2a^2t' = a^2t - tt^2$.

From this, by the resolution of a quadratic equation, we find

$$t' = \frac{a^2}{t}\left\{\sqrt{\left(1 + \frac{t^2}{a^2}\right)} - 1\right\}; \quad (A)$$

and similarly, $t'' = \dfrac{a^2}{t'}\left\{\sqrt{\left(1 + \dfrac{t^2}{a^2}\right)} - 1\right\}$, &c.

A few of the quantities t', t'', t''', &c. may be computed from this formula; but when one (t''', for instance) has been found such that $\frac{t'''}{a}$ is a small fraction, those which follow may be most readily computed by a series obtained from $\sqrt{\left(1 + \frac{t^2}{a^2}\right)}$ by evolution, or the binomial theorem; thus, since

$$\sqrt{\left(1 + \frac{t^2}{a^2}\right)} = 1 + \tfrac{1}{2}\frac{t^2}{a^2} - \tfrac{1}{8}\frac{t^4}{a^4} + \tfrac{1}{16}\frac{t^6}{a^6} -, \text{ &c.}$$

therefore $t' = \frac{1}{2}t - \frac{1}{8}\frac{t^3}{a^2} + \frac{1}{16}\frac{t^5}{a^4} -$, &c.

For the quadrature of the hyperbola, the tangents t', t'', &c. are found from the first by formulas entirely similar to the above, differing only in the signs of the terms. In this curve, however, the tangents have a property which those in the circle have not, by which their computation may be facilitated. For since, in the hyperbola,

$$a : t = a^2 + t^2 : 2at' \text{ (Prop. IV.)}$$

therefore $a + t : a - t = a^2 + 2at' + t^2 : a^2 - 2at' + t^2$;

that is, $a + t : a - t = (a + t')^2 : (a - t')^2$.

$$\text{Hence } \frac{a + t'}{a - t'} = \left(\frac{a + t}{a - t}\right)^{\frac{1}{2}};$$

$$\text{and similarly, } \frac{a + t''}{a - t''} = \left(\frac{a + t'}{a - t'}\right)^{\frac{1}{2}}, \text{ &c.}$$

Now, let $\frac{a+t}{a-t} = v$, then $\frac{a+t'}{a-t'} = v^{\frac{1}{2}}$, $\frac{a+t''}{a-t''} = v^{\frac{1}{4}}$, &c.;

and hence $t' = a\dfrac{v^{\frac{1}{2}} - 1}{v^{\frac{1}{2}} + 1}$, $t' = a\dfrac{v^{\frac{1}{4}} - 1}{v^{\frac{1}{4}} + 1}$, $t'' = a\dfrac{v^{\frac{1}{8}} - 1}{v^{\frac{1}{8}} + 1}$, Areas.

&c.

This series of fractions, by which the tangents t', t'', t''', are expressed, being formed in a very simple manner from the square, the fourth, the eighth root, &c. of $v = \frac{a+t}{a-t}$, they may be easily computed, and thence the values of t', t'', &c., and the sector, readily found.

The trigonometrical tables may be made available in the quadrature of the hyperbolic sector, by the preceding formula in this way.

It has been proved in the calculus of sines, that v and z being any two arcs,

$$\frac{\text{sin. } v + \text{sin. } z}{\text{sin. } v - \text{sin. } z} = \frac{\text{tan. } \frac{1}{2}(v + z)}{\text{tan. } \frac{1}{2}(v - z)}. \text{ (Algebra, sect. 246.)}$$

Suppose now that v is a right angle $= \frac{1}{2}\pi$, then the formula becomes

$$\frac{1 + \text{sin. } z}{1 - \text{sin. } z} = \frac{\text{tan. } \left(\frac{\pi}{4} + \frac{1}{2}z\right)}{\text{tan. } \left(\frac{\pi}{4} - \frac{1}{2}z\right)}.$$

$$\text{Now tan. } \left(\frac{\pi}{4} + \tfrac{1}{2}z\right) = \frac{1 + \text{tan. } \frac{1}{2}z}{1 - \text{tan. } \frac{1}{2}z},$$

$$\text{and tan. } \left(\frac{\pi}{4} - \tfrac{1}{2}z\right) = \frac{1 - \text{tan. } \frac{1}{2}z}{1 + \text{tan. } \frac{1}{2}z}, \quad \text{Algebra, sect. 241.}$$

$$\text{therefore } \frac{1 + \text{sin. } z}{1 - \text{sin. } z} = \left(\frac{1 + \text{tan. } \frac{1}{2}z}{1 - \text{tan. } \frac{1}{2}z}\right)^2.$$

Now we have, in the hyperbola,

$$\frac{1 + \frac{t}{a}}{1 - \frac{t}{a}} = \frac{\left(1 + \frac{t'}{a}\right)^2}{\left(1 - \frac{t'}{a}\right)^2}; \quad \frac{1 + \frac{t'}{a}}{1 - \frac{t'}{a}} = \frac{\left(1 + \frac{t''}{a}\right)^2}{\left(1 - \frac{t''}{a}\right)^2}, \text{ &c.}$$

From this it appears that $\frac{t'}{a}$ is related to $\frac{t}{a}$ exactly as in the trigonometrical formula tan. $\frac{1}{2}z$ is related to sin. z; and a like remark may be made on the relations between $\frac{t''}{a}$, $\frac{t}{a}$, &c.

Hence we have the following formula for finding the area of the hyperbolic sector.

Find from the trigonometrical tables the series of sines sin. z, sin. z', sin. z'', sin. z''', &c. such that sin. $z = \frac{t}{a}$, sin. $z' =$ tan. $\frac{1}{2}z$, sin. $z'' =$ tan. $\frac{1}{2}z'$, &c.; then s denoting, as above, the hyperbolic sector,

$$2s = \frac{a^2t}{a - t\left(\frac{1}{2}\text{ sin. } \frac{1}{2}z + \frac{1}{4}\text{ sin. } \frac{1}{4}z + \frac{1}{8}\text{ sin. } \frac{1}{8}z +, \text{ &c.}\right)}$$

$$2s = \frac{a^2}{\frac{a}{t} - \left(\frac{1}{2}\text{ sin. } z' + \frac{1}{4}\text{ sin. } z'' + \frac{1}{8}\text{ sin. } z''' +, \text{ &c.}\right)}$$

Since the series in the denominator approaches continually to a geometrical series, of which the common ratio is $\frac{1}{4}$, any term is nearly three times the sum of all the terms which follow it. If then a term be found which agrees in all the figures with $\frac{1}{4}$ of that before it, then $\frac{1}{3}$ of that term may be taken as the sum of the remaining terms.

These expressions, and others, for the areas of the circle and hyperbola, were given by Professor Wallace of Edinburgh, in the *Edinburgh Philosophical Transactions*, vol. v. They are also contained in his *Treatise on Conic Sections*

(W. W.)

Conichthyodontes || Connaught.

CONICHTHYODONTES, or PLECTRONITÆ, a name sometimes applied to the fossil teeth of fishes.

CONIFERÆ, a natural order of exogenous plants, including the *pines, fir-trees, cypresses, junipers,* &c. See BOTANY.

CONIROSTRES. See index to ORNITHOLOGY.

CONJEVERAM, a considerable town of Southern India, in the British district of Chingleput, presidency of Madras, situate on the route from the city of Madras to Arcot. It has all the appearance of a flourishing place. The streets are wide, and cross each other at right angles, and have a row of cocoa-nut trees on each side. The houses are generally built of mud, and for the most part roofed with tiles. Conjeveram contains several water-tanks, lined with stone and in good repair. It is chiefly supported by a famous Hindu temple dedicated to Mahadeva. The principal entrance is very grand and lofty, and the sides of the steps leading to the temple are formed by two elephants drawing a chariot carved in stone. The sanctuary is surrounded by a double wall, the outer inclosure of which contains an extensive chantrai or caravanserai for pilgrims and devotees. Distance from Madras, S.W., 42 miles. Lat. 12. 50., Long. 79. 46.

CONJUGATE DIAMETER or *Axis of an Ellipsis*, the shortest of the two diameters, or that which bisects the axis.

CONJUGATION, in *Grammar*, a regular distribution of the several inflections of verbs into their different voices, moods, tenses, numbers, and persons.

CONJUNCTION, in *Astronomy*, the meeting of two or more stars or planets in the same degree of the zodiac.

CONJUNCTION, in *Grammar*, an indeclinable word or particle which serves to join words and sentences, and shows their relation or dependence upon one another.

CONJURATION (Lat. *con*, and *juro*, to swear), the act of using certain magical words, characters, or ceremonies, to expel evil spirits, allay storms, or perform supernatural or extraordinary acts. The priests of the Roman Catholic Church pretend to expel devils by the sprinkling of holy water over the possessed, accompanied with a number of conjurations and exorcisms.

CONNAUGHT, the smallest of the four provinces into which Ireland is divided, and, together with Munster, the most western portion of Europe; bound chiefly, and peninsulated, by the Atlantic Ocean and the river Shannon. It comprises an area of 6862 square miles, or 4,392,043 acres; of which 2,220,960 are arable; 1,906,002 uncultivated; 48,340 in plantations; 3877 in towns and villages; and 212,864 under water. The population may be considered even now as almost pure Celtic, having never been much affected by the very slight intermixture which has taken place with other races; and the Irish language is still the ordinary language of the people. The number of inhabitants in the province at and since the census of 1821 has been ascertained to have been as follows:—

	Inhabitants.	Increase.	Decrease.
1821	1,110,229	...	...
1831	1,343,914	233,685	...
1841	1,418,859	74,940	...
1851	1,010,211	...	408,648

In early times Connaught comprised, beyond its present limits, the territory of Thomond, forming the present county of Clare, and North Breifne, the present county of Cavan. When Sir Henry Sydney, in the sixteenth century, divided the province into counties, he adopted the ancient boundaries, excluding North Breifne; but in 1602 the county of Clare was restored to Munster, and Connaught comprises now the counties of Galway, Mayo, Sligo, Leitrim, and Roscommon, including Joyce's country, Connemara, Erno, Tyrawley, and other tracts of wild and romantic scenery. The chief towns are the sea-ports,—Galway (pop. 20,686); Sligo (pop. 11,104); and Ballina (pop. 5,230). The annual value of property, according to Griffith's valuation, is L.1,353,720. The western portion is hilly, and occasionally mountainous; while the eastern part is generally level. It is well watered, and has on the greater portion of its eastern boundary the river Shannon. The river Moy is navigable from Killala to Ballina; the extensive lakes Conn, Corrib, and Mask, are navigable; and the sea-coast affords many fine bays and harbours. The climate is moist, but temperate and healthful. Agriculture, although the main support of the population, has hitherto been much neglected: the chief crops in cultivation are oats, potatoes, and green crops. The value of live stock in 1841 was computed to be L.3,369,078, and in 1852 L.4,832,842. The trade of the province is merely local and retail, and there are no manufactures. The mineral treasures of the soil have not been developed, and their extent is very doubtful, little capital having been heretofore engaged in their extraction.

There are no canals in Connaught; and the only line of railway, viz., that portion of the Midland Great Western which extends from Athlone to Galway, was constructed by means of an advance of the necessary sum from the imperial treasury, the interest of the loan being secured in case of rates levied on the counties of Roscommon and Galway.

Ecclesiastically the province is under the control of the Archbishop of Armagh, the Bishops of Kilmore and Tuam, and the Archbishop of Dublin, with his suffragan, the Bishop of Killaloe. The great majority of the population, however, are Roman Catholics; and Connaught corresponds exactly in extent to the Roman Catholic archdiocese of Tuam. See GALWAY, LEITRIM, MAYO, ROSCOMMON, SLIGO, and IRELAND. (H. S—R.)

Connecticut

CONNECTICUT, one of the United States of North America, bounded on the N. by Massachusetts, W. by New York, S. by Long Island Sound, and E. by Rhode Island. It lies between 41. and 42. 2. N. Lat., and between 71. 40. and 73. 43. W. Long; is 90 miles in length from E. to W., and from 60 to 70 miles in breadth from N. to S., and has an area of about 4750 square miles.

Its coast is deeply indented by numerous bays and creeks, affording excellent harbours. Of these harbours the best is that of New London, which is spacious, deep, and not liable to be frozen over in winter: next in importance are those of New Haven, Stonington, and Bridgeport. The surface of the state is much diversified by hills and valleys. None of the hills attain an elevation of more than 1000 feet. The principal ranges are spurs of those of Massachusetts, and extend in a southerly direction towards the coast. The Housatonic range enters the state on the N.W., and extends along the Housatonic river to the coast. The Green mountain range terminates at West Rock, 2 miles N.W. of New Haven. Between this and the Connecticut river is the Mount Tom range, which terminates at East Rock a little N.E. by New Haven. On the E. side of the Connecticut is a fourth range which crosses the river at Chatham, and terminates at East Haven.

The state is watered by numerous rivers and streams. Few of the rivers are navigable for more than a short distance from their mouths. The principal is the Connecticut, which rises on the N. border of New Hampshire, and after a course of about 400 miles falls into Long Island Sound between Saybrook and Lyme. Its general direction is S. by W., separating New Hampshire from Vermont, and afterwards passing through the western part of Massachusetts and the central part of Connecticut. Below Middleton it turns to the S.S.E., and continues in that direction to its mouth. It is navigable to Middleton, 30 miles from the sea, for vessels drawing 10 feet, and to Hartford, 20 miles higher, for vessels drawing 8 feet of water. The canals and other improvements recently made to overcome the rapids and falls, have rendered it navigable for small boats as far

Connecticut.

as Well's River, 250 miles above Hartford. The principal tributary of the Connecticut in this state is the Tunxis or Farmington, which rises in the E. slope of the Green Mountains in Massachusetts, and flows southward to Farmington, where it abruptly changes its course to the N. On breaking through the trap range of the Talcott Mountains, it again takes a southerly direction, and falls into the Connecticut opposite East Windsor. The Housatonic rises in the western part of Massachusetts, and enters this state near its N.W. corner, after which it has a S. and S.E. course to the Sound. Its entrance is obstructed by a bar, but there is a sloop navigation for 12 miles. The Thames, formed by the junction of the Quinnebang, Shetucket, and Yantic rivers near Norwich, falls into the Sound at New London.

The mineral wealth of Connecticut is considerable. Iron ore of excellent quality is found abundantly in various parts. The copper mines of Bristol and Plymouth are said to be the most profitable in the United States. According to Professor Silliman, the Bristol vein extends in a southerly direction for more than 30 miles, and if fully worked is capable of affording employment to 30,000 miners. The Plymouth mines are considered to be equally rich. Copper is also found at Granby. Fine marbles of different kinds are abundant, and extensive quarries of freestone exist in the mountain regions, and furnish an excellent building material. Zinc, cobalt, manganese, and plumbago are also found; and the mineral waters of Stafford have long been celebrated.

The soil for the most part is fertile, but is in general considered to be better suited for grazing than for grain. Some of the river valleys, however, produce very fine crops. The principal valley is that of the Connecticut, a rich agricultural district, varying in breadth from 10 to 16 miles, and extending northward from Middleton for about 30 miles in this state. It has a strong argillaceous loam, varying in different parts from a hard stiff clay to a light sandy loam. The valleys of the Quinnebang and Housatonic are also of great fertility. In the eastern part of the state the prevailing soil is excellent for grasses; in the western are many fertile districts. The north-western is more cold and sterile, but contains some good grazing districts. The farms are chiefly small; and most of the farmers follow some manufacturing occupation during a part of the year. In 1850 there were 22,445 farms, consisting of 1,768,178 acres of improved, and 615,701 acres of unimproved land in the state. The chief productions are wheat, oats, rye, maize, barley, potatoes, peas, beans, tobacco, maple sugar, flax, and wine.

The country is healthy, notwithstanding its being exposed to the extremes of heat and cold, and also to sudden changes of temperature. In winter keen north-west winds prevail; but the serenity of the sky and the dryness of the atmosphere during the same season compensate in some degree for the severity of the weather. Upon the coast, in particular, the wind is exceedingly variable, but the inland country is less subject to this vicissitude.

The following table shows the decennial increase of the population since 1790:—

	Whites.	Free Coloured.	Slaves.	Total.
1790	232,581	2801	2759	238,141
1800	244,721	5330	951	251,002
1810	255,279	6453	310	262,042
1820	267,161	7944	97	257,202
1830	289,603	8047	25	297,675
1840	301,856	8105	17	309,978
1850	Males 179,884	3820	..	370,792
	Females 183,215	3873	...	

The federal population in 1850 was 370,792, returning 4 members to the House of Representatives. The present constitution was framed in 1818, and superseded the previous form of government under the charter granted in 1662 by Charles II. The legislature meets annually on the first Monday of May, alternately at Hartford and New Haven. The governor exercises the chief executive power, and has power to grant reprieves, except in cases of impeachment, but not pardons; he may also veto a bill, but a majority of both Houses may pass it again, after which it becomes law.

Connecticut.

The judiciary consists of a supreme court, a superior court, county courts, &c. The supreme court consists of a chief and four associate justices, and meets annually in each county. The superior court is held by one judge of the superior court every half-year in each county. County courts are held three times a year in the several counties by a judge elected annually by the legislature. In 1850 there were 734 churches in the state, with accommodation for 307,299 persons. Of these, 114 were Baptist churches, 252 Congregational, 101 Episcopal, and 185 Methodist. There were 1656 public schools, with 1787 teachers, and 71,269 pupils; 202 academies and other schools, with 329 teachers, and 6996 pupils; and 4 colleges, with 56 teachers and 738 pupils. This state has a school fund, derived in 1795 from the sale of some lands situated in the north-eastern part of Ohio. The proceeds of this sale constituted a fund, the annual income of which was appropriated to the support of common schools. This fund is now estimated to be of the value of $2,049,482, and the dividends from it for the year ending March 1852 amounted to $132,792. The number of common school societies in 1851 was 217; of school districts, 1652; and of children between 4 and 16 years of age, 94,852. The legislature in 1849 appropriated $10,000 for the establishment of a state normal school. The principal of the normal school is *ex officio* superintendent of common schools. The number of pupils is limited to 220, to be selected one from each school society: tuition free. The number of pupils in 1850 was 154. Connected with the normal school are Schools of Practice, containing (in 1851) 400 pupils organized into three grades. In 1851 a state reform school was established "for the instruction, employment, and reformation of juvenile offenders." Boys under 16 years of age, convicted of offences punishable by imprisonment, may, at the discretion of the court, be sent to this school, to be kept disciplined, instructed, &c., until they shall either be reformed and discharged, or bound out to service by the trustees, or remanded to prison as incorrigible. Yale college at New Haven is one of the oldest, most richly endowed, and most extensively useful institutions of learning in the United States. It was founded in 1701 by the gentleman whose name it bears, and in 1850 had 432 students in the academical department, 38 in theology, 26 in law, 38 in medicine, and 21 in philosophy and the arts. Trinity college at Hartford is an Episcopal institution, founded in 1824; and in 1850 had 9 professors, and 66 students. The Wesleyan university at Middleton was founded in 1831; and in 1850 had 8 professors and 125 students. There is also a theological institution at Hartford in connection with the Congregationalists, having, in 1850, 3 instructors and 17 students. The retreat for the insane, opened in 1824 at Hartford, contained at 1st April 1851, 157 patients; and during the subsequent year 158 patients were admitted, and 134 discharged, leaving at 1st April 1852, 181 patients in the retreat. The American asylum for the deaf and dumb, also at Hartford, was the first institution of the kind in the States, and has been well endowed by individual, state, and federal bounties. The number of pupils, who must on admission be between 8 and 25 years of age, for year ending 1st May 1852, was 207, of whom 118 were males, and 89 females. The state prison at Wethersfield contained, at 1st March 1851, 158 convicts. They receive instruction in the rudiments of learning; and there is a small library for their use. The receipts for the year were $15,083, and the expenditure $10,901. The state in 1850 had 42 public libraries, with 38,609 vols.; 4 school libraries, with 5039 vols.; 107 Sunday-school libraries, with 38,445 vols.; 8 college libraries.

Connecticut River. || Conon.

with 82,600 vols.; and 3 church libraries, with 625 vols.; being in all 142 libraries, with 165,318 vols. The total number of newspapers and periodicals published in the state in 1850 was 51, of which 30 were political, and 21 religious, scientific, &c.

The manufacturing establishments in the state, producing annually to the value of $500 and upwards, amounted in 1850 to $3913: of these 128 were cotton factories, 149 woollen mills, and 91 engaged in the manufacture of iron-work.

The remainder include establishments for the manufacture of various kinds of hardware, cutlery, fire-arms, gunpowder, paper, boots, shoes, &c. A considerable part of the manufacturing industry is carried on in small shops not noticed in the census, but which, it is calculated, add one-third to the apparent extent of the manufacturing interest of the state. The foreign commerce is comparatively small. The exports for year ending 30th June 1851 amounted to $434 078, and the imports to $342,994. In the same year 35 vessels of 3414 tons were built in the state. The amount of shipping owned in 1850 was 113,085 tons, of which 31,028 tons were employed in foreign commerce, 11,483 tons in the whale fishery, 5249 in cod fishing, 571 in mackerel fishing, and the remainder chiefly in the coasting trade The roads are numerous and well kept. In 1853, 591 miles of railway were completed, and 106 miles in course of construction. The total revenue of the state for year ending 31st March 1852, including $26,266 balance of last year, was $176,456, and the expenditure $137,326: the state debt, chiefly contingent, was $91,212.

CONNECTICUT RIVER. See preceding article.

CONNOISSEUR (French, from *connoitre*, to know), a person well versed in any subject; a critical judge or master of any art, particularly of painting, sculpture, or virtù.

CONNOR, BERNARD (1666–1698), a learned physician, born in Kerry, Ireland. He studied medicine at Montpellier, and afterwards at Paris. Having travelled through Italy with the two sons of the high chancellor of Poland, he was introduced at the court of Warsaw, and appointed physician to King John Sobieski. In 1695 he visited England, and read a course of lectures on the animal economy, in London and Oxford. He was afterwards elected member of the Royal Society and College of Physicians; and was invited to Cambridge, where he also read public lectures. He was the author of a treatise entitled *Evangelium Medici* (the Physician's Gospel), in which he endeavoured to explain away the Christian miracles as physical events, upon the principles of natural philosophy. He also wrote a History of Poland in 2 vols.

CONOID, in *Geometry*, a solid body generated by the revolution of a conic section around its axis.

CONON, a renowned Athenian general and admiral who flourished about 390 B.C. (See ATTICA.) After his defeat by Lysander, he fled to Evagoros, king of Cyprus, and then put himself under the protection of Artaxerxes, king of Persia, with whose army he delivered Athens from the Lacedæmonian yoke, and restored the walls. He afterwards (B.C. 394) defeated the Lacedæmonians in a naval encounter near Cnidos, and thus deprived them of the empire of the sea (which they had held ever since the taking of Athens), besides crippling their resources in other respects. According to one account, he is said to have been put to death by Teribazus, when on an embassy to the Persian court; but it seems more probable that he escaped to Cyprus, where he had considerable property, and that he died there a natural death, B.C. 388.

CONON, of *Samos*, a mathematician and astronomer, who flourished during the reigns of Ptolemy Philadelphus and Euergetes. He was the inventor of the curve called afterwards, from its more famous expounder, the *spiral of Archimedes*, and is mentioned in terms of admiration by the Syracusan mathematicians. None of his treatises are extant. There is also a grammarian of the same name who flourished in the age of Augustus, and wrote a work on the mythical period of the early colonies.

Conops || Consanguinity

CONOPS, a genus of insects belonging to the order Diptera. (See index to ENTOMOLOGY.)

CONQUEST, in *Law*, the acquiring of property by other means than by succession; as by purchase, donation, &c.

CONRAD II., *the Salic*, elected Emperor of Germany in 1024. He was crowned as emperor and king of the Romans by Pope John XIX.; and having taken the field against the insurgent German dukes, he put Ernest, Duke of Suabia, under the ban of the empire. As this is one of the earliest instances of such a proscription, the formula is inserted here on account of its singularity:—"We declare thy wife a widow, thy children orphans; and we send thee, in the name of the devil, to the four corners of the world." It was for the most part during the reign of this prince that the German fiefs became hereditary. Conrad died at Utrecht in 1039, and was succeeded by his son Henry III., who during the lifetime of his father had been invested with the crown of Burgandy.

CONRAD III., elected Emperor of Germany in 1138. His election having been opposed by the Duke of Bavaria, Conrad put that prince under the ban of the empire, and deprived him of his duchy, a disgrace which he could not survive. The Margrave of Austria being ordered by the emperor to take possession of Bavaria Welst, uncle of the deceased duke, attacked him, but was defeated near the castle of Winsburg. The battle fought upon this occasion is famous in history, as having given rise to the party names of *Guelfs* and *Ghibelines*, afterwards assumed in Italy. The parole of the day with the Bavarians was *Welst*, from the name of their general; that of the Imperialists *Waiblingen*, from the patrimonial seat of the family of their commander. These names were gradually used to distinguish the two parties, and by the Italians were corrupted into the more euphonic Guelfi and Ghibelini. Conrad joined with Louis VII. in the second crusade (see CRUSADES); but the flower of his army perished before Damascus and Ascalon, and he was compelled to return home to check the intrigues of Welst. After defeating the insurgents, Conrad was preparing to set out for Italy to be crowned by the Pope, when he died at Bamberg in 1152.

CONRAD, or *Conradin*, the younger son of Conrad, was an infant at his father's death. He was acknowledged as emperor by the Ghibelines, who received him in triumph at Rome; but Pope Alexander IV. published a crusade against him; and Urban VII. gave the empire to Charles of Anjou, brother of Louis IX., king of France. The unfortunate youth, though powerfully supported even by the Turks, lost a battle, in which he was taken prisoner; and in 1229, in the eighteenth year of his age, he was publicly beheaded at Naples, by order of his base opponent. With him the race of the Dukes of Suabia, which had produced several kings and emperors, became extinct.

CONSANGUINITY (Lat. *consanguinitas; con*, and *sanguis*, blood), or KINDRED, is defined by the writers on this subject to be *vinculum personarum ab eodem stipite descendentium;* that is, the connection or relation of persons descended from the same stock or common ancestor. This consanguinity is either lineal or collateral.

Lineal consanguinity is that which subsists between persons of whom one is descended in a direct line from the other. It falls strictly within the definition of *vinculum personarum ab eodem stipite descendentium;* since lineal relations are such as descend one from the other, and both of course from the same common ancestors.

Collateral kindred answers to the same description: collateral relations agreeing with the lineal in this, that they descend from the same stock or ancestor, but with this difference, that they do not descend the one from the other.

Conscience ‖ Conscription.

Collateral kinsmen, then, are such as lineally spring from one and the same ancestor, who is the *stirps*, or root, as well as the *stipes*, trunk, or common stock whence these relations branch out.

CONSCIENCE. See MORAL PHILOSOPHY.

CONSCIOUSNESS. See METAPHYSICS.

CONSCRIPT, *in Roman Antiquity*, an appellation given to the senators of Rome, who were called *patres conscripti* (conscript fathers), because their names were written in a register of the senate. See SENATE.

CONSCRIPTION, the plan adopted by the French and some other nations for recruiting their armies.

The Code de la Conscription forms a part of the French system of jurisprudence, and furnishes the most complete body of regulations for working this tremendous engine of military despotism.

The conscription was first published in the form of a general law by the Council of Ancients in 1798, and afterwards underwent some slight modifications.

By the law of the Directory, which is attributed to Carnot, all Frenchmen are pronounced soldiers; and, when the country is in danger, they are liable to be summoned to its defence; but in ordinary circumstances the wants of the army are to be supplied by the conscription. The legislative body, at the suggestion of the executive government, determines the requisite number of conscripts. The contingent of each department is regulated by the law in proportion to its population, and subdivided by the same rule among the districts, cantons, and municipalities. All Frenchmen between the full age of 20 and 25 complete are liable to the conscription.[1]

At the *drawing* or designation by lot of those who are to form the quota of the district, those who draw the numbers below the amount of the quota are taken for active service. Absentees not presenting themselves within a month after the drawing, are declared and pursued as deserters. Besides the contingent for active service, the law requires an equal number to form the conscription of the reserve, who are to march only in cases of emergency, which emergency, however, during war, has almost always been found to exist. These are all organized and carefully disciplined. A third class is also balloted for equal to one-fourth of the whole contingent, who are called the supplemental conscripts, being destined to fill up the vacancies that may occur before junction at headquarters. The conscription is enforced with rigour, and parents are held responsible for their absent children, till they can produce an official attestation of their death.

Conscription.

Against all parents, public functionaries, or others, who contribute to defeat or retard the operation of the law, there are heavy denunciations. Any health officer convicted of furnishing a false certificate of infirmity, is subjected to five years' imprisonment in irons. Other offences against the Code de la Conscription are punished with corresponding severity. Every conscript absenting himself for 24 hours from his depôt is treated as a deserter. The penalty for desertion is—public or hard labour, the punishment of the ball, or death. In the punishment of the ball, an iron ball of eight pounds weight, fastened to an iron chain of seven feet in length, is attached to the leg of the deserter. He first hears his sentence read on his knees, and is condemned to ten hours hard labour daily, and in the interval of rest chained in solitary confinement. The duration of the punishment is ten years, aggravated by every mark of ignominy in dress and appearance; and in cases of contumacy it is prolonged beyond ten years, with an additional ball fastened to the leg.

The directory admitted of no substitution, and it is still studiously discouraged by the Government; but the severity of this principle is now relaxed in a few special cases. Even in these, however, the conditions attached to them are exceedingly oppressive. For the great majority even of the better classes of conscripts, it is almost impossible to obtain proxies.

The legal duration of the service is seven years; but the dread of the hardships and of the indeterminate duration of military service, enhance enormously the price of eligible substitutes.

The system of conscription is no doubt a simple and ready means for obtaining the requisite number of soldiers; and so would a system of confiscation be a ready means for obtaining funds for carrying on a war. In fact, the conscription is a system of confiscation; it falls with peculiar hardship upon the poor, and upon those of slender fortunes. When dragged from their peaceful pursuits, their prospects in life are often ruined; and whether they sacrifice their domestic happiness and join the ranks, or ransom themselves at the expense of their small property, they are equally despoiled of their most valued possessions.

In an impending invasion it might be imperative to call upon all who are fit to bear arms, or such of them as can be most readily gathered together, without distinction, to rally round the standard of their country; but in the ordinary cases of warfare this is not necessary. Louis XIV., when at war with the whole of the north of Europe, maintained an army of 300,000, made up by ordinary levies; and even the forces of Louis XVI., recruited

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[1] *La Presse* of September 1, 1849, contained, under the head of "The Net Product of Twenty Years of War," a remarkable article in support of its arguments in favour of a reduction of the army. It is as follows:—

	Men.		Men.		Men.
Levy of June 24, 1791, ...	150,000	Conscription of Nivose 8, an XIII.,...	60,000	Conscription of December 13, 1809,...	120,000
... September, 1792, ...	109,000	... Nivose 27, an XIII.,..	60,000	... Same day, ...	40,000
... February 24, 1793, ...	300,000	... Vend. 2, an XIV., ...	80,000	... September 1, 1812, ...	120,000
... April 16, 1793, ...	30,000	... December 15, 1806,..	80,000	... January 11, 1813, ...	350,000
Requisition of August 16, 1793,.....	1,050,000	... April 7, 1807,.....	80,000	... April 3, 1813, ...	180,000
Conscription of Vend. 3, an VII., ...	100,000	... January 21, 1808, ...	80,000	... August 24, 1813, ...	30,000
... Germin. 28, an VII.,..	150,000	... September 10, 1808,..	80,000	... October 9, 1813, ...	280,000
... Messidor 24, an VII.,	110,000	... September 12, 1808,..	80,000	... November 15, 1813,...	300,000
... Floreal 28, an X., ...	120,000	... January 1, 1809, ...	80,000		
... Floreal 5, an X., ...	120,000	... April 25, 1809,.....	40,000	Total, ...	4,556,000
... ... XII., ...	60,000	... October 5, 1809,.....	36,000		

Napoleon, for his part, obtained by the conscription 2,476,000 men. Those who set out were never freed from service. Spain was the tomb of most of our own soldiers; what remained perished almost entirely in the snows of Russia. The army of 1813 was composed of recruits of from 18 to 20 years of age. Illness, fatigue, and privation, decimated them. Of the 1,260,000 men raised in 1813, there remained, in 1814, to defend the soil of France, but 100,000 men above the guard. In 1792 France had, as now, 86 departments. The conquests of the Republic gave her, in two years, the Rhine and the Alps for frontiers. From 1794 to 1800, the number of our departments was increased by 19, and made 105. Napoleon, in 1805, joined to France, Holland, maritime Germany, and half of Italy, and created 27 new departments, France then having 132. In 1814, France was reduced to her old limits of 1790, and from her were taken Marienburg, Philippeville, and Landau. Such, then, was the net produce of twenty years' gigantic wars, heroic efforts, immeasurable sacrifices, and bloodshed on every battle-field of Europe. A single battle lost, that of Waterloo, sufficed to take from France the fruit of twenty immortal victories, and to render her smaller in 1845 than in 1790. But that is not all! To 4,500,000 of men (how many nations have not 4,500,000 souls!) cut down by balls and bullets, must be added 7,000,000 of indemnity of war paid by France to the Allied Powers, and which was payable in equal portions in five years by means of *bons* to bearer on the royal treasury, *plus* 490,000,000 for the support of the foreign garrison, *plus* a multitude of various indemnities, the whole amounting to nearly two milliards.

Consecration ‖ Consentes.

in the same manner, amounted to 200,000. The regular troops levied by enlistments, and maintained by Great Britain, in 1815, exceeded 250,000, exclusive of the ordnance. Were war and conquest, as in some of the states of antiquity, the great object and business of a nation, then it might be advisable to have such an organization as would furnish a constant supply to replace the wear and tear of successive military campaigns, and the population at large might be treated as the *materiel* for this purpose; but since civilized nations have learnt to consider war as an unmitigated evil, to be encountered only when every means to avoid it consistent with safety has failed, it is surely unwise to have recourse to an organized system of compulsion to force a large portion of the population to forsake the arts of peace and those industrial pursuits which are the true sources of national wealth and prosperity. And what adds to the malignity of the system is the fact, that the conscripts are taken at a time of life when they are beginning to settle down into those habits of industry and enterprise which form the useful and respectable citizen; habits which can scarcely be acquired after years of roving restless excitement in camps and warfare.

If a country requires soldiers, why should not fair inducements be offered to recruits, as well as to others employed in the public service? There is no difficulty in finding an abundance of qualified candidates for the lowest situations in the public offices, and there is even no want of competitors to fill the ranks of the police establishments. Then let there be sufficient inducement and fair remuneration held out, and the ranks of the army will be voluntarily filled by men disposed to adopt the military life as a profession, and whom it will neither be a hardship nor a loss to withdraw from other pursuits to military service.

CONSECRATION, the act of devoting anything to sacred uses. The Mosaic law ordained, that all the first-born both of man and beast should be consecrated to God. We find also that Joshua consecrated the Gibeonites, as Solomon and David did the Nethinims, to the service of the temple; and that the Hebrews sometimes consecrated their fields and cattle to the Lord, after which they were no longer in their own power.

In England, churches have always been consecrated with particular ceremonies, the form of which is left in a great measure to the discretion of the bishop.

CONSECRATION is also used for the benediction of the elements in the eucharist.

CONSECRATION, or the ancient ceremony of the apotheosis of an emperor, is thus represented on medals:—On one side is the emperor's head, crowned with laurel, sometimes veiled, while the inscription gives him the title of *divus*; on the reverse is a temple, a bustum, an altar, or an eagle taking its flight towards heaven, either from off the altar, or from a cippus. In others the emperor is borne up in the air by the eagle. The inscription is always *consecratio*. These are the usual symbols; yet on the reverse of that of Antoninus is the Antonine column. In the apotheosis of empresses, instead of an eagle there is a peacock. The honours rendered to these princes after death were explained by the words *consecratio*, *pater*, *divus*, and *deus*. Sometimes around the temple or altar are put the words *memoria felix*, or *memoriæ æternæ*; and for princesses, *æternitas*, and *sideribus recepta*; whilst on the one side of the head is *dea*, or θεα.

CONSENTES, in the Etrusco-Roman language of religion, the twelve superior deities who formed the common council of the gods assembled by Jupiter. Their names are comprehended in the two following verses of Ennius, as quoted by Apuleius, *De Deo Socratis*:—

> Juno, Vesta, Minerva, Ceres, Diana, Venus, Mars,
> Mercurius, Jovi', Neptunus, Vulcanus, Apollo.

The word is derived from *consentio*, to agree, to unite upon something accordantly. These deities were also styled *Dii Magni*, and *Cælestes*, or *Nobiles*, as distinguished from the inferior gods.

Consequence ‖ Consols.

CONSEQUENCE, in *Logic*, the conclusion, or that which results from the premises.

CONSERVATORY, a place for preserving anything; as a greenhouse for exotic plants, an ice-house, &c.

CONSERVATORY, in *Music* (from the Italian *conservatorio*), is applied to a school for training boys and girls to the musical profession. At one time *conservatorj* were numerous and flourishing at Venice and Naples; but they began to decline in the last century, and are now almost extinct in Italy, except at Milan and Bologna. The French have their Paris *Conservatoire*; and in Germany there are several excellent schools of the same kind. The only one in Great Britain is the London Royal Academy of Music.

CONSISTENTES, in *Church History*, penitents who were allowed to assist at prayers, but not admitted to receive the sacrament.

CONSISTORY, a term commonly used to denote a council-house of ecclesiastical persons, or place of justice in the spiritual court, and also a session or assembly of prelates.

CONSISTORY, at Rome, denotes the college of cardinals, or the pope's senate and council, before which causes are pleaded. The word is derived from the post-classical Latin *consistorium*, which, according to Du Cange, is *locus ubi consistitur*; a vestibule, gallery, or ante-chamber, where courtiers wait for admission, and so called *a consistente multitudine*.

The consistory is the first court or tribunal of Rome, and only meets when convoked by the pope, who presides in person, seated on a magnificent throne, and habited in his pontifical robes. On the right are the cardinal-bishops and priests, and on the left the cardinal-deacons. It is held in a large hall in the apostolical palace where princes and ambassadors are received. The rest of the prelates, the prothonotaries, auditors of the rota, and other officers, are seated on the steps of the throne. The courtiers sit below ambassadors on the right, and consistorial and fiscal advocates behind the cardinals.

Besides the public, there is also a private consistory, held in a chamber called the *chamber of papogay*. None are admitted but cardinals, whose opinions are collected, and called *sentences*. Here are first proposed and passed all bulls for bishoprics, abbeys, &c.; and hence bishoprics and abbeys are said to be consistorial benefices. Anciently they were elective; but by the concordat, which abolishes elections, they are appointed to be collated by the pope alone, on the nomination of the prince.

CONSISTORY is also used in the reformed church to signify a council or assembly of ministers and elders, convened in order to regulate matters of discipline, and other church affairs.

CONSISTORY *Court*, in the English law, is a council of ecclesiastical persons, or the place of justice in an ecclesiastical or spiritual court. Every diocesan bishop has a consistory court, which is held before his chancellor or commissary, in their several cathedrals, or in some other convenient place of the diocese, for the trial of all ecclesiastical causes arising within their respective dioceses, and for granting probates and administrations. Under the 24th Hen. VIII., cap. 12, an appeal lies to the archbishop of the province from the decision of the consistory court.

CONSOLE, in *Architecture*, a projecting bracket, usually in the form of the letter S. Consoles are often placed as ornaments on the side of door-cases. In Vitruvius, the terms *ancon* (ἀγκων) and *prothyris* (προθυρὶς) appear to be other names for the same thing. See ARCHITECTURE, vol. iii., p. 508.

CONSOLS (an abbreviation of "consolidated"), a term familiarly used to denote a considerable portion of the pub-

Consonance || Constable.

lic debt of this kingdom, properly known as the *three per cent. consolidated annuities.* There is a similar description of stock called the "reduced threes," or three per cents. See ENGLAND, § *National Debt.*

CONSONANCE, in *Music.* See MUSIC.

CONSONANT, a letter which cannot be sounded without the aid of a vowel placed before or after it; as, *b, c, d, f, m,* &c.

CONSPIRACY—CONSPIRATOR. These, and the cognate terms, come from the Latin, which literally expresses breathing together. Two eminent characteristics of conspiracy are thus indicated; the one extreme secrecy, the other a union of action among persons—more than one: conspiracy is incapable of being committed by one person. In history it may be contrasted with rebellion, which is a public offence, and capable of being committed by a single person. Private conspiracy to injure an individual person by some illegal act is an offence punishable by every criminal code. The most common and dangerous species is that by which a plan is concocted for bringing home to the victim a false charge of the commission of a crime. The punishment of private conspiracy in England is adjusted by 14th and 15th Vict., cap. 100, § 29.

CONSTABLE. This word, according to Coke, Selden, and several other writers, is derived from the Saxon words *koning,* king, and *stabel* or *stapel,* a stay or support—*quasi columen regis,* the stay or support of the king. But as we borrowed the name as well as the office from the French, it is rather to be deduced, according to Spelman, Menage, Du Cange, Vossius, Cowell, and Skinner, from *comes stabuli,* a term denoting a kind of master of the horse; an officer, as Blackstone observes, "well known in the Empire, and so called because, like the Lord High Constable of England, he was to regulate all matters of chivalry, tilts, tournaments, and feats of arms, which were performed on horseback.

The CONSTABLE *of France* was the first officer of the crown, and had the chief command of the army; and it was his duty also to regulate all matters of chivalry and feats of arms. This office was suppressed by an edict of Louis XIII. in 1607. It was revived by Napoleon; but in 1814, on the restoration of the Bourbon dynasty, it was finally abolished.

The Lord High CONSTABLE of England was anciently an officer of the crown of the highest dignity. This office appears to have been first instituted immediately after the Norman Conquest, with duties, powers, and jurisdiction very similar to those of the Constable of France. As judge of the court of chivalry, along with the Earl Marshal, the power of the Lord High Constable was so formidable, and so improperly used, that a statute was passed in the 13th of Richard II. to restrict the jurisdiction of that court to "contracts and deeds of arms and things which touch war, and which cannot be discussed or determined by the common law." This office became hereditary in the family of the Bohuns, earls of Hereford and Essex; and afterwards passed into that of the Staffords, as their heirs-general: but in 1521 it became forfeited to the crown in the person of Edward Stafford, duke of Buckingham, who was attainted of high treason. Since that time no Lord High Constables have been appointed, otherwise than *pro hac vice*—as at coronations, and on other solemn occasions.

The Lord High CONSTABLE of Scotland. The office of Lord High Constable of Scotland is also one of great antiquity, since as many as eleven Lord High Constables of Scotland are enumerated in a list of the twelfth century. To him belonged (according to the *Leges Malc. II.*), jointly with the mareschal, the trial of all offences committed within certain limits of the king's court; though, in fact, such offences, it appears, were judged by the lord justiciar—the Constable merely protesting in favour of his right. The extent and nature of this jurisdiction, as defined in the report of the commission of inquiry in the reign of Charles I., were found to apply to all slaughters and riots committed within four miles of the king's person, of the privy-council, or the parliament; which precinct was called the *Chalmer of Peace.* The office was conferred heritably on Sir Gilbert de Hay by King Robert Bruce in 1314; and it still remains in the noble family of Erroll, the office having been expressly reserved by the Treaty of Union. Constable.

Inferior CONSTABLES. From the great office of high constable is derived that inferior order since called the *constables of hundreds and franchises.* These were first instituted in the thirteenth year of Edward I. by the statute of Winchester, which, for the conservation of the peace, and view of armour, appointed two constables to be chosen in every hundred and franchise. These are what are now called *constabularii capitales,* or *high constables;* because, with the increase of population, it was found necessary to appoint in every town others of like nature but inferior authority, called *sub-constabularii,* or *petty constables.* These were first instituted about the reign of Edward III.

In Scotland, constables are the officers of the justices of the peace, intrusted with the execution of their warrants, decrees, and orders. They are appointed by the justices at their quarter-sessions, and in royal burghs by the magistrates. It is the duty of constables, without any special warrant, to apprehend offenders against the peace, vagrants, and such as can give no account of themselves, and to take them to the next justice. It is also their duty to suppress riots, and apprehend the rioters; but after the riot is over, a constable is not authorized to seize *brevi manu* any person concerned in it, unless some one has been dangerously wounded in the affray. See POLICE.

CONSTABLE, *Archibald,* an eminent bookseller and publisher, was born Feb. 24th, 1774, at Kellie, in Fifeshire, where his father was land-steward on the estate of the Earl of Kellie. He received the usual branches of education at the parish school of Carnbee; and in 1788 was apprenticed to Mr Peter Hill, bookseller in Edinburgh. After the expiry of his apprenticeship he married the daughter of Mr Willison, a respectable printer; and established himself as a bookseller in a small shop in the High Street, to which his sale catalogues of curious and rare books soon attracted all the bibliographers and lovers of learning in the city.

In 1801 he became the proprietor of the *Farmer's Magazine,* and also of the *Scots Magazine*—a miscellany which, under the editorial superintendence of Dr John Leyden and the Rev. Dr Alexander Murray, attained a considerable reputation. Constable is, however, chiefly known from his connection with the *Edinburgh Review;* the first number of which was published by him in October 1802. However much his sagacity may have tended to guide its projectors in the carrying out of their design, it is certain that he himself was not the author of the project, and was rather startled at the boldness of the scheme when first propounded to him.

His reputation as a publisher was greatly enhanced by his connection with the novels of Sir Walter Scott, the first of which appeared in 1805. For some of these tales Mr Constable had the merit of occasionally suggesting subjects and finding titles. He was also the proprietor of the *Encyclopædia Britannica,* and published a supplement to one of its earlier editions. In 1826, whilst busily engaged in the publication of the *Miscellany* which bears his name, Mr Constable became bankrupt; and a sudden illness shortly afterwards brought him to the grave, July 21, 1827.

CONSTABLE, *John,* (1776–1837), an eminent English landscape painter, was born near Woodbridge, Suffolk, where his father was a miller. By his parents he was destined for the church, but being averse to study, he was apprenticed to his father's trade. His passion for painting, however, led him quickly to abandon this employment; and in 1799 he

Constance. was admitted a student at the Royal Academy, London. He first appeared as an exhibitor in 1802; and in 1829 he was elected an academician.

Like all painters who have attained eminence in their art, Constable delighted in the contemplation of nature; and in his compositions he laboured to give a faithful transcript of its simplicity and beauty. Before sketching from nature, he used to remark, he first tried to forget that he had ever seen a picture. His picture of the Corn Field, in the National Gallery, is a good specimen of his style and abilities.

CONSTANCE (Costnitz), the capital of the Baden See-Kreis or Lake Circle, situated on the Swiss side of the Rhine, on a peninsula at the W. extremity of the Bodensee or Lake of Constance. It is an ancient town, and its population has fallen from 40,000 in the fifteenth century to 5300 in the present. Its fortifications consist of a wall flanked by towers, and one of its suburbs, that of Kreuzlingen, is defended by two bastions. The suburb of Petershausen, which was originally a free abbey of the empire, communicates with the city by means of a long covered wooden bridge raised on stone piers. The only other suburb, that of Bruhl, contains the field in which Huss suffered martyrdom. The principal buildings of Constance are the minster, the old Dominican convent on the island of Genf, now a cotton-printing establishment, and the *Kaufhaus* or public mart, in the hall of which sat the famous council of Constance (1414–18). It contains also a lyceum, a hospital, a conventual school for females, and several museums. Constance is the seat of the circle and district governments, and has a considerable local trade. There are a few manufactures of cotton and silk stuffs; and a considerable proportion of the inhabitants are engaged in the fisheries and navigation of the lake.

Constance, *Lake of* (Bodensee Costnitz), a large lake of Central Europe, on the confines of Baden, Wirtemberg, Bavaria, Austria, and Switzerland. Greatest length from Bregenz to Bodmann 44 miles; greatest breadth between Rorshach and Friederichshafen 13 miles; greatest depth 912 feet; height above the level of the sea 1280 feet. It is divided into the upper and lower lakes, the latter of which contains the fertile island of Reichenau. They are connected with each other by the channel of the Rhine, which enters the lake at Rheineck, and leaves it at Stein. The shores of the lake are flat and undulating, being more fertile than picturesque. The navigation is rendered dangerous by sudden squalls, but there is a considerable traffic in rural produce, and numerous steamboats ply between the towns on the margin of the lake. Its waters are subject to sudden risings, proceeding from some unknown subterraneous agency: they abound in salmon, trout, pike, carp, &c., and are frequented by numerous species of aquatic birds. To the Romans the lake of Constance was known as the *Brigantinus Lacus*. Its northern shore was inhabited by the Vindelicians, the southern bank was held by the Helvetians, and the south-east by the Rætians.

CONSTANT, Benjamin (1767–1830), a celebrated French political writer, was born at Geneva, where his father, who had been a general officer in the Dutch service, lived in retirement. For some time the younger Constant held a situation at the court of Brunswick; but at the outbreak of the French revolution he went to Paris, and being descended from an exiled French family he claimed the privileges of a French citizen. At this time he published several small political tracts containing his views on the character of the existing governments, one in support of the Directory, and a second in condemnation of the Reign of Terror. Under the First Consul Constant became a member of the tribunate, but his systematic opposition to the measures of the consular government procured his expulsion from Paris along with Madame de Staël. Returning to Paris for a short time he afterwards repaired to Göttingen, where he wrote his *History of the Different Modes of Worship*, and a tragedy entitled *Wolstein*. At the restoration he again appeared at Paris as the advocate of the Bourbons, and denounced Napoleon on his escape from Elba. He had the meanness, however, to accept from Napoleon the title of councillor of state, and afterwards to employ his pen in rousing the nation to rally round the Emperor. He retired from Paris for a short time after the restoration of Louis XVIII., and on his return he joined the constitutional opposition, and obtained a seat in the Chamber of Deputies. He wrote in *Le Mercure*, and was conjoint editor of *La Minerve* for several years before his death. Constantia || Constantinople.

CONSTANTIA, a small village about eight miles W. from Cape Town, celebrated for its luscious red and white wines, of which it produces about 10,000 gallons yearly.

CONSTANTINA (the modern name of the ancient Roman Cirta), the capital of the French province of Constantina, Algiers. It stands on a peninsulated eminence, surrounded by deep ravines, which are traversed by the Rummell; and it is fortified by walls and gates, which, though of Arabic masonry, seem to have been formed from the ruins of Roman edifices. The streets of the town are narrow and irregular, and the houses generally two stories high with sloping roofs. The principal manufacture is that of saddles, and leather goods generally. A large trade is carried on with the south, in which the corn of the district and various articles of European manufacture are exchanged for the gold dust, ostrich feathers, and other products of Central Africa. Pop. (1849) 22,994, of whom 2050 were Europeans. See Cirta.

CONSTANTINE the Great, Roman emperor, A.D. 306–337. See Roman History.

Constantine VII. (*Flavius Porphyrogenitus*), Emperor of the East, 911–959. During his retirement under the usurpation of Romanus Lecapenus, he had acquired a taste for literature and art; and after having assumed the purple, he abandoned the cares of the empire in a great measure to his wife Helena, and devoted himself to his favourite pursuits. During his reign, however, the arms of the empire were crowned with victory, and the power of the emperor was strengthened by alliances with the Khalifs of Baghdad and Africa. Constantine's end was hastened by poison, administered by his son Romanus. His works are peculiarly valuable as throwing light on the manners and customs of a period otherwise wholly unknown to us.

CONSTANTINOPLE, the capital of the Turkish empire, the Stanboli of the Greeks, or Istanboul of the Turks. An attempt was made to change this latter name into Islamboul, that is, the town of Islam or Mohammedanism, and coins were even struck bearing the new name; but the attempt failed, and the coinage again bears the impression "struck at Istanboul." The entire civil and ecclesiastical authority of the Turkish empire is concentrated in the city, where reside the chief pashas, muftis, and ulemas; the patriarch and synod of the Greek Church; an Armenian and a Catholic archbishop. That part of it which is now occupied by the seraglio, and which is separated from the rest by a wall, is understood to have been the Byzantium of the ancients. See Byzantium.

It is built on a triangular promontory, of which the base is toward Europe, and is bounded by the sea of Marmora on the south-eastern, and the harbour or Golden Horn on the northern side. The seraglio is at the apex of the triangle, and forms the western side of the mouth of the Bosporus, of which the harbour is an extensive inlet. The city stands upon and between seven hills or risings, and was defended on the side of the land by a triple wall from 14 to 20 feet high, beyond which was a ditch 25 feet broad. These defences still remain apparently as left at the conquest of the town. A single wall around the water boundary of the city is still quite visible on the Marmora side, and though concealed

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towards the harbour by buildings on the shore, may yet be easily traced by the square towers which are placed at short distances along it, and of which the number is said to be 548. These walls give evidence of having been constructed in great haste; and the materials of which they are composed seem to have been taken in good part from the valuable remains of antiquity which abounded in the city. An immense number of columnar pieces have been laid as the foundation, for which they were ill-adapted from their roundness; and fragments of architraves and entablatures have been fitted in with their mouldings, inwards or outwards as suited the convenience of the mason. In one or two places the workmen seem to have amused themselves by trying to keep the more ornamental pieces together; and one edifice, described by tourists as the Lion's Fountain, has been ludicrously transferred to the top of the wall, the arch stones which had probably come first to hand having been clumsily stuck together below. Sometimes also an attempt had been made to preserve the inscriptions, some of which may be seen in that part of the wall which defends the palace towards the Marmora, but disjointed and occasionally even inverted. Before these walls were constructed, there seems to have existed an immense breakwater all along the Marmora side of the town. Many of the stones of this breakwater are several tons in weight, and are much waterworn. In many places the wall has been built upon the breakwater, and in some cases the ignorant masons have used the old stones as building material. Those above the sea-level seem as much waterworn as those below, which have been for 500 years exposed to the action of the waves. In the interior of the town the Greeks had constructed extensive subterraneous cisterns: one of these is still in use; and another, celebrated as the Bin bir Direk, or thousand and one columns, is now converted into a receptacle for street sweepings.

The town has extensive suburbs. The largest of these Scutari, called by the Turks Iskudar, is situated on the Asiatic side of the Bosporus. The second is the town of Galata on the northern side of the harbour—celebrated for the obstinacy with which it was long held by the Genoese against the Turks. The defence walls of Galata also remain almost as at the date of the conquest, and still bear tablets with the insignia of Genoa. Galata has gradually become the principal seat of mercantile enterprise, which is almost entirely in the hand of Franks and Christian subjects. Two bridges of boats connect Galata with Stanboli. The first of these was built by Sultan Mahmoud, who has left funds to keep it in repair. Originally it was built on logs, but has lately been renewed on copper-sheathed pontoons. The second bridge was constructed by the present Sultan Abdul Medjid, and is maintained in repair by means of a toll of five paras (about one farthing) for each foot passenger. A third bridge has been thrown across the upper part of the harbour by a joint stock company; but from the injudiciousness of the position it has proved a failure.

The almost total absence of roads is compensated by the vast number of caiques which ply for moderate fares on the harbour and the Bosporus. These again are beginning to be supplanted by small steamers: and a considerable number of large steamers keep up the communication with the more distant parts of the empire. Steamers also sail regularly to Britain, France, Trieste, and Greece.

The gentle undulations on which the town stands, and the great number of whitewashed minarets, give a magnificent appearance to Constantinople as seen from the water, and the view is particularly grand from the opening of the Bosporus and harbour; but the internal by no means corresponds with the external appearance. The streets are most irregular and badly paved, and the houses are wretchedly built of wood. There are neither names to the one, nor numbers to the other; but the town is divided into separate districts, somewhat like our parishes, allotted to the Turks, Greeks, Armenians, and Jews. The Franks chiefly reside in the suburbs of Pera and Galata. The Turkish districts are the most extensive, and, on account of the yearly diminution of Turkish inhabitants, have often a most dilapidated appearance: they are at once recognised from a distance by the extent of open ground which is often allowed to lie waste around them. The Christian quarters, on the other hand, are closely built and densely peopled, the value of ground being several times that of similar ground in the contiguous Turkish quarter.

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Of late years, some little attention has been paid to the keeping of the streets. The vulture, which once was common, has now disappeared, and the number of kites and dogs which live on the offal is rapidly diminishing; yet even now few large towns can compete with the so-called Deri Saadet (Gate of Felicity) in filthiness and defective drainage. Conflagrations are common, and said, indeed, to be frequently wilful. Thus within fifteen years the whole of Pera has been burned down: the principal part, however, has been rebuilt in stone, and contrasts favourably with Stanboli, on the opposite side of the harbour. In one night, in 1851 or 1852, there were no fewer than seven fires in various parts of the city and suburbs, which consumed an aggregate of some 3500 houses. A new law, ordaining that every house which has been burned or taken down shall be rebuilt one arsheen (30 inches) further from the street than that which it replaces, is making a rapid improvement in the airiness of the streets, but leaves them as crooked as ever.

In the neighbourhood of the seraglio and the government offices is an open space called the At-Meidan (horse place), about 500 feet in length and 300 in breadth, which was the Hippodrome, and in which the game of throwing the jereed was practised by the Turks. Along the centre line of it are placed an Egyptian obelisk, the remains of a small column, composed of three twisted serpents in bronze, and a tall obelisk much decayed. Though much vaunted, the At-Meidan has a very mean appearance; the buildings on the east, north, and west sides are irregular, but the south side is occupied by the magnificent mosque of Sultan Ahmed with its six minarets. Among the mosques, the most celebrated is that of Agia (Aya) Sofia, converted from a Christian church to a Mohammedan jamih. St Sophia is 260 feet long by 230 broad, and has a large dome supported on marble and granite pillars, of which it is said there are 170 about the building. Some of these, in green jasper, are reported to have been the supports of the temple of Diana at Ephesus. Several other mosques vie in magnitude with St Sophia, or even exceed it; and of smaller ones, there are said to be above a thousand scattered through the town.

The Seraglio is the chief object of curiosity in Constantinople. It is not a single building, but an assemblage of various palaces, mosques, and gardens. In the outer court is the palace of the grand vizier, the exchequer, and the mint, including the church in which Theodosius convened that council distinguished as the second of Constantinople. The mint was fitted up about the year 1844 with improved coining machinery from England, which is worked under the superintendence of British foremen. In the middle court is the divan, where may be seen the celebrated pillar of Theodosius the Great. In the third or inner division of the seraglio is the especial presence-chamber, with the hall of the throne, the treasure apartment, as well as the summer and winter harems, and the library, which is believed to be very rich in manuscripts. The Seraglio is in fact a city of itself, and is said to contain upwards of 6000 inhabitants. The present sultan has never resided in the Seraglio: he passes a short time there on state occasions, but usually lives during winter at the palace of Tsheragan on the European side, and in summer at Beylerbey on the Asiatic side of the Bosporus. He is building a magnificent palace in stone at

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Dohna-Baghtshé, on which it is said that above two millions sterling have already been expended, and yet is is far from being finished.

As the Turks do not allow a census to be taken, all statements of the number of inhabitants in their dominions must be doubtful and conjectural. Eton calculates the population of Constantinople at no more than 300,000; whilst General Andréossy calculated it, without including Scutari, at 597,600; his calculation being founded on the daily consumption of bread. The number of houses is about 88,100. According to Andréossy the division of the inhabitants is as follows:—300,000 Turks, Tātars, and other Mussulmans; 200,000 Greeks; 50,000 Armenians; 30,000 Jews; and the remainder of the various Frank nations. In 1851, the census of the resident British gave only 200. The mortality is said to be greater than in any other city in Europe; but the recruits that arrive from all parts of the Turkish dominions, and especially the slaves brought for sale, fill up the numbers faster than they fall away by death. Of late years, too, the rayahs seek refuge from the exactions of the provincial pashas in the neighbourhood of the seat of government, where the Tanzimat or new constitution is better observed. Although the public slave market has been shut for a few years, the trade in slaves is still carried on with all its episodes of horror and abomination. The closely latticed windows of the harems of the rich, the prison-like aspect of the better streets, and the caravan of gaunt shoeless Nubian girls in their cotton wrappers, are part and parcel of the odious system.

There are four establishments for education on the European system. The first of these was founded by Sultan Selim at Sudlijeh near the top of the harbour. This establishment has lately been enlarged so as to accommodate about 200 students, of whom two-thirds are intended as military, and the remaining third as civil engineers. A lithographic and copperplate printing office is attached to this school. On the height beyond Pera there is an extensive military school capable of admitting 300 students; and on the island of Heibileh (Khalki) there is a naval school for 200 pupils. In all of these the students are lodged, fed, and clothed by the state, and receive besides a monthly pay regulated according to the rank; but the progress made is insignificant, the systematic corruptness of the examinations paralyzing every exertion. In the centre of Pera there is also the medical school of Galata Serai. Its buildings were burned down about six years ago, and the classes are temporarily transferred to Cumbur-Hana near Sudlijeh. Christians and Jews are admitted to this school along with the Turks, and any progress that is made is almost exclusively confined to these and to the Arab Mussulmans.

In general, each jamih has its attendant school, at which the education consists in the rehearsal of the Koran in ancient Arabic, and the merest elementary reading and counting. There is a second class of schools called rushtii, at which a little more progress is made. Above these are the academies of Mohammed the Second and Mustapha the Third, numbering 400 or 500 students, from among the graduates of which the ulemas are taken. An immense building for a university is in progress near the jamih of St Sophia.

By the generosity of the pashas, the viziers, and other wealthy persons, many charitable institutions have been founded. Connected with most of the mosques there is a hospital; with others, a house for the reception of lunatics; and with some, a cooking institution for the poor. There is an orphan house, a Greek and Frank hospital, and four pest-houses for those who have the smallpox.

The trade of Constantinople consists chiefly in the supply of the wants of the state officers, and of the military and naval persons who are attracted to the capital; but it is chiefly by foreigners that the handicraft operations are performed. The principal manufactures are those of cotton and silk goods. The Armenians are the chief jewellers and silversmiths. The Jews are perfumers, druggists, and brokers; the Franks are the principal mechanics; and the chief business is transacted at the several bazaars.

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The foreign trade of Constantinople is favoured by its excellent harbour, capable of containing 1200 ships. It is the medium of intercourse between that part of Asia whence laden camels arrive, and the different divisions of Europe, collecting the drugs and silks of the one, and distributing them among the others. It would require much space to collect and enumerate the ramifications of such a trade as is carried on in minute articles to and from the city of Constantinople. This city is distant 1680 miles from London.

The geographic position of the mosque of St Sophia is Lat. 41. 0. 16. north. Long. 28. 59. 14. east of Greenwich.

CONSTANTINOPOLITAN HISTORY. Constantinople, anciently Byzantium, became the seat of empire under Constantine the Great. Its removal to this quarter is generally considered as having been one of the principal causes of the sudden decline of the western empire after this period.

In the year 332 the Sarmatians implored Constantine's assistance against the Goths, who had made an irruption into their territories, and destroyed every thing by fire and sword. The emperor readily granted their request, and gained a complete victory. Nearly a hundred thousand of the enemy perished, either in the battle, or after it from hunger and cold. In consequence of this overthrow the Goths were obliged to sue for peace; but the ungrateful Sarmatians were no sooner delivered from their enemies than they turned their arms against their benefactor, and ravaged the provinces of Mœsia and Thrace. The emperor, having received intelligence of this treachery, returned with incredible expedition, cut great numbers of them in pieces, and obliged the remainder to submit to such terms as he pleased to impose.

Constantine seems to have been a prince very highly respected, even by distant nations. In the year 333, according to Eusebius, ambassadors arrived at Constantinople from the Blemyes, Indians, Ethiopians, and Persians, to solicit his friendship. They were received in a most gracious manner; and having ascertained from the ambassadors of Sapor, king of Persia, that there were great numbers of Christians in their master's dominions, Constantine wrote a letter in their behalf to the Persian monarch.

Next year the Sarmatians being again attacked by the Goths, found themselves obliged to set at liberty and to arm their slaves against the assailants. By this means they were enabled to overcome the Goths; but the victorious slaves turning their arms against their masters, drove the latter out of the country. This misfortune obliged them, to the number of three hundred thousand, to apply for relief to the Roman emperor, who incorporated with his legions such of them as were capable of service, and gave settlements to the remainder in Thrace, Scythia, Macedonia, and Italy. This was the last remarkable action of Constantine the Great. He died on 15th May 337, after having divided the empire among his children and nephews. Constantine, his eldest son, obtained Gaul, Spain, and Britain; Constantius, the second, Asia, Syria, and Egypt; and Constans, the youngest, Illyricum, Italy, and Africa. To his nephew Dalmatius he gave Thrace, Macedonia, and Achaia; and to King Annibalianus, his other nephew, Armenia Minor, Pontus, Cappadocia, and the city of Cæsarea, which he desired might be the capital of his kingdom.

After the death of Constantine the army and senate proclaimed his three sons emperors, without taking any

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notice of his two nephews, who were soon afterwards murdered, with Julius Constantius the late emperor's brother, and all their friends and adherents. Thus the family of Constantine was at once reduced to his three sons, and two nephews, Gallus and Julian, the sons of Julius Constantius; and of these the former owed his life to a malady, from which no one thought he could recover, and the latter to his infancy, being then about seven years of age. The three brothers divided among themselves the dominions of the deceased princes; but they did not long agree together. In 340, Constantine, having in vain solicited Constans to yield to him part of Italy, raised a considerable army, and, under pretence of marching to the assistance of his brother Constantius, who was then at war with the Persians, made himself master of several places in Italy. Upon this Constans detached part of his army against him; and Constantine, having been drawn into an ambuscade near Aquileia, was cut off with his whole forces. His body was thrown into the river Ansa; but being afterwards discovered, it was sent to Constantinople, and interred there near the tomb of Constantine.

By the defeat and death of his brother, Constans remained sole master of all the western part of the empire, in the quiet possession of which he continued till the year 350. This year Magnentius, the son of one Magnus, a native of Germany, finding that Constans was despised by the army on account of his indolence and inactivity, resolved to murder him, and set up for himself. Having found means to gain over to his designs the principal officers of the army, he seized on the imperial palace at Autun, distributed among the populace the sums which he found there, and thus induced not only the city, but the neighbouring country, to espouse his cause. Constans, informed of what had passed, and unable to resist the usurper, fled towards Spain. He was, however, overtaken by Gaiso, whom Magnentius had sent after him with a chosen body of troops, and dispatched with many wounds, at Helena, a small village situated at the foot of the Pyrenees.

Thus Constantius acquired a right to the whole Roman empire, though one half of it had been seized by Magnentius after the murder of Constans. The former had been engaged in a war with the Persians, in which little advantage was gained on either side; but as the Persians now gave him scarcely any disturbance, the emperor marched against the usurpers in the West. Besides Magnentius, there were at that time two other pretenders to the western empire. Veteranio, general of infantry in Pannonia, had, on the first news of the death of Constans, caused himself to be proclaimed emperor by the legions under his command. He was a native of Upper Mœsia, and advanced in years when he usurped the sovereignty, but so illiterate that he then for the first time learned to read. The third pretender was Flavius Popilius Nepotianus, son of Eutropia, the sister of Constantine the Great. Having assembled a company of gladiators and men of desperate fortunes, this person assumed the purple on the 3d of June 350, and in that attire presented himself before the gates of Rome. The prefect Anicetus, who commanded there for Magnentius, sallied out against him with a body of Romans, who, however, were soon driven back into the city. Soon afterwards Nepotianus made himself master of the city itself, which he filled with blood and slaughter. Magnentius being informed of what had happened, sent against this new competitor his chief favourite and prime minister Marcellinus. Nepotianus received him with great resolution; and a bloody battle ensued between the soldiers of Magnentius and the Romans who had espoused the cause of Nepotianus; but the latter being betrayed by a senator named Heraclitus, his men were put to flight, and he himself killed, after having enjoyed the sovereignty only twenty-eight days. Marcellinus ordered his head to be carried on the point of a lance through the principal streets of the city; put to death all those who had declared for him; and, under pretence of preventing disturbances, commanded a general massacre of all the relations of Constantine. Soon afterwards Magnentius himself came to Rome to make the necessary preparations for resisting Constantius, who was exerting himself to the utmost in order to revenge the death of his brother. In the city he behaved most tyrannically, putting to death many persons of distinction in order to seize their estates, and obliging others to contribute half of all they were worth towards the expense of the war. Having by this means raised a great sum, he assembled a mighty army, composed of Romans, Germans, Gauls, Franks, Britons, Spaniards, and other nations; and at the same time, dreading the uncertain issues of war, he dispatched ambassadors to Constantius with proposals of accommodation. Constantius set out from Antioch about the beginning of autumn, and, passing through Constantinople, arrived at Heraclea, where he was met by deputies from Magnentius and Veteranio, who had agreed to support each other in case the emperor would hearken to no terms. The deputies of Magnentius proposed in his name a match between him and Constantia, or rather Constantina, the sister of Constantius and widow of Annibalianus, offering at the same time to Constantius the sister of Magnentius. At first the emperor would listen to no terms; but afterwards, that he might not be obliged to contend with two enemies at once, he concluded a separate treaty with Veteranio, by which he agreed to adopt him as his partner in the empire. But when Veteranio ascended the tribunal along with Constantius, the soldiers pulled him down, crying out that they would acknowledge no other emperor than Constantius. Upon this Veteranio threw himself at the emperor's feet and implored his mercy. Constantius received him with great kindness, and sent him to Prusa, in Bithynia, where he allowed him a maintenance suitable to his quality.

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Constantius, now master of Illyricum, and of the army commanded by Veteranio, resolved to march without delay against Magnentius. In the mean time, however, being informed that the Persians were preparing to invade the eastern provinces, he married his sister Constantina to his cousin-german Gallus, created him Cæsar on the 15th of March, and allotted him as his share not only all the East, but likewise Thrace and Constantinople. About the same time Magnentius conferred the title of Cæsar on his brother Decentius, whom he dispatched into Gaul to defend that country against the barbarians who had invaded it; for Constantius had not only stirred up the Franks and Saxons to break into that province, by promising to relinquish to them all the places which they should conquer, but had sent them large supplies of men and arms for the purpose. On this encouragement the barbarians invaded Gaul with a mighty army, overthrew Decentius in a pitched battle, committed everywhere dreadful ravages, and reduced the country to a most deplorable situation. In the mean time Magnentius having assembled a numerous army, left Italy, and crossing the Alps, advanced into the plains of Pannonia, where Constantius, whose main strength consisted in cavalry, waited his approach. Magnentius hearing that his competitor had encamped at a small distance, invited him by a messenger to proceed to the extensive plains of Sciscia, on the Save, there to decide which of them had the best title to the empire. This challenge Constantius received with great joy; but as his troops marched towards Sciscia in disorder, they fell into an ambuscade, and were put to flight with great slaughter. This suc-

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cess so elated Magnentius that he rejected the terms of peace which were now offered by Constantius; but after some time a general engagement ensued at Mursa, in which Magnentius was entirely defeated, with the loss of twenty-four thousand men.

After his defeat at Mursa, Magnentius retired into Italy, where he recruited his shattered forces as well as he could. But in the beginning of the following year, 352, Constantius, having assembled his troops, surprised and took, without the loss of a man, a strong castle on the Julian Alps belonging to Magnentius. After this the emperor advanced in order to force the remainder; upon which Magnentius, struck with terror, immediately abandoned Aquileia, and ordered the troops who guarded the other passes of the Alps to follow him. Thus Constantius having entered Italy without opposition, made himself master of Aquileia, and thence advanced to Pavia, where Magnentius gained a considerable advantage over him. Notwithstanding this loss, however, Constantius reduced the whole country bordering on the Po, and Magnentius's men deserted to him in whole troops, delivering up the places which they had garrisoned; which circumstances so disheartened the tyrant, that he left Italy, and retired with all his forces into Gaul. Soon after this, Africa, Sicily, and Spain, declared for Constantius, upon which Magnentius sent a senator, and after him some bishops, to negotiate a peace; but the emperor treated the senator as a spy, and sent back the bishops without any answer. Magnentius now finding that his affairs were desperate, and that there were no hopes of pardon, recruited his army in the best manner he could, and dispatched an assassin into the East to murder Gallus Cæsar; hoping that the death of the latter would oblige the emperor to withdraw his forces from Gaul, and to march in person for the defence of the eastern provinces, which were threatened by the Persians. The assassin gained over some of Gallus's guards; but the plot being discovered before it could be put in execution, they were all seized and executed as traitors.

In the year 353, the war against Magnentius was carried on with more vigour than ever, and at last happily ended by a battle fought in the higher Dauphiny. Magnentius, being defeated, took shelter in Lyons; but the few soldiers who attended him, despairing of any further success, resolved to purchase the emperor's favour by delivering up his rival, the author of so calamitous a war. Accordingly they surrounded the house where he lodged; upon which the tyrant in despair slew with his own hand his mother, his brother Desiderius, whom he had created Cæsar, and such of his friends and relations as were with him; and then fixing his sword in a wall, threw himself upon it, in order to avoid a more shameful death, which he had every reason to apprehend.

After the death of Magnentius, his brother Decentius Cæsar, who was marching to his assistance, and had already reached Sens, finding himself surrounded on all sides by the emperor's forces, chose rather to strangle himself than to fall alive into the hands of his enemies. Thus Constantius was left sole master of the Roman empire. His panegyrists tell us that, after his victory, he behaved with the greatest humanity, forgiving and receiving into favour his greatest enemies; but other historians affirm that Constantius now became haughty, imperious, and cruel, of which disposition many instances are given.

This year the empire was subjected to the most grievous calamities. Gaul was ravaged by the barbarians beyond the Rhine, and the disbanded troops of Magnentius. At Rome, the populace rose on account of a scarcity of provisions. In Asia, the Isaurian robbers overran Lycaonia and Pamphylia, and even laid siege to Seleucia, a city of great strength, of which, however, they failed to make themselves masters. At the same time the Saracens committed dreadful ravages in Mesopotamia; and the Persians also invaded the province of Anthemusia on the Euphrates. But the eastern provinces were not so much harassed by the barbarians as by Gallus Cæsar himself, who ought to have protected them. That prince was naturally of a cruel, haughty, and tyrannical disposition, and being elated with his successes against the Persians, he behaved more like a tyrant and a madman than a governor. His natural cruelty is said to have been heightened by the instigations of his wife Constantina, who is styled by Ammianus the *Megæra*, or fury of her sex; and he adds, that her ambition was equal to her cruelty. Thus all the provinces and cities in the East were filled with blood and slaughter. No man, however innocent, could be sure to live or enjoy his estate a whole day; for Gallus's temper being equally suspicious and cruel, those who had any private enemies took care to accuse them of crimes against the state, and with Gallus to be accused was to be condemned. At last the emperor being informed from all quarters of the evil conduct of his brother-in-law, and being at the same time told that he had aspired at the sovereignty, resolved upon his ruin. For this purpose he wrote letters to Gallus and Constantina, inviting both of them to repair to Italy. Though they had each sufficient reason to dread the worst, yet they durst not venture to disobey the emperor's express command. Constantina, who was well acquainted with her brother's temper, and hoped to pacify him by her artful insinuations, set out first, leaving Gallus at Antioch; but she had scarcely entered the province of Bithynia when she was seized with a fever, which put an end to her life. Gallus now despairing of being able to appease his sovereign, thought of revolting openly; but most of his friends having deserted him on account of his inconstant and cruel temper, he was at last obliged to submit to the pleasure of Constantius. He advanced, therefore, according to his orders; but at Petavium he was arrested, stripped of all the ensigns of his dignity, and thence carried to Fianona, now *Franone*, in Dalmatia, where he was examined by two of his most inveterate enemies. He confessed most of the crimes laid to his charge; but urged as an excuse the evil counsels of his wife Constantina. The emperor, provoked at this plea, which reflected on his sister, and instigated by the enemies of Gallus, signed a warrant for his execution, which was accordingly carried into effect.

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During this time the emperor had been engaged in a war with the Germans; he had marched against them in person; and, though he gained no important advantage, the barbarians thought proper to make peace with him. This, however, was but short lived. No sooner had the Roman army withdrawn than they began to make new inroads into the empire. Constantius dispatched Arbetio with the flower of the army against them; but the latter fell into an ambuscade, and was put to flight, with the loss of a great number of men. This, however, was soon retrieved by the valour of Arinthæus, and of two other officers, who, falling upon the Germans without waiting for the orders of their general, put the barbarians to flight, and obliged them to withdraw from the Roman territories.

The tranquillity of the empire which ensued on this repulse of the Germans, was soon interrupted by a pretended conspiracy, which in the end produced a real one. Sylvanus, a leading man among the Franks, commanded in Gaul, and had there performed great exploits against the barbarians. He had been raised to this post by Arbetio; but only with the design of removing him from the emperor's presence in order to accomplish his ruin, which he succeeded in effecting. One Dynames, keeper of the em-

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peror's mules, on leaving Gaul, begged of Sylvanus letters of recommendation to his friends at court, which being granted, the traitor erased from them all but the subscription. He then inserted directions to the friends of Sylvanus for carrying on a conspiracy; and delivering these forged letters to the prefect Lampidius, they were by him shown to the emperor. Thus Sylvanus was forced to revolt, and to cause himself to be proclaimed emperor by the troops under his command. In the mean time, however, Dynames having thought proper to forge another letter, the fraud was discovered, and an inquiry set on foot, which brought the whole matter to light. Sylvanus was now declared innocent, and letters were sent to him by the emperor, confirming him in his post; but these had scarcely been dispatched when certain news arrived at court of Sylvanus having revolted and caused himself to be proclaimed emperor. Constantius, thunderstruck at this news, dispatched against him Ursicinus, an officer of great integrity, as well as valour and experience in war; who, forgetting his former character, pretended to be Sylvanus's friend, and thus found means to cut him off by treachery.

The barbarians, who had hitherto been kept quiet by the brave Sylvanus, no sooner heard of his death than they broke into Gaul with greater fury than ever. They took and pillaged above forty cities, and amongst the rest Cologne, which they levelled with the ground. At the same time the Quadi and Sarmatians entering Pannonia, destroyed every thing by fire and sword. The Persians also, taking advantage of the absence of Ursicinus, overran, without opposition, Armenia and Mesopotamia; Prosper and Mausonianus, who had succeeded that brave commander in the government of the East, being more intent upon pillaging than defending the provinces committed to their care. Constantius not thinking it advisable to leave Italy himself, resolved at last to raise his cousin Julian, the brother of Gallus, to the dignity of Cæsar. Julian, it seems, was a man of extraordinary talent and ability; for although before this time he had been entirely buried in obscurity, and conversed only with books, no sooner was he put at the head of an army than he behaved with the same bravery, conduct, and experience, as if he had been all his life bred up to the practice of war. He was appointed governor of Gaul; but before he set out, Constantius gave him in marriage his sister Helena, and made him many valuable presents. At the same time, however, the jealous emperor greatly limited his authority; gave him written instructions how to behave; ordered the generals who served under him to watch all his actions no less than those of the enemy; and strictly enjoined Julian himself not to give any largesses to the soldiery.

Julian set out from Milan on the first of December 355, the emperor himself accompanying him as far as Pavia, whence he pursued his journey to the Alps, attended only by three hundred and sixty soldiers. On his arrival at Turin he was first informed of the loss of Cologne, which had been kept concealed from the emperor. He arrived at Vienna before the end of the year, and was received by the people of that city and the neighbourhood with extraordinary joy.

In 356, the barbarians having besieged Autun, Julian marched with what forces he could raise to the relief of the place. When he arrived there he found the siege had been raised; on which he went in pursuit of the barbarians to Auxerre, crossing with no small danger thick woods and forests, from Auxerre to Troyes. On his march he was surrounded on all sides by the barbarians, who moved about the country in great bodies; but he put them to flight with a handful of men, cut great numbers of them in pieces, and took some prisoners. From Troyes he hastened to Rheims, where the main body of the army, commanded by Marcellus, waited his arrival. Leaving Rheims, he pursued his route towards Decempagi, now Dieuze, on the Seille, in Lorrain, with the design of opposing the Germans, who were busy in ravaging that province. But the enemy having unexpectedly attacked his rear, would have cut off two legions, had not the rest of the army, alarmed at the sudden noise, turned back to their assistance. A few days afterwards he defeated the Germans, though with great loss to his own army; the victory, however, opened him the way to Cologne. This city he found abandoned by the barbarians. They had neglected to fortify it; but Julian commanded the ancient fortifications to be repaired with all possible expedition, and the houses to be rebuilt; after which he retired to Sens, and there took up his winter quarters. This year also Constantius entered Germany on the side of Rhætia, laid waste the country far and wide, and obliged the barbarians to sue for peace, which was readily granted. The same year he enacted two laws; one of which declared it capital to sacrifice or pay any kind of worship to idols; and the other granted the effects of condemned persons to their children and relations within the third degree, except in cases of magic and treason; but this last one he revoked two years after.

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In the beginning of the year 357 the barbarians besieged Julian for a whole month in Sens; Marcellus, the commander-in-chief, never once offering to assist him. Julian, however, defended himself so valiantly with the few forces he had, that the barbarians at last retired. After this Constantius declared Julian commander-in-chief of all the forces in Gaul, and appointed under him one Severus, an officer of great experience, and of a more accommodating disposition than Marcellus. On his arrival in Gaul, Julian received him with great joy, raised new troops, and supplied them with arms which he had luckily found in an old arsenal. The emperor, resolving at all events to put a stop to the terrible devastations committed by the barbarous nations, chiefly by the Alemans, wrote to Julian to march directly against them; and at the same time he sent Barbatio, who had been appointed general in stead of Sylvanus, with a body of twenty-five or thirty thousand men, from Italy, in order to inclose the enemy between two armies. The Leti, however, a German nation, passing between the armies, advanced as far as Lyons, hoping to surprise that wealthy city; but meeting with a warmer reception than they had expected, they contented themselves with ravaging the country all round. On the first notice of this expedition, Julian detached strong parties to guard the passages through which he knew the barbarians must return; and thus they were all cut off, excepting those who marched near the camp of Barbatio, who was so far from intercepting their retreat, that he complained by a letter to Constantius of some officers for attempting it. These officers, among whom was Valentinian, afterwards emperor of the West, were, by the order of Constantius, cashiered for their disobedience. The other barbarians either fortified themselves in the countries which they had seized, stopping up all the avenues with huge trees, or took shelter in the islands formed by the Rhine. Julian resolved first to attack the latter, and with this view he demanded some boats of Barbatio; but the latter, instead of complying with his just request, immediately burnt all his boats, as he did on another occasion the provisions which had been sent to both armies, after he had plentifully supplied his own. Julian, not in the least disheartened by this unaccountable conduct, persuaded some of the most resolute of his men to wade over to one of the islands, where they killed all the Germans who had taken shelter in it.

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They then seized the boats belonging to the barbarians, and pursued the slaughter in several other islands, till the enemy abandoned them all, and retired to their respective countries with their wives and what booty they could carry. On their departure Barbatio attempted to construct a bridge of boats over the Rhine; but the enemy, apprised of his intention, threw a great number of huge trees into the river, which being carried by the stream against the boats, sunk several of them, and parted the rest. The Roman general then thought proper to retire; but the barbarians falling unexpectedly upon him in his retreat, cut great numbers of his men in pieces, took most of his baggage, laid waste the neighbouring country, and returned in triumph loaded with booty. Elated with this success, they assembled in great numbers under the command of Chnodomarius, a prince of great renown among them, and six other kings. They encamped in the neighbourhood of Strasburg. Here they were encountered by Julian, who put them to flight, with the loss of six or eight thousand men killed on the field, and a greater number drowned in the river; whilst Julian himself lost only two hundred and forty-three private men and four tribunes. In this action Chnodomarius was taken prisoner and sent to Rome, where he soon afterwards died.

After the battle Julian advanced with his army to Mayence or Mentz, where he formed a bridge over the Rhine, and entered Germany, having with difficulty prevailed upon his army to follow him. Here he ravaged the country till the time of the autumnal equinox, when being prevented by snow from advancing farther, he began to repair the fort of Trajan, by some supposed to be the castle of Cromburg, about three or four leagues from Frankfort. The barbarians were now so much alarmed that they sent deputies to treat of peace; but this Julian refused to grant them upon any terms. He consented, however, to a truce for seven months, upon their promising to store with provisions the fort he was building in their country. This year Constantius made some remarkable laws. By one he punished with confiscation such as renounced the Christian for the Jewish religion; and by another, addressed to Felix, bishop of Rome, he exempted all trading ecclesiastics, with their wives, children, and domestics, from every imposition ordinary and extraordinary; supposing that the gains made by them were applied to the relief of the poor.

In 358, as soon as the season for action arrived, Julian took the field against the Franks, with a design to conquer them before the truce he had concluded with the Alemans had expired. The Franks were at that time divided into several tribes, the most powerful of which were the Salii and Chamavi. The first of these sent deputies, entreating that he would suffer them to remain as friends to the empire in the country they possessed. But Julian, disregarding this deputation, entered their country, and obliged them to submit; after which he allotted them lands in Gaul, incorporating great numbers of them into his cavalry. He next marched against the Chamavi, whom he defeated and obliged to retire beyond the Rhine; and he afterwards rebuilt three forts on the river Meuse, which had been destroyed by the barbarians; but provisions becoming scarce in a country so often ravaged, he ordered six or eight hundred vessels to be built in Britain for the purpose of conveying corn from thence into Gaul. Julian continued in the country of the Chamavi till the expiration of his truce with the Alemans, and then constructing a bridge of boats over the Rhine, he entered their country, putting all to fire and sword. At last two of their kings came in person to him to sue for peace, which Julian granted, upon their promising to set at liberty the captives they had taken, to supply a certain quantity of corn when required, and to furnish wood, iron, and carriages, for repairing the cities they had ruined. The prisoners whom he at this time released amounted to upwards of twenty thousand.

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Soon after the vernal equinox of this year, 358, Constantius marched in person against the Quadi and Sarmatians, whose country lay beyond the Danube. Having crossed that river on a bridge of boats, he laid waste the territories of the Sarmatians, who thereupon came in great numbers, together with the Quadi, pretending to treat for peace. Their true design was to surprise the Romans; but the latter suspecting it, fell upon them sword in hand, and cut them in pieces. This obliged the rest to sue for peace in good earnest, which was granted on the delivery of hostages. The emperor then marched against the Limigantes, that is, the slaves who, in 334, had driven the Sarmatians out of their country, and seized it for themselves. They used the same artifice as the Sarmatians and Quadi had done, coming in great numbers under pretence of submitting, but prepared to fall upon him unexpectedly if opportunity offered. The emperor, observing their surly looks, and distrusting them, caused his troops to surround them insensibly while he was speaking. The Limigantes then, displeased with the conditions which he offered them, laid their hands on their swords; whereupon they were attacked by the Roman soldiers. Finding it impossible to make their escape, they rushed with great fury towards the tribunal, but were repulsed by the guards forming themselves into a wedge, and every one of them cut in pieces. After this, the emperor ravaged their country to such a degree, that they were in the end obliged to submit to the only condition he thought proper to allow them, which was to quit their country, and retire to a more distant region. The country was then restored to the Sarmatians, who were its original possessors.

This year is also remarkable for an embassy from Sapor, king of Persia. The ambassador, named Narses, brought a letter, in which the Persian monarch styled himself King of Kings, brother of the Sun and Moon, and appropriated other epithets of the same hyperbolical kind. He acquainted the emperor, that he might lawfully insist on having all the countries beyond the river Strymon in Macedonia delivered up to him; but lest his demands should seem unreasonable, he would be contented with Armenia and Mesopotamia, which had been most unjustly taken from his grandfather Narses. He added, that unless justice were done him, he had resolved to assert his right by force of arms. This letter was presented to Constantius wrapped up in a piece of white silk; but the emperor, without entering into any negotiation with the ambassador, wrote a letter to Sapor, in which he told the Persian monarch, that as he had maintained the Roman dominions in their full extent when he was possessed only of the East, he could not suffer them to be curtailed now when he was master of the whole empire In a few days, however, he sent another letter, with rich presents; being desirous at least to postpone the war until he had secured the northern provinces against the incursions of the barbarians, that he might then employ all the forces of the empire against so formidable an enemy. This embassy proved unsuccessful, as did also another which was sent soon afterwards. The last ambassadors were imprisoned as spies, but afterwards dismissed uninjured. By a law of Constantius dated in 358, all magicians, augurs, astrologers, and pretenders to the art of divination, were declared enemies to mankind; and such of them as were found in the court, either of the emperor or of Julian, he commanded to be put to the torture, at the same time specifying what torments they were to undergo.

In 359, Julian continued his endeavours for relieving the

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province of Gaul, which had suffered so much from the incursions of the barbarians. He erected magazines in different places, visited the cities which had suffered most, and gave orders for repairing their walls and fortifications. He then crossed the Rhine, and pursued the war in Germany with so great success that the barbarians submitted to such terms as he pleased to impose. In the mean time, the emperor, having received intelligence that the Limigantes had quitted the country to which he had driven them, hastened to the banks of the Danube, in order to prevent their entering Pannonia. On his arrival he sent deputies, desiring to know what had induced them to abandon the country which had been allotted them. The Limigantes answered with the greatest apparent submission imaginable, that they were willing to live as true subjects of the empire in any other place; but that the country he had allotted them was quite uninhabitable, as they could demonstrate if they were but allowed to cross the river, and lay their complaints before him. This request was granted; but whilst he ascended his tribunal, the barbarians unexpectedly fell upon his guards sword in hand, killed several of them, and the emperor with difficulty saved himself by flight. The rest of the troops, however, soon took the alarm, and surrounding the Limigantes, cut them off to a man. This year Constantius instituted a court of inquisition against all those who had consulted heathen oracles. Paulus Catena, a noted and cruel informer, was dispatched into the East to prosecute them; and Modestus, then count of the East, and equally remarkable for his cruelty, was appointed judge. His tribunal was erected at Scythopolis, in Palestine, whither persons of both sexes, and of every rank and condition, were daily dragged in crowds from all parts, and either confined in dungeons, torn in pieces in a most cruel and barbarous manner by racks, or publicly executed.

In 359, Sapor, king of Persia, began hostilities, being encouraged thereto by the absence of Ursicinus, whom the emperor had recalled, having appointed in his stead one Sabinianus, a person very unfit for such an office. During this campaign, however, he made very little progress, having only taken two Roman forts, and destroyed the city of Amida, the siege of which is said to have cost him thirty thousand men. On the first news of the Persian invasion, Constantius thought proper to send Ursicinus into the East; but his enemies prevented him from receiving the supplies necessary for carrying on the war; so that he found it impossible to take any effectual means for stopping the progress of the Persians. On his return, he was unexpectedly charged with the loss of Amida, and all the disasters which had happened during the campaign. Two judges were appointed to inquire into his conduct; but they, being creatures of his enemies, left the matter doubtful. On this Ursicinus was so much exasperated, that he appealed to the emperor, and in the heat of passion let fall some unguarded expressions, which, being immediately carried to the emperor, irritated him so much that the general was deprived of all his employments.

Constantius resolved to march next year in person against the Persians; but in the mean time dreading to encounter so formidable an enemy, he applied himself wholly to the assembling of a mighty army, by which he might be able fully to cope with them. For this purpose he wrote to Julian to send him part of his forces, without considering that by so doing he left the province of Gaul exposed to the ravages of the barbarians. Julian resolved immediately to comply with the emperor's orders, but at the same time to abdicate the dignity of Cæsar, that he might not be blamed for the loss of the province. Accordingly he suffered the best soldiers to be draughted from his army. They were, however, very unwilling to leave him, and at last proclaimed him emperor. Whether this was done absolutely against Julian's consent or not is uncertain; but he wrote to the emperor, and persuaded the whole army also to send a letter along with his, in which they acquainted Constantius with what had happened, and entreated him to acknowledge Julian as his partner in the empire. But this was positively refused by Constantius, who began to prepare for war. Julian then, designing to be beforehand with the emperor, caused his troops to take an oath of allegiance to himself, and with surprising expedition made himself master of the whole country of Illyricum, and of the important pass separating that country from Thrace. Constantius was thunderstruck with this news; but hearing that the Persians had retired, he marched with all his force against his competitor. On his arrival at Tarsus, in Cilicia, he was seized with a feverish distemper, occasioned chiefly by the uneasiness and perplexity of his mind. He pursued his march, however, to Mosucrene, a place on the borders of Cilicia, at the foot of Mount Taurus, where he was obliged to stop by the violence of his disorder, which increased every day, and at last carried him off on the thirteenth of November 361, in the forty-fifth year of his age.

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By the death of Constantius, Julian now became master of the whole Roman empire without a rival. He had been educated in the Christian religion, but had secretly apostatized from it long before; and as soon as he saw himself master of Illyricum, he openly avowed his apostacy, and caused the temples of the gods to be opened. When the messengers arrived at Naissus, in Illyricum, where he then was, to acquaint him with his being sole master of the empire, they found him consulting the entrails of victims concerning the event of his journey. As the omens were uncertain, he was at that time very much embarrassed and perplexed; but the arrival of the messengers put an end to all his fears, and he immediately set out for Constantinople. At Heraclea he was met by almost all the inhabitants of the metropolis, into which he made his public entry on the 11th of December 361, attended by the whole senate in a body, by all the magistrates, and by the nobility magnificently dressed, every one testifying the utmost joy at seeing such a promising young prince raised to the empire without bloodshed. He was again declared emperor by the senate of Constantinople; and as soon as that ceremony was over, he caused the obsequies of Constantius to be celebrated with great pomp.

The first care of Julian was to inquire into the conduct of the late emperor's ministers, several of whom being found guilty of enormous crimes, were condemned and executed; particularly the noted informer Paulus Catena, and another one named Apodamus, who were sentenced to be burnt alive. Along with these, however, was put to death Ursula, a man of unexceptionable character, to whom Julian himself had been highly indebted. He had been supplied with money by Ursula, unknown to the emperor, at the time when he was sent into Gaul with the title of Cæsar, but without the means necessary for the support of that dignity. For what reason he was now put to death historians do not acquaint us. Julian himself assures us that Ursula was executed without his knowledge.

The emperor next set about reforming the court. As the vast number of offices had in his time become an intolerable burden, he discharged all those whom he thought useless: among the rest, he reduced the officers called *agentes in rebus*, from ten thousand to seventeen; and discharged thousands of cooks, barbers, and others, whose large salaries had drained the exchequer. The *curiosi*, whose office it was to inform the emperor of what had passed in the different provinces, were all discharged, and that employment entirely suppesserd. Thus he was en-

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abled to disburthen the people of the heavy taxes with which they were loaded; and this he did by abating a fifth part of all taxes and imposts throughout the kingdom.

As to religious matters, Julian, as before observed, was a Pagan, and immediately on his accession to the throne restored the heathen religion. He invited to court the philosophers, magicians, and such like persons, from all parts; nevertheless, he did not institute any persecution against the Christians. On the contrary, he recalled from banishment all the orthodox bishops who had been sent into exile during the former reign; but with a design, as is observed both by the Christian and Pagan writers, to raise disturbances and sow dissensions in the church.

As the Persians were now preparing to carry on the war with vigour, Julian found himself under the necessity of marching in person against them. But before he set out, he enriched the city of Constantinople with many valuable gifts: he formed a large harbour to shelter the ships from the south wind; built a magnificent porch leading to it; and founded a stately library, in which he lodged all his books. In the month of May 362 he set out for Antioch, and on the first of January renewed in that city the sacrifices to Jupiter for the safety of the empire, which had so long been omitted. During his stay in this city, he continued his preparations for the Persian war; erecting magazines, making new levies, and above all consulting the oracles, aruspices, magicians, and the like. The oracles of Delphi, Delos, and Dodona, assured him of victory. The aruspices, indeed, and most of his courtiers and officers, did all that lay in their power to divert him from his intended expedition; but the deceitful answers of the oracles and magicians, and the desire of adding the Persian monarch to the many kings whom he had already seen humbled at his feet, prevailed over all other considerations. Many nations sent deputies to him offering their assistance; but these offers he rejected, telling them that the Romans were to assist their allies, but stood in no need of any assistance from them. He likewise rejected, in a very disobliging manner, the offers of the Saracens; and when they complained of his stopping the pension paid them by other emperors, he told them that a warlike prince had steel, but no gold; a reply which irritated them so much that they joined the Persians, and continued faithful to them to the last. However, he wrote to Arsaces, king of Armenia, enjoining him to keep his troops in readiness to execute the commands which he should soon transmit to him.

Having made the necessary preparations for so important an enterprise, Julian sent orders to his troops to cross the Euphrates, designing to enter the enemy's country before they had the least notice of his march; and for this purpose he had placed guards on all the roads. From Antioch he proceeded to Litarba, a place about fifteen leagues distant, which he reached the same day; and thence he marched to Beræa, where he halted a day, and exhorted the council to restore the worship of the gods; but this exhortation, it seems, was complied with by few. From Beræa he proceeded to Batnæ, and was better pleased with the inhabitants of the latter, because they had, before his arrival, restored the worship of the gods. There he offered sacrifices, and having immolated a great number of victims, pursued the next day his journey to Hierapolis, the capital of the province of Euphratesiana, which he reached on the 9th March 363. Here he lodged in the house of one for whom he had a particular esteem, chiefly because neither Constantius nor Gallus, who had both lodged in his house, had been able to make him renounce the worship of his idols. As he entered this city, fifty of his soldiers were killed by the fall of a porch. He left Hierapolis on the 13th of March, and having passed the Euphrates on a bridge of boats, arrived at Batnæ, a small city of Osrhoene, about ten leagues from Hierapolis. From Batnæ he proceeded to Carrhæ, where, in the famous temple of the moon, it is said he sacrificed a woman to that planet.

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While Julian continued in this city, he received advice that a party of the enemy's horse had broken into the Roman territories. On this he resolved to leave an army in Mesopotamia, to guard the frontiers of the empire on that side, whilst he advanced on the other into the heart of the Persian dominions. This army consisted, according to some, of twenty thousand, but according to others of thirty thousand chosen troops. It was commanded by Procopius, and Sebastian, a famous Manichean who had been governor of Egypt, and had there persecuted, with the utmost cruelty, the orthodox Christians. These two were to join, if possible, Arsaces, king of Armenia, to lay waste the fruitful plains of Media, and to meet the emperor in Assyria. To Arsaces Julian himself wrote, but in the most disobliging manner imaginable, threatening to treat him as a rebel if he did not execute, with the utmost punctuality, the orders given him, and in the conclusion telling him, that the God he adored would not be able to screen him from punishment, in the event of disobedience.

There were two roads leading from Carrhæ to Persia; the one to the left by Nisibis, and the other to the right through the province of Assyria, along the banks of the Euphrates. Julian chose the latter, but caused magazines to be erected on both roads; and, after having reviewed his army, set out on the 25th of March. He passed the Abora, which separated the Roman and Persian dominions near its conflux with the Euphrates; after which he broke down the bridge, that his troops might not be tempted to desert. As he proceeded on his march, a soldier and two horses were struck dead by lightning; and a lion of extraordinary size presenting himself to the army, was in a moment dispatched by the soldiers with a shower of darts. These omens occasioned great disputes between the philosophers and aruspices. The latter looking upon them as inauspicious, advised the emperor to return; but the former refuted their arguments with others more agreeable to Julian's temper.

Having passed the Abora, Julian entered Assyria, which he found very populous, and abounding in all the necessaries of life; but he laid it waste far and near, destroying the magazines and provisions which he could not carry along with him; and thus he put it out of his power to return the same way he advanced, a step which was judged most impolitic. As he met with no army in the field to oppose him, he advanced to the walls of Ctesiphon, the metropolis of the Persian empire, having reduced all the strongholds that lay in his way. Here, having caused the canal to be cleared which had formerly been dug by Trajan between these two rivers, he conveyed his fleet from the former to the latter. On the banks of the Tigris he was opposed by the enemy. But Julian passed that river in spite of their utmost efforts, and drove them into the city, with the loss of a great number of their men.

Julian had now advanced so far into the enemy's country that he found it necessary to think of a retreat, as it was impossible for him to winter in Persia. For this reason he made no attempt on Ctesiphon, but began to march back along the banks of the Tigris, soon after he had passed that river. In the mean time the king of Persia had assembled a formidable army, with the intention of falling upon the Romans in their march; but being desirous of putting an end to so destructive a war, he sent advantageous proposals of peace to Julian. These, however, the Roman emperor most imprudently rejected; and soon afterwards, deceived by treacherous guides, he quitted

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the river, and entered into an unknown country totally laid waste by the enemy, and where he was continually harassed by strong parties, who in a manner surrounded his army, and attacked him sometimes in front and sometimes in rear. But the treacherous guides already mentioned persuaded him to take a step still more ruinous and fatal, namely, to burn his fleet, lest it should fall into the hands of the enemy. As soon as the fleet had been set on fire, the whole army cried out that the emperor was betrayed, and that the guides were traitors employed by the enemy. Julian ordered them immediately to be put to the rack, upon which they confessed the treason; but it was too late. The fleet was already in flames which could by no means be extinguished; and no part was saved except twelve vessels, which were designed to be made use of in the building of bridges, and which for this purpose were conveyed over land in waggons.

The emperor thus finding himself in a strange country, and his army greatly dispirited, called a council of his chief officers, in which it was resolved to proceed to Corduene, which lay south of Armenia, and belonged to the Romans. But they had not proceeded far in this direction when they were met by the king of Persia, at the head of a numerous army, attended by his two sons, and all the principal nobility of the kingdom. Several sharp encounters happened, in which, though the Persians were always defeated, yet the Romans reaped no advantages from their victories, but were reduced to the last extremity for want of provisions. In one of these skirmishes, when the Romans were suddenly attacked, the emperor, eager to repulse the enemy, hastened to the field of battle without his armour, when he received a mortal wound by a dart, which, through his arm and side, pierced his very liver. Of this wound he died the same night, the 26th of June 363, in the thirty-second year of his age, after having reigned scarcely twenty months from the time he became sole master of the Roman empire.

As Julian had declined naming any successor, the choice of a new emperor devolved on the army, who unanimously chose Jovian, a very able commander, whose father had lately resigned the post of *comes domesticorum*, in order to lead a retired life. The valour and experience of Jovian, however, were not sufficient to extricate the Roman army from the difficulties in which it had been plunged by the imprudence of his predecessor. Famine raged in the camp to such a degree, that not a single man would have been left alive, had not the Persians unexpectedly sent proposals of peace, which were now received with the utmost joy. A peace was concluded for thirty years, the terms of which were that Jovian should restore to the Persians the fine provinces which had been taken from them in the reign of Diocletian, with several castles, and the cities of Nisibis and Singara. After the conclusion of the treaty, Jovian pursued his march without molestation. When he arrived at Antioch, he revoked all the laws which had been made in the former reign against Christianity, and in favour of Paganism. He also espoused the cause of the orthodox Christians against the Arians; and he recalled all those who had been formerly banished, particularly Athanasius, to whom he wrote a very obliging letter with his own hand. It is generally believed also that Athanasius, at the desire of Jovian, now composed the creed which still bears his name, and is subscribed by all the bishops in Europe. But this emperor did not live to make any great alterations, nor even to visit his capital as emperor; for in his way to Constantinople he was found dead in his bed, on the 16th or 17th of February 364, after having lived thirty-three years, and reigned seven months and forty days.

After the death of Jovian, Valentinian was chosen emperor. Immediately on his accession the soldiers mutinied, and with great clamour required him to choose a partner in the sovereignty. He did not instantly comply with this demand; but in a few days he chose his brother Valens as his partner; and the empire being threatened on all sides with an invasion of the barbarous nations, he thought proper to divide it. This famous partition was executed at Mediana, in Dacia. Valens received as his share the whole of Asia, Egypt, and Thrace; and Valentinian retained all the West, including Illyricum, Italy, Gaul, Spain, Britain, and Africa.

Constantinopolitan History. 369.

After this partition Valens returned to Constantinople, where the beginning of his reign was disturbed by the revolt of Procopius, a relation of Julian. On the death of that emperor, he had fled into Taurica Chersonesus, from dread of Jovian; but not trusting the barbarians who inhabited that country, he returned in disguise into the Roman territories, where, having gained over an eunuch of great wealth, called Eugenius, lately disgraced by Valens, and some officers who commanded the troops sent against the Goths, he got himself proclaimed emperor. At first he was joined only by the lowest of the people, but at length he was acknowledged by the whole city of Constantinople. On the news of this revolt, Valens would have abdicated the sovereignty, had he not been prevented by the importunities of his friends. He therefore dispatched some troops against the usurper; but these were gained over, and Procopius continuing for some time to gain ground, it is probable he would finally have succeeded, had he not become so much elated with his good fortune that he grew tyrannical and insupportable to his own party. In consequence of this alteration in his disposition, he was first abandoned by some of his principal officers, and soon afterwards defeated in battle, taken prisoner, and put to death.

This revolt produced a war betwixt Valens and the Goths. The latter, having been solicited by Procopius, had sent three thousand men to his assistance. On hearing the news of the usurper's death, they countermarched; but Valens detached against them a body of troops, who took them all prisoners, notwithstanding the vigorous resistance they made. Athanaric, king of the Goths, expostulated with Valens against this proceeding; but that emperor proving obstinate, both parties prepared for war. In 367 and 369, Valens gained great advantages over his enemies, and obliged them to sue for peace, which was concluded upon terms advantageous to the Romans. The rest of his reign contains nothing remarkable, except the cruelty with which he persecuted the orthodox clergy. The latter sent eighty of their number to him, in order to lay their complaints before him; but, instead of giving them any relief, he determined to put them all to death. The person, however, who was ordered to execute this sentence, fearing lest the public execution of so many ecclesiastics might raise disturbances, ordered them all to be put on board a ship, pretending that the emperor had ordered them only to be sent into banishment; but when the vessel was at some distance from the land, the mariners set fire to it, and made their own escape in a boat. The ship was driven by a strong wind into a harbour, where it was consumed, with all who were on board. A persecution was also commenced against magicians, or those who had books of magic in their custody. This occasioned the destruction of many innocent persons; for books of this kind were often conveyed into libraries, unknown to the owners of them, an act which was certainly followed by death and confiscation of goods. Persons of all ranks were consequently seized with such terror that they burnt their libraries, lest books of magic should be secretly conveyed amongst those of which they consisted

Constantinopolitan History. 380.

In 378 the Goths whom Valens had admitted into Thrace advanced from that province to Macedonia and Thessaly, where they committed dreadful ravages. They afterwards blockaded the city of Constantinople, plundered the suburbs, and at last totally defeated and killed the emperor himself. The day after the battle, hearing that an immense treasure was lodged in Adrianople, the barbarians laid siege to that place; but being strangers to the art of besieging towns, they were repulsed with great slaughter, upon which they abandoned the enterprise, and returned before Constantinople. But here great numbers of them were cut in pieces by the Saracens, whom Maria, the queen of that people, had sent to the assistance of the Romans; so that they were obliged to abandon this design likewise, and retire from the neighbourhood of the city.

By the death of Valens the empire once more fell into the hands of a single person. This was Gratian, who had held the empire of the West, after the death of Valentinian. He repulsed many barbarous nations who threatened inroads on various sides; but finding himself severely pressed, he soon resolved to take a colleague, in order to relieve himself of part of the burden. Accordingly, on the 19th of January 379, he declared Theodosius his partner in the empire, and committed to his care all the provinces which had been governed by Valens.

Theodosius is greatly extolled by the historians of those ages on account of his extraordinary valour and piety; and for these qualifications he has been honoured with the surname of Great. From the many persecuting laws, however, made in his time, it would seem that his piety was at least very much misdirected; and that if he was naturally of a humane and compassionate disposition, superstition and passion had often totally obscured it. He certainly was a man of great conduct and experience in war; and indeed the present state of the empire called for an exertion of all his abilities. The provinces of Dacia, Thrace, and Illyricum, were already lost; the Goths, Taifali, Alans, and Huns, were masters of the greater part of these provinces, and had ravaged and laid waste the remainder. The Iberians, Armenians, and Persians, were likewise up in arms, and ready to take advantage of the distracted state of the empire. The few soldiers who had survived the late defeat kept within the strongholds of Thrace, without even daring to look abroad, much less to face the victorious enemy, who moved about the country in great bodies. But notwithstanding this critical situation, the historians of those times give us no account of the transactions of the year 379. Many great battles indeed are said to have been fought, and as many victories obtained by Theodosius; but the accounts of these are so confused and contradictory, that no stress can be laid upon them.

In the month of February 380, Theodosius was seized with a dangerous malady, so that Gratian found himself obliged to carry on the war alone. This emperor, apprehending that the neighbouring barbarians might break into some of the provinces, concluded with the Goths a peace, which was confirmed by Theodosius on his recovery. The treaty was very advantageous to the barbarians; but they, disregarding all their engagements, no sooner heard that Gratian had left Illyricum than they passed the Danube, and breaking into Thrace and Pannonia, advanced as far as Macedonia, destroying all with fire and sword. Theodosius, however, having collected his forces, marched against them, and, according to the most respectable authorities, gained a complete victory; though Zosimus relates that he was utterly defeated.

The following year Athanaric, the most powerful of all the Gothic princes, being driven out by a faction at home, applied to Theodosius, by whom he was received with great tokens of friendship. The emperor himself went out to meet him, and attended him with his numerous retinue into the city. The Gothic prince died the same year, and Theodosius caused him to be buried after the Roman manner, with such pomp and solemnity that the Goths who attended him in his flight returned home with a resolution never to molest the Romans any more. Nay, out of gratitude to the emperor, they took upon them to guard the banks of the Danube, and prevent the empire from being invaded on that side.

Constantinopolitan History. 389.

In 383, one Maximus revolted against Gratian in Britain; and having at length got the unhappy emperor into his power, caused him to be put to death, upon which the usurper assumed the empire of the West himself. Gratian had divided his dominions with his brother Valentinian, whom he allowed to reign in Italy and Western Illyricum, reserving the rest to himself. Maximus, therefore, immediately after his usurpation, sent deputies to Theodosius, assuring him that he had no designs on the dominions of Valentinian. As Theodosius at that time found himself in danger from the barbarians, he not only forbore to attack Maximus after this declaration, but even acknowledged him as his partner in the empire. It was not long, however, before the ambition of the usurper prompted him to violate his promise. In 387 he suddenly passed the Alps; and meeting with no opposition, marched to Milan, where Valentinian usually resided. The young prince fled first to Aquileia, and thence to Thessalonica, in order to implore the protection of Theodosius. The latter, in answer to Valentinian's letter, informed him that he was not at all surprised at the progress Maximus had made, because the usurper had protected, and Valentinian had persecuted, the orthodox Christians. At last he prevailed on the young prince to renounce the Arian heresy, which the latter had hitherto maintained; after which Theodosius promised to assist him with all the forces of the East. At first, however, he sent messengers to Maximus, earnestly exhorting him to restore the provinces which he had taken from Valentinian, and content himself with Gaul, Spain, and Britain. But the usurper would hearken to no terms. This very year he besieged and took Aquileia, Quaderna, Bononia, Mutina, Rhegium, Placentia, and many other cities in Italy; and the following year he was acknowledged in Rome, and in all the provinces of Africa. Theodosius, therefore, finding a war inevitable, spent the remaining months of this and the beginning of the following year in making the necessary preparations. His army consisted chiefly of Goths, Huns, Alans, and other barbarians, whom he was glad to take into his service in order to prevent their raising disturbances on the frontiers. He defeated Maximus in two battles, took him prisoner, and put him to death. The usurper had left his son Victor, whom he created Augustus, in Gaul, to overawe the inhabitants in his absence. Against him the emperor dispatched Arbogastes, who took him prisoner after having dispersed the troops that attended him, and put him to death. The victory was afterwards used by Theodosius with great clemency and moderation.

In 389 Theodosius made a journey to Rome, and, according to Prudentius, at this time converted the senate and people from idolatry to Christianity. The next year was remarkable for the destruction of the celebrated temple of Serapis in Alexandria, which, according to the description of Ammianus Marcellinus, surpassed all others in the world, that of Jupiter Capitolinus alone excepted. The reason of its being now destroyed was this. Theophilus, bishop of Alexandria, having begged and obtained of the emperor an old temple, formerly consecrated to Bacchus, but then ruined and forsaken, with the design of converting it into a church, the workmen found among the

rubbish several obscene figures, which the bishop, in order to ridicule the superstition of the heathens, caused to be exposed to public view. This provoked the Pagans to such a degree that they flew to arms; and falling unexpectedly upon the Christians, cut great numbers of them in pieces. The latter, however, soon took arms in their own defence; and being supported by the few soldiers who were quartered in the city, began to repel force by force. Thus a civil war was kindled, and no day passed without some encounter. The Pagans used to retire to the temple of Serapis, and thence sallying out unexpectedly, seized on such Christians as they met, and dragging them into the temple, either forced them by the most exquisite torments to sacrifice to their idol, or, if they refused, racked them to death. As soon as they expected to be attacked by the emperor's troops, they chose a philosopher named Olympus as their leader, with the design of defending themselves to the last extremity. The emperor, however, would not suffer any punishment to be inflicted upon them for the lives of those whom they had put to death, but readily forgave them; however, he ordered all the temples of Alexandria to be immediately pulled down, and commanded the bishop to see his orders put in execution. The Pagans no sooner heard that the emperor was acquainted with their proceedings than they abandoned the temple, which was in a short time destroyed by Theophilus; nothing being left except the foundations, which could not be removed, on account of the extraordinary weight and size of the stones. Not satisfied with the destruction of the Alexandrian temples, the zealous bishop encouraged the people to pull down all the other temples, oratories, chapels, and places set apart for the worship of the heathen gods throughout Egypt, and ordered the statues of the gods themselves to be either burnt or melted down. Of the innumerable statues which at that time were to be found in Egypt, he is said to have spared but one, namely, that of an ape, in order to expose the Pagan religion to ridicule. On his return to Constantinople, Theodosius ordered such temples as were yet standing to be thrown down, and the Arians to be everywhere driven out of the cities.

In 392 Valentinian, emperor of the West, was treacherously murdered by Arbogastes his general, who, though he might afterwards have easily seized on the sovereignty himself, chose to confer it upon one Eugenius, and to reign in his name. This new usurper, though a Christian, was greatly favoured by the Pagans, who were well apprised that he only bore the title of emperor, while the whole power lodged in Arbogastes, who pretended to be greatly attached to their religion. The aruspices appeared anew, and informed him that he was destined to the empire of the whole world, and that he would soon gain a complete victory over Theodosius, who was as much hated as Eugenius was beloved by the gods. But though Eugenius seemed to favour the Pagans, yet in the very beginning of his reign he wrote to St Ambrose. The holy man did not answer his letter till he was pressed by some friends to recommend them to the new prince; and then he wrote to the usurper with all the respect due to an emperor. Soon after his accession to the empire, Eugenius sent deputies to Theodosius, who is said to have received them in a very obliging manner. He did not, however, intend to enter into any alliance with this usurper, but immediately began his military preparations. In 394 he set out from Constantinople, and reached Adrianople on the 15th of June that year. He bent his march through Dacia, and the other provinces between Thrace and the Julian Alps, with the design of forcing the passes of these mountains, and breaking into Italy before the army of Eugenius was in a condition to oppose him. On his arrival at the Alps he found these passes guarded by Flavianus, prefect of Italy, at the head of a considerable body of Roman troops. These, however, were utterly defeated by Theodosius, who thereupon crossed the Alps and advanced into Italy. He was soon met by Eugenius, and a bloody battle ensued, without any decisive advantage on either side; but the next day the emperor led his troops in person against the enemy, utterly defeated them, and took their camp. Eugenius was taken prisoner by his own men, and brought to Theodosius, who reproached him with the murder of Valentinian, with the calamities which he had brought on the empire by his unjust usurpation, and with putting his confidence in Hercules, and not in the true God; for on his chief standard he had displayed the image of that fabulous hero. Eugenius begged earnestly for his life; but whilst he lay prostrate at the emperor's feet, his own soldiers cut off his head, and carrying it about on the point of a spear, showed it to those in the camp who had not yet submitted to Theodosius. At this they were all thunderstruck; but being informed that Theodosius was ready to receive them into favour, they threw down their arms and submitted. After this Arbogastes, despairing of pardon, fled to the mountains; but being informed that diligent search was made for him, he laid violent hands on himself. His children, and those of Eugenius, took sanctuary in churches; the emperor, however, not only pardoned, but took the opportunity of converting them to Christianity, restored to them their paternal estates, and raised them to considerable employments in the state. Soon after this, Theodosius appointed his son Honorius emperor of the West, assigning him as his share Italy, Gaul, Spain, Africa, and West Illyricum. But the next year, as he prepared for his return to Constantinople, he was seized with a dropsy, owing to the great fatigues he had undergone during the war. As soon as he perceived himself to be in danger, he made his will, by which he bequeathed the empire of the East to Arcadius, and confirmed Honorius in the possession of the West. He likewise confirmed the pardon which he had granted to all those who had borne arms against him, remitted a tribute which had proved very burdensome to the people, and charged his two sons to see that these points of his will were executed. He died at Milan on the 17th of January 395, in the sixteenth year of his reign, and fiftieth of his age.

From the time of Theodosius to the time when the Roman empire in the West was totally destroyed by the Goths, we find but very little remarkable in the history of Constantinople. At this time the eastern empire was usurped by Basiliscus, who had driven out Zeno, the lawful emperor, being assisted in his conspiracy by the empress Verina, his sister. Zeno fled into Isauria, whither he was pursued by Illus and Trecondes, two of the usurper's generals, who having easily defeated the few troops he had with him, forced the unhappy prince to shut himself up in a castle, which they immediately invested. But in a short time Basiliscus having disobliged the people by his cruelty, avarice, and other bad qualities, for which he was no less remarkable than his predecessor had been, his generals joined with Zeno, whom they restored to the throne. After his restoration, Zeno having got Basiliscus into his power, confined him in a castle of Cappadocia, together with his wife Zenonides, where they both perished with hunger and cold. This happened in the year 467, after Basiliscus had reigned about twenty months. During the time of this usurpation a dreadful fire happened at Constantinople, which consumed great part of the city, with the library containing 120,000 volumes, among which were the works of Homer, written, as is said, on the great gut of a dragon a hundred and twenty feet long.

Constantinopolitan History. 485–532.

The misfortunes which Zeno had undergone did not work any reformation upon him. He still continued the same vicious courses which had given occasion to the usurpation of Basiliscus; and other conspiracies were formed against him, but he had the good fortune to escape them. He engaged in a war with the Ostrogoths, in which he proved unsuccessful, and was obliged to yield to them the provinces of Lower Dacia and Mœsia. In a short time, however, Theodoric their king made an irruption into Thrace, and advanced within fifteen miles of Constantinople, with the design of besieging that capital; but the following year, 485, they retired in order to attack Odoacer, king of Italy, of which country Theodoric was proclaimed king in 493. The emperor Zeno died in the year 491, in the sixty-fifth year of his age, and seventeenth of his reign.

The Roman empire had now for a long time been on the decline; and the valour and military discipline which had for so many ages rendered the Romans superior to other nations had now greatly degenerated. The tumults and disorders which had happened in the empire from time to time by the many usurpations, had also greatly contributed to weaken it. But what proved of the greatest detriment was the allowing vast swarms of barbarians to settle in the different provinces, and to serve in the Roman empire in separate and independent bodies. This had proved the immediate cause of the dissolution of the western empire; but as it affected the eastern parts less, the Constantinopolitan empire continued for upwards of nine hundred years after that of the West had been totally dissolved. The weak and imprudent administration of Zeno, and of Anastasius, who succeeded him, had reduced the eastern empire still more; and it might possibly have expired in a short time after the western one, had not the wise and vigorous conduct of Justin and his partner Justinian revived in some measure the ancient martial spirit which had originally raised the Roman empire to its highest pitch of grandeur.

Justin ascended the throne in 518. In 521 he engaged in a war with the Persians, who had all along been formidable enemies to the Roman name. Against them he employed the famous Belisarius, of whom, however, we hear nothing remarkable till after the accession of Justinian. This prince was the nephew of Justin, and was by him taken as his partner in the empire in 527; and the same year Justin died, in the seventy-seventh year of his age and ninth of his reign. Justinian being now sole master of the empire, directed his whole force against the Persians. The latter proved successful in the first engagement, but were soon afterwards utterly defeated by Belisarius on the frontiers of Persia, and likewise by another general, named Dorotheus, in Armenia. The war continued with various success during the first five years of Justinian's reign. In the sixth year a peace was concluded upon the conditions that the Roman emperor should pay to Cosrhoes, the king of Persia, a thousand pounds weight of gold; that both princes should restore the places they had taken during the wars; that the commander of the Roman forces should no longer reside at Daras, on the Persian frontiers, but at a place called Constantina, in Mesopotamia, as he had formerly done; and that the Iberians who had sided with the Romans should be at liberty either to return to their own country or to remain at Constantinople. This peace, concluded in 532, was styled "eternal;" but in the event it proved of very short duration.

About this time happened at Constantinople the greatest tumult mentioned in history. It began among the different factions in the circus, but ended in an open rebellion. The multitude, highly dissatisfied with the conduct of John, the *prefectus prætorio*, and of Tribonianus, then questor, forced Hypatius, nephew of the emperor Anastasius, to accept the empire, and proclaimed him with great solemnity in the forum. As the above-mentioned ministers were greatly abhorred by the populace on account of their avarice, Justinian immediately discharged them, hoping by that means to appease the tumult; but this was so far from answering the purpose, that the multitude only grew the more outrageous; and most of the senators joining them, the emperor became so much alarmed that he had thoughts of abandoning the city and making his escape by sea. In this dilemma the Empress Theodora encouraged and persuaded him rather to part with his life than with his kingdom; and he at last resolved to defend himself to the utmost, with the few senators who had not yet abandoned him. In the mean time, the rebels having attempted in vain to force the gates of the palace, carried Hypatius in triumph to the circus, where, whilst he was beholding the sports from the imperial throne, amidst the shouts and acclamations of the people, Belisarius, who had been recalled from Persia, entered the city with a considerable body of troops. Being then apprised of the usurpation of Hypatius, he marched straight to the circus, fell sword in hand upon the disarmed multitude, and with the assistance of a band of Heruli, headed by Mundus, governor of Illyricum, cut about thirty thousand of them in pieces. Hypatius the usurper, and Pompeius, another of the nephews of Anastasius, were taken prisoners and carried to the emperor, by whose orders they were both beheaded, and their bodies cast into the sea. Their estates were confiscated, and likewise the estates of such senators as had joined with them; but the emperor caused great part of their lands and effects to be afterwards restored to their children, together with their honours and dignities.

Constantinopolitan History. 532–558.

Justinian having now no other enemy to contend with, turned his arms against the Vandals in Africa, and the Goths in Italy, both of which provinces he recovered out of the hands of the barbarians. But before his general Belisarius had time to establish fully the Roman power in Italy, he was recalled in order to carry on the war against Cosrhoes, king of Persia, who, in defiance of the treaty concluded in 532, had entered the Roman dominions at the head of a powerful army. The same year, however, a peace was concluded between the two nations, upon the conditions that the Romans should, within two months, pay to the Persian king five thousand pounds weight of gold, and an annual pension of five hundred; that the Persians should relinquish all claim to the fortress of Daras, and maintain a body of troops to guard the Caspian gates, and prevent the barbarians from breaking into the empire; and that upon payment of the above-mentioned sum, Cosrhoes should immediately withdraw his troops from the Roman dominions. The treaty being signed, and the stipulated sum paid, Cosrhoes began to march back again; but on the way he plundered several cities, as if the war had still continued. Justinian therefore resolved to pursue the war with the utmost vigour, and for this purpose dispatched Belisarius into the East. But soon afterwards he was obliged to recal him in order to oppose the Goths, who after his departure had gained great advantages in Italy. The Persian war was then carried on with indifferent success till the year 558, when a peace was concluded upon the emperor again paying an immense sum to the enemy. The same year the Huns, having passed the Danube in the depth of winter, marched in two bodies directly for Constantinople, and laying waste the countries through which they passed, came, without meeting the least opposition, within a short distance of the city. But Belisarius having marched out against them with a handful of men, put them to flight. The emperor, however, in order to prevent them from invading the empire anew, agreed to pay them an

Constantinopolitan History. 565–697.

annual tribute, upon their promising to defend the empire against all other barbarians, and to serve in the Roman armies when required. This was the last exploit performed by Belisarius, who on his return to Constantinople was disgraced, stripped of all his employments, and confined to his house, on pretence of a conspiracy against the emperor. In the year 565 a real conspiracy was formed against Justinian, which he happily escaped, and the conspirators were executed; but the emperor did not long survive it, being carried off by a natural death in 566, in the thirty-ninth year of his reign.

During the reign of Justinian, the majesty of the Roman empire seemed in some measure to revive. He recovered the provinces of Italy and Africa from the hands of the barbarians, by whom they had been held for a number of years; but soon after his death they were lost to the empire, which now tended fast to dissolution. In 569 Italy was conquered by the Lombards, who held it for the space of two hundred years. Some amends, however, was made for the loss by the acquisition of Persarmenia, the inhabitants of which, being persecuted by the Persians on account of the Christian religion, which they professed, revolted to the Romans. This produced a war between the two nations, who continued to weaken each other, till at last the Persian monarchy was utterly overthrown, and that of the Romans greatly reduced, by the Saracens. These new enemies attacked the Romans in the year 632, and pursued their conquests with incredible rapidity. In the space of four years they reduced the provinces of Egypt, Syria, and Palestine. In 648 they were also masters of Mesopotamia, Phœnicia, Africa, Cyprus, Aradus, and Rhodes; and having defeated the Roman fleet commanded by the Emperor Constans in person, they concluded a peace on condition of retaining the vast extent of territory which they had seized, and paying for it a thousand nummi a year.

An expedition against the Lombards was about this time undertaken, but with very little success; a body of twenty thousand Romans having been almost entirely cut off by one of the Lombard generals. In 671 the Saracens ravaged several provinces, made a descent on Sicily, took and plundered the city of Syracuse, and overran the whole island, destroying every thing with fire and sword. In like manner they laid waste Cilicia, and having passed the winter at Smyrna, entered Thrace in the year 672, and laid siege to Constantinople itself. Here, however, they were repulsed with great loss; but next spring they renewed their attempt, in which they met with the same ill success, many of their ships being consumed by the *sea-fire*, as it was called, because it burned under water; and in their return home their fleet was wrecked off the Scyllæan promontory. At last a peace was concluded for thirty years, on condition that the Saracens should retain all the provinces which they had seized, and that they should pay the emperor and his successors three thousand pounds weight of gold, fifty slaves, and as many choice horses.

This peace had scarcely been concluded when the empire was invaded by a new enemy, who for a long time proved very troublesome. These were the Bulgarians, who breaking into Thrace, defeated the Roman army sentagainst them, and ravaged the country far and wide. The emperor consented to pay them an annual pension rather than continue a doubtful war, and allowed them to settle in Lower Mœsia, which from them was afterwards called Bulgaria. In 687, they were attacked by Justinian II. who entered their country without provocation, and in disregard of the treaties formerly concluded with them. But, having fallen suddenly upon him, they drove him out of their country, and obliged him to restore the towns and captives he had taken. In 697 this emperor was deposed, and in his exile fled to Trebelis, king of the Bulgarians, by whom he was kindly entertained, and by whose means he was restored to his throne; but soon forgetting this favour, he invaded the country of the Bulgarians, with a design of wresting from them those provinces which he had yielded to them. In this expedition, however, he was attended by no better success than his ingratitude deserved, his army being utterly defeated, and he himself obliged to make his escape in a light vessel to Constantinople. The Bulgarians continued their inroads and ravages at different times, generally defeating the Romans who ventured to oppose them, till the year 809, the seventh of the reign of Nicephorus, when they surprised the city of Sardica, in Mœsia, and put the whole garrison, consisting of six thousand men, to the sword. The emperor marched against them with a considerable army, but the enemy retired at his approach, and he, instead of pursuing them, returned to Constantinople. Two years afterwards he entered Bulgaria at the head of a powerful army, destroying every thing with fire and sword. The king offered to conclude a peace with him upon honourable terms; but Nicephorus, rejecting his proposals, continued to waste the country, destroying the cities, and putting all the inhabitants, without distinction of age or sex, to the sword. The king was so much affected with these cruelties which were exercised on his subjects, that he sent a second embassy to Nicephorus, offering to conclude a peace with him upon any terms, provided he would quit his country. But Nicephorus having dismissed the ambassadors with scorn, the Bulgarian monarch unexpectedly attacked the Roman camp, forced it, and cut off almost the whole army, with the emperor himself, and a great number of patricians. His successor Michael likewise engaged in a war with the Bulgarians; but being utterly defeated, he was so grieved that he resigned the empire. After this the Bulgarians continued to be formidable enemies of the empire till the year 979, when they were attacked by Basilius II. The Bulgarians were at that time governed by a king named Samuel, who ravaged the Roman territories, as was the common practice of his nation; upon which Basilius sent against him one Nicephorus Uranus, at the head of a powerful army. Uranus, leaving his baggage at Larissa, reached the Sperchius by forced marches, and encamped with his whole army opposite the enemy, who lay on the other bank. As the river was greatly swelled with heavy rains which had lately fallen, Samuel, not imagining the Romans would attempt to pass it, suffered his troops to roam in large parties about the country in quest of booty. But Uranus having at length found out a place where the river was fordable, passed it in the dead of the night without being perceived. He then fell upon the Bulgarians who remained in the camp, and lay for the most part asleep; cut a great number of them in pieces; took many prisoners, with all their baggage, and made himself master of their camp. Samuel and his son were dangerously wounded, and would have been taken had not they all that day concealed themselves among the dead. The next night they stole away to the mountains of Ætolia, and thence made their escape into Bulgaria. The following year the emperor entered Bulgaria at the head of a numerous and well-disciplined army, defeated Samuel in a pitched battle, and took several strong cities. The emperor himself, however, at last narrowly escaped being cut off with his whole army, being unexpectedly attacked by the Bulgarians in a narrow pass. From this danger he was relieved by the arrival of Nicephorus Xiphias, governor of Philippopolis, with a considerable number of troops, who, falling upon the enemy's rear, put them to flight. Basilius pursued them closely, and having taken an incredible number of prisoners, caused their eyes to be pulled out, leaving to every hundred a guide with one

Constantinopolitan History. 800–979.

Constantinopolitan History. 980–1041.

eye, that he might conduct them to Samuel. This shocking spectacle so affected the unhappy king, that he fell into a deep swoon, and died two days afterwards. The Roman emperor pursued his conquests, and in the space of two years made himself master of most of the enemy's strongholds. He also defeated the successor of Samuel in several engagements; and having at last killed him in battle, the Bulgarians submitted themselves without reserve. The vast treasures of their princes were by Basilius distributed among his soldiers by way of donative. Soon afterwards the widow of the late king, with her six daughters and three of her sons, surrendered themselves to the Roman emperor, by whom they were received with the utmost civility and respect. This obliging behaviour encouraged the three other sons of the late king, and most of the princes of the blood, who had taken shelter in the mountains, to submit, and throw themselves on the emperor's clemency.

Ibatzes, however, a person nearly allied to the royal family, who had distinguished himself during the whole course of the war, refused to submit, and fled to a steep and craggy mountain, with the design of defending himself there to the last extremity. Basilius endeavoured to induce him to submit by fair means; but he equally despised both threats and promises. At last Eustathius Daphnomelus, whom Basilius had lately appointed governor of Achridus, the chief city of Bulgaria, undertook to seize him. Without communicating his design to any, he repaired, with two persons in whom he could confide, to the mountain on which Ibatzes had fortified himself, hoping to pass undiscovered among the many strangers who flocked thither to celebrate the approaching feast of the Virgin Mary, for whom Ibatzes had a particular veneration. In this, however, he found himself mistaken; for he was discovered by the guards, and carried before the prince. To the latter he pretended to have something of importance to communicate; but as soon as Ibatzes had retired with him into a remote place, Daphnomelus threw himself suddenly upon him, and with the assistance of the two men whom he had brought with him, pulled out both his eyes, and got safely to an abandoned castle on the top of the hill. Here they were immediately surrounded by the troops of Ibatzes; but Daphnomelus exhorting them now to submit to the emperor, by whom he assured them they would be well received, they congratulated Daphnomelus on his success, and suffered him to conduct the unhappy Ibatzes a prisoner to Basilius. The emperor was no less surprised than pleased at the success of this bold attempt, and rewarded Daphnomelus with the government of Dyrrhachium, and all the rich moveables of his prisoner. After this, having accomplished the entire reduction of Bulgaria, he returned with an incredible number of captives to Constantinople, where he was received by the senate and people with all possible demonstrations of joy.

During this time the Saracens had at intervals invaded the Roman dominions, and even attempted to make themselves masters of Constantinople. Their internal divisions, however, rendered them now much less formidable enemies than they had formerly been; so that some provinces were even recovered for a time out of their hands, though the weak and distracted state of the empire rendered it impossible to preserve such conquests. In 1041, the empire was invaded by an enemy, not very powerful at that time, indeed, but who by degrees gathered strength sufficient to overthrow both the Roman and Saracen empires. These were the Turks, who, having quitted their ancient habitations in the neighbourhood of Mount Caucasus, and passed the Caspian Straits, settled in Armenia Major about the year 844. There they continued, an unknown and despised people, till the intestine wars of the Saracens gave them an opportunity of aggrandizing themselves. About the year 1030, Mohammed, the son of Sambrael, sultan of Persia, not finding himself a match for Pisaris, sultan of Babylon, with whom he was at war, had recourse to the Turks, who sent him three thousand men, under the command of Tangrolipix, a leading man among them. By their assistance, Mohammed defeated his adversary; but when the Turks desired leave to return home, he refused to part with them. Upon this they withdrew without his consent to a neighbouring desert; and there being joined by several discontented Persians, began to make frequent inroads into the sultan's territories. Mohammed immediately dispatched against them an army of twenty thousand men, who being surprised in the night, were utterly defeated by Tangrolipix. The fame of this victory drew multitudes from all parts to his standard; so that in a short time Tangrolipix saw himself at the head of fifty thousand men. Upon this, Mohammed marched against them in person, but was thrown from his horse in the beginning of the engagement, and killed by the fall; upon which his men threw down their arms, and submitted to Tangrolipix.

Constantinopolitan History. 1030–60.

After this victory, the Turkish general made war upon the sultan of Babylon, whom he at length slew, and annexed his dominions to his own. He then sent his nephew, named Cutlu-Moses, against the Arabians; but he was defeated by them, and forced to fly towards Media. But he was denied a passage through this province by Stephen, the Roman governor; upon which Cutlu-Moses was obliged to force his way, by encountering the Roman army. These he put to flight, took the governor himself prisoner, and without any further opposition reached the confines of Persia, where he sold Stephen as a slave. Returning thence to Tangrolipix, he excused, in the best manner he could, his defeat by the Arabians; but at the same time acquainted him with his victory over the Romans in Media, encouraging him to invade that fertile country, which he said might be easily conquered, as it was inhabited by none but women, meaning thereby the Romans. At that time Tangrolipix did not hearken to his advice, but marched against the Arabians at the head of a numerous army. He was, however, attended with no better success than his nephew had been, and therefore began to reflect on what the latter had told him. Soon afterwards he sent Asan, his brother's son, with an army of twenty thousand men, to reduce Media; and, pursuant to his orders, the young prince entered that country, and committed everywhere dreadful ravages; but being in the end drawn into an ambuscade by the Roman generals, he was cut off with his whole army. Tangrolipix, nowise discouraged by this misfortune, sent a new army into Media, nearly one hundred thousand strong, which, after having ravaged the country without opposition, laid siege to Artza, a place of great trade, and reckoned the most wealthy in those parts. But not being able to reduce it by any other means, they set it on fire, and thus in a short time it was utterly destroyed; the buildings being reduced to ashes, while one hundred and fifty thousand of the inhabitants perished either by the flames or the sword. After this Abraham Halim, brother to Tangrolipix, hearing that the Romans, reinforced with a body of troops under the command of Liparites, governor of Iberia, had taken the field, marched against them and offered them battle, which they accepted. The two armies engaged with incredible fury, and the victory continued long doubtful, but at length inclined to the Romans, who nevertheless did not think proper to pursue the fugitives, as their general Liparites had been taken prisoner. The emperor, greatly concerned for the captivity of Liparites, dispatched ambassadors with rich presents, and a large

Constantinopolitan History. 1062.

sum of money to redeem him, and at the same time to conclude an alliance with Tangrolipix. The sultan received the presents, but generously returned them, together with the money, to Liparites, whom he set at liberty without ransom, only requiring him at his departure to promise never more to bear arms against the Turks. Not long afterwards, Tangrolipix sent a person of great authority among the Turks, in the capacity of ambassador, to Constantinople; but he having arrogantly exhorted the emperor to submit to his master, and acknowledge himself his tributary, was ignominiously driven out of the city.

Tangrolipix, highly affronted at the reception which his ambassador had met with, entered Iberia while the emperor Constantine Monomachus was engaged in a war with the Patzinacæ, a Scythian nation. Having ravaged that country, he returned thence to Media, and laid siege to Mantzichierta, a place defended by a numerous garrison, and fortified by a triple wall and deep ditches. However, as it was situated in an open and level country, he hoped to be master of it in a short time. But finding the besieged determined to defend themselves to the last extremity, he resolved to raise the siege, after he had continued it for thirty days. One of his officers, however, named Alcan, prevailed on him to persevere one day longer, and to commit the management of the attacks to him. This being granted, Alcan disposed his men with such skill, and so encouraged them by his example, that, notwithstanding the vigorous opposition they met with, the place would have probably been taken, had not Alcan been slain as he was mounting the wall. The besieged, knowing him by the richness of his armour, drew him by the hair into the city, and cutting off his head, threw it over the wall amongst the enemy; a circumstance which so disheartened them that they gave over the assault and retired. The next spring Tangrolipix returned, and ravaged Iberia with the utmost cruelty, sparing neither age nor sex. But on the approach of the Roman army he retired to Tauris, leaving thirty thousand men behind him, with orders to infest the frontiers of the empire. This they did with great success, the borders being through the avarice of Monomachus left unguarded. Till the time of this emperor, the provinces bordering on the countries of the barbarians had maintained, at their own charge, forces to defend them, and were on that account exempted from paying tribute; but as Monomachus had exacted from them the same sums which were paid by others, they were no longer in a condition to defend themselves.

In 1062 died the emperor Constantine Ducas, having left the empire to his three sons, Michael, Andronicus, and Constantine; but as they were all very young, he appointed the empress Eudocia regent during their minority, after having required of her an oath never to marry, which oath was with great solemnity lodged in the hands of the patriarch. He likewise obliged the senators solemnly to swear that they would acknowledge none for their sovereign but his three sons. No sooner was he dead, however, than the Turks, hearing that the empire was governed by a woman, broke into Mesopotamia, Cilicia, and Cappadocia, destroying all with fire and sword. The empress was nowise in a condition to oppose them, the greater part of the army having been disbanded in her husband's lifetime, and the troops that were still on foot being undisciplined, and altogether unfit for service. The concern which this gave the empress was aggravated by the seditious speeches of a discontented party at home, who repeated on all occasions, that the present state of affairs required a man of courage and address at the helm, instead of a weak and helpless woman; and as they imagined that the empress would never think of marrying, in consequence of the oath which she had taken, they hoped by these speeches to induce the people to revolt and choose a new emperor. This Eudocia was aware of, and therefore determined to prevent the evils which threatened herself and her family, by marrying some person of merit, capable of defeating her enemies both at home and abroad. At this time one Romanus Diogenes, a person of a beautiful form, extraordinary parts, and illustrious birth, being accused of aspiring to the empire, tried, and convicted, was brought forth to receive sentence of death; but the empress, touched with compassion at his appearance, gently upbraided him with his ambition, set him at liberty, and soon afterwards appointed him commander-in-chief of all her forces. In this station he acquitted himself so well, that the empress resolved to marry him, if she could but recover the writing which contained her oath, out of the hands of the patriarch. In order to this, she applied to a favourite eunuch, who having repaired to the patriarch, told him that the empress was so taken with his nephew named Bardass, that she was determined to marry and raise him to the empire, provided the patriarch absolved her from the oath which she had taken, and convinced the senate of the lawfulness of her marriage. The patriarch, dazzled with the prospect of his nephew's promotion, readily undertook to perform both. He first obtained the consent of the senate, by representing to them the dangerous state of the empire, and exclaiming against the rash oath which the jealousy of the late emperor had extorted from the empress. He then publicly discharged her from it, restored the writing to her, and exhorted her to marry some deserving person, who being intrusted with absolute authority, might be capable of defending the empire. The empress, thus discharged from her oath, married a few days afterwards Romanus Diogenes, who was thereupon proclaimed emperor, to the grievous disappointment of the patriarch.

Constantinopolitan History. 1062–7.

As the new emperor was a man of great activity and experience in war, he no sooner saw himself vested with the sovereign power, than he took upon him the command of the army, and passed over into Asia with the few forces he could assemble, recruiting and training them on his march to military discipline, which had been utterly neglected in the preceding reigns. On his arrival in that continent, he was informed that the Turks had surprised and plundered the city of Neocæsarea, and were retiring with their booty. On this news he hastened after them at the head of a chosen body of light-armed troops, and came up with them on the third day. As the Turks were marching in disorder, without the least apprehension of an enemy, Romanus cut great numbers of them in pieces, and easily recovered the booty; he then pursued his march to Aleppo, which he retook, together with Hierapolis, where he built a strong castle.

As he was returning to join the forces he had left behind, he was met by a numerous body of Turks, who attempted to cut off his retreat. At first he pretended to decline an engagement through fear; but afterwards attacked them with such vigour, when they least expected it, that he put them to flight at the first onset, and might have gained a complete victory, had he thought proper to pursue them. After this, several towns submitted to him; but the season being now far spent, the emperor returned to Constantinople. The following year he passed over into Asia early in the spring; and being informed that the Turks had sacked the rich city of Iconium, besides gaining other considerable advantages, he marched in person against them; but the Turks not thinking it advisable to wait his arrival, retired in great haste. The Armenians, however, encouraged by the approach of the emperor's army, fell upon the enemy in the plains of Tarsus, put them to flight, and stripped them of their baggage and of the booty which they had taken. The spring following, the emperor once more

Constantinopolitan History. 1062–7.

entered Asia at the head of a considerable army which he had raised, and with incredible pains disciplined, during the winter. When the two armies approached each other, Axan, the Turkish sultan, and son of the famous Tangrolipix, sent proposals to Romanus for a lasting and honourable peace. These were imprudently rejected, and a desperate engagement ensued, when, in spite of the utmost efforts of the emperor, his army was routed, and he himself wounded and taken prisoner. When this news was brought to Axan, he could scarcely believe it; but being convinced by the appearance of the royal captive in his presence, he tenderly embraced him, and addressed him in an affectionate manner: "Grieve not," said he, "most noble emperor, at your misfortune; for such is the chance of war, sometimes overwhelming one, and sometimes another. You shall have no occasion to complain of your captivity; for I will not use you as my prisoner, but as an emperor." The Turk was as good as his word; he lodged the emperor in a royal pavilion, assigned him attendants, with an equipage suitable to his quality, and discharged such prisoners as he desired. After he had for some days entertained his royal captive with extraordinary magnificence, a perpetual peace was concluded betwixt them, and the emperor dismissed with the greatest marks of honour imaginable. He then set out with the Turkish ambassador for Constantinople, where the peace was to be ratified; but by the way he was informed that Eudocia had been driven from the throne by John, the brother of Constantine Ducas, and Psellus, a leading man in the senate, who had confined her to a monastery, and proclaimed her eldest son, Michael Ducas, emperor. On this intelligence, Romanus retired to a strong castle near Theodosiopolis, where he hoped in a short time to be joined by great numbers of his friends and adherents. But in the mean time John, who had taken upon him to act as guardian to the young prince, dispatched Andronicus with a considerable army against him. Andronicus having easily defeated the small army which Romanus had with him, obliged him to fly to Adana, a city in Cilicia, where he was closely besieged, and at last obliged to surrender. Andronicus carried his prisoner into Phrygia, where he fell dangerously ill, being, as was suspected, secretly poisoned. But the poison being too slow in its operation, John ordered his eyes to be put out, which was performed with such cruelty that he died soon afterwards, in the year 1067, having reigned three years and eight months.

Axan was no sooner informed of the tragical end of his friend and ally, than he resolved to invade the empire anew, and that not with a design to plunder as formerly, but to conquer, and to keep what he had once conquered. The emperor dispatched against him Isaac Comnenus with a considerable army; but he was utterly defeated and taken prisoner by Axan. Another army was quickly sent off under the command of John Ducas, the emperor's uncle, who at first gained some advantages, and would probably have put a stop to their conquests, had not one Ruselius, or Urselius, revolted with the troops he had under his command, caused himself to be proclaimed emperor, and reduced several cities in Phrygia and Cappadocia. John marched against him with all his forces, suffering the Turks in the mean time to pursue their conquests; but coming to an engagement with the rebels, his army was entirely defeated, and himself taken prisoner. Notwithstanding this victory, Ruselius was so much alarmed at the progress of the Turks, that he not only released his prisoner, but joined him against the common enemy, by whom they were both defeated and taken prisoners. Axan, however, was for some time prevented from pursuing his conquest, by Cutlu-Moses, nephew to the late Tangrolipix. The latter had revolted against his uncle; but being defeated by him in a pitched battle, had taken refuge in Arabia, whence he now returned at the head of a considerable army, in order to dispute the sovereignty with Axan. But whilst the two armies were preparing to engage, the caliph of Babylon, who was still looked upon as the successor of the Prophet, interposed his authority. He represented the dangers of their intestine dissensions; and by his mediation an agreement was at last concluded, on condition that Axan should enjoy undisturbed the monarchy lately left him by his father, and Cutlu-Moses should possess such provinces of the Roman empire as he or his sons should in process of time conquer.

Constantinopolitan History. 1077.

After this agreement both the Turkish princes turned their forces against the empire, and before the year 1077 made themselves masters of all Media, Lycaonia, Cappadocia, and Bithynia, fixing the capital city of their empire at Nice, in the latter province. During this time the emperors of Constantinople, as well as their subjects, seemed to be in a manner infatuated. No notice was taken of the great progress made by these barbarians. The generals were ambitious only of seizing the tottering empire, which seemed ready to become a prey to the Turks; and after it had been obtained, they spent their time in oppressing their subjects, rather than in making any attempts to repulse the enemy.

At last Alexius Comnenus, having wrested the empire from Nicephorus Botoniates in 1077, began to prepare for opposing so formidable an enemy. But before he set out, as his soldiers had committed great outrages on his accession to the empire, he resolved to make confession of his sins, and do open penance for those which he had suffered his army to commit. Accordingly he appeared in the attire of a penitent before the patriarch and several other ecclesiastics; acknowledged himself guilty of the many disorders which had been committed by his soldiers; and begged of the patriarch to impose upon him a penance suitable to the greatness of his crimes. The penance enjoined him and his adherents by the patriarch was to fast, lie upon the ground, and practise several other austerities for the space of forty days. This command was religiously obeyed, and the emperor then began to prepare for war with so much vigour, that Solyman, the Turkish sultan, son and successor to Cutlu-Moses, dispatched ambassadors to Alexius with proposals of peace. These were at first rejected; but the emperor was at last glad to accept them, on receiving certain advices that Robert Guiscard, duke of Puglia and Calabria, was making great preparations against him in the West.

To this expedition Robert was incited by Michael Ducas. That prince had been deposed by Nicephorus Botoniates, and towards the end of the usurper's reign fled into the west, where he was received by Robert, who was prevailed upon to favour his cause. For this purpose Robert made great preparations; and these were continued even after the deposition of Botoniates. He sailed with all his forces from Brundusium, and landing at Buthrotum, in Epirus, made himself master of that place; whilst his son Bohemond with part of the army reduced Aulon, a celebrated port and city in the country now called Albania. From this they advanced to Dyrrhachium, which they invested both by sea and land; but met with a most vigorous opposition from George Palæologus, whom the emperor had intrusted with the defence of that important place. In spite of the utmost efforts of the enemy, this commander held out till the arrival of the Venetian fleet, by which Robert's navy, commanded by Bohemond, was utterly defeated, and the admiral himself narrowly escaped being taken prisoner. After the victory the Venetians landed without loss of time, and being joined by Palæologus's men, fell upon Robert's troops with such fury that they de-

Constantinopolitan History. 1083.

stroyed their works, burnt their engines, and forced them to retreat to their camp in great disorder. As the Venetians were now masters at sea, the besieged were supplied with plenty of provisions, whilst a famine began to rage in the camp of the enemy; and this calamity was soon followed by a plague, which is said to have destroyed ten thousand men in the space of three months. Notwithstanding all these disasters, however, Robert did not abandon the siege. Having found means to supply his famished troops with provisions, he continued it with such vigour that the courage of the besieged began at last to fail them, and Palæologus sent repeated messages to the emperor, acquainting him that he would be obliged to surrender unless very speedily relieved. On this Alexius marched in person to the relief of the city, but was defeated with great loss by Robert. The whole right wing of Alexius's army, finding themselves hard pressed by the enemy, fled to a church dedicated to St Michael, imagining that they would there find themselves in a place of safety; but the victorious army pursuing them, set fire to the church, which was burnt to ashes with all who were in it. The emperor himself with great difficulty made his escape, leaving the enemy masters of his camp and all his baggage. Soon after this defeat the city surrendered; and Alexius being destitute of resources for carrying on the war, seized on the wealth of churches and monasteries, which gave serious offence to the clergy, and had nearly occasioned great disturbances in the imperial city. At the same time, Alexius having entered into an alliance with Henry, emperor of Germany, persuaded him to invade the dominions of Robert in Italy. At first Henry met with great success, but he was soon overcome and driven out of that country by Robert. Bohemond, in the mean time, reduced several places in Illyricum; and having defeated Alexius in two pitched battles, entered Thessaly, and sat down before Larissa. But this place, being defended by an officer of great courage and experience in war, held out till the emperor came to its relief. Soon after his arrival he found means to draw a strong party of Bohemond's men into an ambuscade, and cut them off almost entirely. In the battle which was fought a few days afterwards, however, Bohemond had the advantage; but his troops having mutinied and refused to carry on the war, he was obliged to return into Italy. Alexius taking advantage of his absence, recovered several cities; and being informed that Robert was making great preparation against him, he had recourse once more to the Venetians. By them he was assisted with a powerful fleet, which defeated that of Robert in two engagements; but being soon after surprised by him, they were defeated with the loss of almost their whole navy. Robert is said to have used his victory with great barbarity, putting many of his prisoners to death with unheard-of torments. The Venetians equipped a second fleet, which having joined that of the emperor, fell unexpectedly upon Robert's navy, while riding at anchor, without the least apprehension, in Buthrotum, sunk most of his ships, and took a great number of prisoners, his wife and younger sons having narrowly escaped falling into their hands. Robert made great preparations to revenge this defeat, but was prevented by death from executing his designs; and after his decease his son Roger did not think proper to pursue so dangerous and expensive a war. He therefore recalled his troops; and the places which had been conquered by Robert and Bohemond submitted anew to the emperor.

This war had scarcely ended, when the Scythians, passing the Danube, laid waste great part of Thrace, and committed everywhere the greatest barbarities. The emperor dispatched against them an army under the command of Pacurianus and Branas. The latter insisted upon engaging the enemy, contrary to the opinion of his colleague; and his rashness caused the loss of the greater part of the army, which was cut off by the Scythians, together with the two generals. Talicius, an officer who had signalized himself on many occasions, was appointed to command the army in their stead; and he fell upon the enemy as they lay encamped in the neighbourhood of Philippopolis, cut great numbers of them in pieces, and obliged the remainder to retire in great confusion. The following spring, however, they returned in such numbers that the emperor resolved to march against them in person. Accordingly he set out for Adrianople, and thence proceeded to a place called Lardea. Here, contrary to the advice of his best officers, he ventured a battle, in which he was utterly defeated with great loss, and himself escaped with the utmost difficulty. The next year he was attended with no better success, his army being entirely defeated, with the loss of his camp equipage and baggage. In the year following, 1084, the emperor retrieved his credit, and inflicted on the Scythians such an overthrow that very few escaped the general slaughter. Notwithstanding this disaster, however, they again invaded the empire in 1093. To this they were encouraged by an impostor called Leo, who pretended to be the eldest son of Romanus Diogenes. The young prince had been slain in a battle with the Turks; but as the Scythians only wanted a pretext for renewing the war, they received the impostor with joy. Leo, however, was murdered by stratagem; and the Scythians being afterwards overthrown in two great battles, were obliged to submit on the emperor's own terms.

Constantinopolitan History. 1093.

Since the year 1083, the war had been carried on against the Turks with various success; but now an association against these infidels was formed in the West, and threatened the utter ruin of the Turkish nation. This was occasioned by the superstition of the Christians, who thought it a meritorious action to venture their lives for the recovery of the Holy Land, at that time possessed by the Turks and Saracens. Had the western princes been properly assisted by the emperors of the East in this undertaking, the Turks undoubtedly would have been unable to resist them; but so far from this, the Latins were looked upon by them as not less enemies than the Turks; and indeed whatever places they took from the infidels, they never thought of restoring to the emperors of Constantinople, to whom they originally belonged, but erected a number of small independent principalities, which neither having sufficient strength to defend themselves, nor being properly supported by one another, soon became a prey to the Turks. In the year 1203 happened a dreadful fire at Constantinople, occasioned by some Latin soldiers. These men having plundered a mosque which the Turks residing in Constantinople had been suffered to build there, they were attacked by the infidels; and the latter being much superior in number, the Latins found themselves obliged to set fire to some houses, in order to cover their retreat. The flames spread in an instant from street to street, and in a short time reduced great part of the city to ashes, with the capacious storehouses which had been built at a vast expense on the quay. The emperor Isaac Angelus, who had been restored to his throne by the Latins, died soon after their departure from Constantinople, leaving his son Alexius sole master of the empire. The young prince, in order to discharge the large sums he had promised the French and Venetians for their assistance, was obliged to impose heavy taxes on his subjects; a circumstance which, with the great esteem and friendship which he showed towards his deliverers, raised a general discontent among the people of Constantinople, who were sworn enemies of the Latins. This encouraged John Ducas, surnamed Murtzuphlus, from his joined and thick eyebrows, to attempt the sovereignty. Unhappily he found means to put

Constantinopolitan History. 1204–61

his treacherous designs in execution, and strangled the young prince with his own hands. After this he presented himself to the people; told them what he had done, pretending that it was in order to secure their liberties; and earnestly entreated them to choose an emperor who had courage enough to defend them against the Latins, who were ready to oppress and enslave them. Upon this he was instantly saluted emperor by the inconstant multitude; but this usurpation proved the ruin of the city. The Latins immediately resolved to revenge the death of the young prince; and, as they had been so often betrayed and retarded in their expeditions to the Holy Land by the emperors of Constantinople, they also determined to make themselves masters of that city, and seize the empire for themselves. In consequence of this resolution they mustered their forces in Asia, and having crossed the straits, laid siege to Constantinople both by sea and land. The tyrant, who was a man of great courage and experience in war, made a vigorous defence. The Latins, however, after having battered the walls for several days together with an incredible number of engines, gave a general assault on the 8th of April 1204. The attack lasted from break of day till three in the afternoon, when they were forced to retire, after having lost some of their engines and a great number of men. The assault was nevertheless renewed four days subsequently to this; when, after a warm contest, the French planted their standard on one of the towers; which the Venetians having observed, quickly made themselves masters of four other towers, where they likewise displayed their ensigns. In the mean time three of the gates being broken down by the battering rams, and those who had scaled the walls having killed the guards, and opened the gates between the towers they had taken, the whole army entered, and drew up in battle array between the walls. The Greeks fled in the greatest confusion; and several parties were dispatched by the Latins to scour the streets, and put all they met to the sword, without distinction of age or condition. Night alone put a stop to the carnage, when the princes sounding the retreat, placed their men in different quarters of the city, with orders to be upon their guard, not doubting that they would be attacked early next morning. They were surprised, however, by the entire submission of the Greeks, to whom they promised their lives, but at the same time ordered them to retire to their houses; upon which they gave up the city to be plundered by the soldiers for that day. They strictly enjoined their men to abstain from slaughter, to preserve the honour of the women, and to bring the whole booty into one place, that a just distribution might be made, according to the rank and merit of each individual. The Greeks had undoubtedly concealed their most valuable effects during the night; many persons of the highest rank had escaped, carrying along with them immense treasures; and the soldiers, as is usual in all such cases, had probably reserved things of great value for themselves, notwithstanding all prohibitions to the contrary; yet the booty, exclusively of statues, pictures, and jewels, amounted to a sum almost incredible. As for Murtzuphlus, he made his escape in the night; having embarked in a small vessel with Euphrosyne, the wife of Alexius Angelus, a late usurper, and her daughter Eudoxia, for whose sake he had abandoned his lawful wife.

Constantinople continued subject to the Latins until the year 1261, when they were expelled by one Alexius Strategopulus. He was a person of an illustrious family, and, on account of his eminent services, distinguished by the title of Cæsar. He had been sent against Alexius Angelus, despot of Epirus, who now attempted to recover some places in Thessaly and Greece from Michael Palæologus, one of the Greek emperors, who, since the capture of Constantinople, had kept their court at Nice; and also to try whether on his march he could surprise the imperial city itself. Alexius, having passed the straits, encamped at Rhegium, where he was informed by the natives that a strong body of the Latins had been sent to the siege of Daphnusa, that the garrison was in great want of provisions, and that it would be no difficult matter to surprise the city. On receiving this intelligence, the Greek general resolved at all events to attempt it; and in this he was encouraged by some of the inhabitants, who, coming privately to his camp, offered to act as guides to his troops. He approached the walls in the dead of the night, which some of his men scaled without being observed, and, killing the sentries, whom they found asleep, opened one of the gates to the rest of the army, when the Greeks rushing in, put all they met to the sword, and, at the same time, in order to create greater terror, set fire to the city in four different places. The Latins, concluding that the enemy's forces were far more numerous than they really were, did not so much as attempt either to drive them out or to extinguish the flames.

Constantinopolitan History. 1261.

In this general confusion, the emperor Baldwin, quitting the ensigns of majesty, fled with Justinian, the Latin patriarch, and some of his intimate friends, to the sea-side; and there, embarking in a small vessel, he sailed first to Eubœa, and afterwards to Venice, leaving the Greeks in full possession of Constantinople. When tidings of this surprising and altogether unexpected success of Alexius were first brought to Palæologus, he could scarcely give credit to the intelligence; but having soon afterwards received letters from Alexius himself, containing a particular account of this memorable event, he ordered thanksgivings to be made in all the churches, appeared in public in his imperial robes, attended by the nobility in their best apparel, and ordered couriers to be dispatched with the agreeable tidings into all parts of the empire.

Palæologus having settled his affairs at Nice, soon afterwards set out for Constantinople, with the empress, his son Andronicus, the senate, and nobility, in order to take possession of the imperial city, and to fix his residence in that place which had originally been designed for the seat of the eastern empire. Having passed the straits, he advanced to the Golden Gate, and continued some days without the walls, whilst the citizens were busied in making the necessary preparations to receive him with a magnificence suitable to the occasion. On the day appointed, the golden gate, which had been long shut up, was opened, and the emperor having entered it amidst the repeated acclamations of the multitude, marched on foot to the great palace. He was preceded by the Bishop of Cyzicus, who carried an image of the Virgin Mary, supposed to have been made by St Luke, and followed by all the great officers, nobility, and principal citizens, pompously dressed. Public thanks were again returned in the church of St Sophia, at which the emperor assisted in person, with the clergy, the senate, and nobility. These exercises were succeeded by all sorts of rejoicings; after which the emperor carefully surveyed the imperial city. This survey greatly allayed his joy. He saw the stately palaces and other magnificent buildings of the Roman emperors lying in ruins; the many capacious edifices which had been erected by his predecessors, at an immense charge, were destroyed by fire, and other unavoidable accidents of war; and several streets abandoned by the inhabitants, and choked up with rubbish. These objects gave the emperor no small concern, and kindled in his mind a desire of restoring the city to its former lustre. In the mean time, looking upon Alexius as the restorer of his country, he caused him to be clad in magnificent robes; placed with his own hand a crown upon his head; ordered him to be conducted throughout the city in a sort of triumph; de-

Constantinopolitan History. 1283.

creed that for a whole year the name of Alexius should be joined in the public prayers with his own; and, to perpetuate the memory of so great and glorious an action, he commanded his statue to be erected on a stately pillar of marble, in front of the church of the apostles. His next care was to re-people the city, many Greek families having withdrawn from it while it was occupied by the Latins. The former were recalled home; while the latter, from the great trade they carried on, were allowed many valuable privileges, which induced many of them not to remove. The Greeks were permitted to live in one of the most beautiful quarters of the city, to be governed by their own laws and magistrates, and to trade without paying customs or taxes of any kind. Great privileges were likewise granted to the natives of Venice and Pisa, which encouraged them to lay aside all thoughts of removing; and the commerce they carried on proved afterwards highly advantageous to the state.

It was not long, however, before these regulations were altered. The emperor being soon afterwards informed that Baldwin, lately expelled from Constantinople, had married his daughter to Charles, king of Sicily, and given him, by way of dowry, the imperial city itself, he ordered the Genoese, who had become very numerous, to remove first to Heraclia, and afterwards to Galata, where they were permitted to remain. As for the Pisans and Venetians, who were not so numerous and wealthy, they were allowed to continue in the city. Palæologus, though he had caused himself to be proclaimed emperor, and was possessed of absolute sovereignty, was as yet only guardian to the young emperor John Lascaris, then about twelve years of age. But having now settled the state, and having gained the affections of both natives and foreigners, he began to think of securing himself and his posterity in the full enjoyment of the empire; and for this purpose he cruelly ordered the eyes of the young prince to be put out, pretending that none but himself had any right to the city or empire of Constantinople, which he alone had recovered from the hands of the Latin conquerors.

This piece of treachery and inhumanity involved him in great troubles. The patriarch immediately excommunicated him; and he would in all probability have been driven from the throne by a combination of the western princes, had he not engaged Pope Urban IV. to espouse his cause, by promising to submit himself and his dominions to the Latin church. By this means he succeeded in diverting the present storm; but the proceeding itself caused the greatest disturbances, not only in Constantinople, but throughout the whole empire: nor was Palæologus able to reconcile his subjects to this union.

In 1283 Michael died, and was succeeded by his son Andronicus, whose first step was to restore the ancient Greek ceremonies, thinking that he could not begin his reign with a more popular act. But he thereby involved himself in greater difficulties than ever; for, although Michael had not been able fully to reconcile his Greek subjects to the Latin ceremonies, yet he had in some degree accomplished his object. The Latins having obtained a considerable footing in the city, defended their ceremonies with great obstinacy; and the empire was again thrown into a ferment by this imprudent step.

During this time the Turks had continued their encroachments on the empire, of which, had it not been for the crusades published against them by the pope, they would already have, in all probability, made themselves masters. They were now, however, very successfully opposed by Constantine, the emperor's brother; but his valour rendered him suspected by the emperor, and he was therefore thrown into prison, along with several persons of great distinction. On the removal of this brave commander, the Turks, under the famous Othoman, made themselves masters of several places in Phrygia, Caria, and Bithynia, and, among these, of the city of Nice. To put a stop to their conquests, the emperor dispatched against them Philanthropenus and Libadarius, two officers of great experience in war. The former gained some advantages over the enemy, but being elated with his success, caused himself to be proclaimed emperor. This rebellion, however, was soon suppressed, Philanthropenus having been betrayed by his own men; but the Turks taking advantage of these intestine commotions, extended their dominions in Asia, conquered most of the islands in the Mediterranean, and, being masters at sea, infested the coasts of the empire, to the utter ruin of trade and commerce.

Constantinopolitan History. 1292–1357.

From this time the Roman empire declined fast towards total dissolution. After the revolt of Philanthropenus, the emperor could no longer trust his subjects, and therefore hired the Massagetes to assist him; but the latter, conducting themselves in a careless manner, were first defeated by their enemies, and afterwards turned their arms against those whom they came to assist. He next applied to the Catalans, who behaved in the same way; and having ravaged the few places left the emperor in Asia, returned into Europe, and called the Turks to their assistance.

This happened in the year 1292, and was the first appearance of the Turks in Europe. The enterprise, however, proved unsuccessful. Having loaded themselves with booty, they offered to depart quietly if they were allowed a safe passage, and ships to transport them to Asia. To this the emperor, willing to get rid of such troublesome guests, readily consented, and ordered the vessels to be got ready with all possible expedition. But the Greek officers observing the immense booty with which they were loaded, resolved to fall upon them in the night, and to cut them off at one blow. This scheme, however, not having been managed with due secrecy, the Turks received notice of it, and were therefore prepared for their defence. They first surprised a strong castle in the neighbourhood, and then found means to inform their countrymen in Asia of their dangerous situation. The latter, enticed by the hope of booty, were not long in coming to their assistance; and having crossed the Hellespont in great numbers, ravaged the adjacent country, making excursions as far as the gates of Constantinople. At last the emperor determined to root them out, and accordingly marched against them with his whole forces, the country people flocking to him from all quarters. The Turks at first gave themselves over for lost; but finding the Greeks negligent of discipline, they attacked their army unexpectedly, utterly defeated it, and made themselves masters of the camp. After this unexpected victory, they continued for two years to ravage Thrace in the most terrible manner. At last, however, they were defeated; and being afterwards shut up in the Chersonesus, they were all either cut in pieces or taken prisoners.

Soon afterwards, new commotions occurred in the unhappy empire, of which the Turks did not fail to take advantage. In 1327 they made themselves masters of most of the cities on the Mæander, and, among the rest, of the strong and important city of Prusa, in Bithynia. The next year, however, Othoman, who may justly be styled the founder of the Turkish monarchy, being now dead, the emperor seized the opportunity to recover Nice, and some other important places, from the infidels. But these were lost the year following, together with Abydus and Nicomedia; and in 1330 a peace was concluded, upon condition that the Turks should retain all their conquests. But this peace they observed no longer than suited their own purposes; for new commotions having arisen in the empire, they pursued their conquests, and by the year 1357 had reduced

Constantinopolitan History. 1357-1424.

all Asia. They next passed the Hellespont under the conduct of Solyman, the son, or, as others allege, the brother of Orchane, the successor of Othoman, and seized on a strong castle on the European side. The Turkish sultan died soon afterwards, and was succeeded by Amurath, who extended the conquests of his predecessors, and in a short time reduced all Thrace, making Adrianople the seat of his empire. Amurath was slain by treachery a little time afterwards, and was succeeded by his son Bajazet, who greatly enlarged his dominions by new conquests. In a short time he reduced the countries of Thessaly, Macedonia, Phocis, Peloponnesus, Mysia, and Bulgaria, driving out the despots or petty princes who ruled there. Elated with his frequent victories, he began to look upon the Greek emperor, to whom nothing was now left but the city of Constantinople and the neighbouring country, as his vassal. Accordingly he sent him an arrogant and haughty message, commanding him to pay a yearly tribute, and send his son Manuel to attend him in his military expeditions. This demand the emperor was obliged to comply with, but soon afterwards died, in the year 1392.

Manuel no sooner heard of his father's death than he hastened to Constantinople, without taking leave of the sultan, or acquainting him with the reason of his sudden departure. Bajazet was so highly offended at this, that he passed with great expedition out of Bithynia into Thrace, ravaged the country adjoining to Constantinople, and at last invested the city itself, both by sea and land. In this extremity Manuel had recourse to the western princes, who sent him an army of a hundred and thirty thousand men, under the command of Sigismund, king of Hungary, and John, count of Nevers. But though the western troops proved at first successful, they were in the end defeated with great slaughter by Bajazet, who then returned to the siege with greater vigour than ever. As he found, however, that the citizens were determined to hold out to the last, he applied to John, the son of Manuel's elder brother, who had a better title to the crown than Manuel himself, with whom he entered into a private agreement, by virtue of which Bajazet engaged to place John upon the throne of Constantinople, while, on the other hand, John consented to deliver up the city to the Turks, and remove the imperial city to Peloponnesus, which the sultan promised to relinquish to him and his posterity. At the same time he sent deputies to the inhabitants of Constantinople, offering to withdraw his army, and cease from further hostilities, provided they expelled Manuel, and placed John upon the throne. This proposal rent the city into two factions; but Manuel prevented the mischiefs which were ready to ensue, by a voluntary resignation, upon condition that he should be allowed to retire with his wife and children to any place he might think proper to fix upon.

John readily complied with this condition, and Manuel having received him into the city, and conducted him to the palace, set sail for Venice, and thence proceeded to the courts of all the western princes, to solicit assistance against the Turks, whose power had grown formidable to all Europe. He was everywhere received with the greatest demonstrations of esteem, and promised large supplies; for all Christendom had now become alarmed at the progress of the infidels.

In the mean time Bajazet did not fail to put John in mind of his promise; but the citizens refusing to comply with so scandalous a treaty, the siege was renewed, and the city assaulted with more fury than ever. When it was reduced almost to the last extremity, news were brought to the sultan that Timour, or Tamerlane, the victorious Tātar, having overrun all the East with incredible celerity, had turned his arms against the Turks, and was preparing to break into Syria. Bajazet, alarmed at the danger which threatened him, raised the siege in great haste, and advanced against Tamerlane with a numerous and well-appointed army; but the Tātar totally defeated and took him prisoner, after having cut most of his men in pieces; and thus Constantinople was for the present saved from destruction.

Constantinopolitan History. 1424-1453

But this relief proved of short duration. In 1424 the city was again besieged by Amurath II.; and although the inhabitants defended themselves with great bravery, they must in the end have submitted, had not the emperor prevailed upon the Prince of Caramania to countenance an impostor and pretender to the Turkish throne. This obliged Amurath to raise the siege, and to march with all his forces against the usurper, whom he soon overthrew. Having then no other enemies to contend with, he entered Macedonia at the head of a powerful army, and having ravaged the country far and near, he took and plundered Thessalonica, as he did also most of the cities of Ætolia, Phocis, and Bœotia. From Greece he marched into Servia, which country he soon reduced. He next broke into the dominions of the king of Hungary, and besieged the strong city of Belgrade; but here he met with a vigorous repulse, no fewer than fifteen thousand Turks having been slain by the Christians in one sally, a circumstance which obliged the sultan to abandon the enterprise and retire.

In his retreat he was attacked by the celebrated John Hunniades, who slew great numbers of his men, and obliged the rest to fly with the utmost precipitation. Not long afterwards, Hunniades gained a still more complete victory over the enemy in the plains of Transylvania, with the loss of only three thousand of his own men, whereas twenty thousand of the Turks were slain on the field of battle, and almost an equal number in the pursuit. Amurath, who was then at Adrianople, sent into Transylvania an army far more numerous than the former; but they were attended with no better success, being cut off almost to a man by the brave Hungarian. Hunniades gained several other victories no less remarkable, but was at last entirely defeated in 1448; and with this defeat ended all hopes of preserving the Roman empire. The unhappy emperor was now obliged to pay an annual tribute of three hundred thousand aspers to the sultan, and to yield up some strongholds which he still held on the Euxine Sea. However, as he doubted not that Amurath would soon attempt to become master of the city itself, he renewed the union between the Greek and Latin churches; hoping that this would induce the western princes to assist him in the defence of the city against the Turks. This union produced great disturbances, which the emperor did not long survive, for he died in 1448, leaving the empire, now confined within the walls of Constantinople, to his brother Constantine.

Amurath the Turkish sultan died in 1450, and was succeeded by his son Mohammed. In the beginning of his reign the latter entered into an alliance with Constantine, and pretended a great desire to live in friendship with him and the other Christian princes; but no sooner had he put an end to a war in which he was engaged with Ibrahim, king of Caramania, than he built a strong fort on the European side of the Bosporus, opposite to another in Asia, in both of which he planted strong garrisons. These castles commanded the straits; and the former being only five miles from the city, kept it in a manner blockaded. This soon produced a misunderstanding between him and the emperor, which ended in his laying siege to the city. The siege commenced on the 6th of April 1453, Mohammed's numerous forces covering the plains before it on the land side, and a fleet of three hundred sail blockading it by sea. The emperor, however, had taken care to secure the haven, in which were three large ships, twenty

Constantinopolitan History. 1453.

small ones, and a great number of galleys, by means of a chain drawn across the entrance. Mohammed began the siege by planting batteries as near the city as he could, and raising in several places mounds as high as the walls themselves, whence the besieged were incessantly galled with showers of arrows. He had in his camp a piece of ordnance of prodigious size, which is said to have carried a ball of a hundred pounds weight made of hard black stone brought from the Euxine Sea. With this vast piece the enemy made several breaches in the walls; which, however, were repaired with incredible expedition by the besieged. But Mohammed, in order to carry on the siege with greater vigour, caused new levies to be made throughout his extensive dominions, by which his army was soon increased to near four hundred thousand men; while the garrison consisted only of nine thousand regular troops, viz. six thousand Greeks and three thousand Genoese and Venetians. As the enemy continued to batter the walls day and night without intermission, a great part of them was at last beaten down; but whilst the Turks were busy in filling up the ditch, in order to deliver the assault, a new wall was constructed. This threw the tyrant into a prodigious rage, which was greatly heightened when he saw his whole fleet worsted by five ships, four of which were laden with corn from Peloponnesus, and the other with all manner of provisions from the isle of Chios. These opened themselves a way through the whole Turkish fleet, and, to the inexpressible joy of the Christians, at last got safe into the harbour.

The Turks attempted several times to force the harbour; but all their efforts proved ineffectual; upon which Mohammed formed the design of conveying into it eighty galleys over land for the space of eighty miles. This he accomplished by means of certain engines, the contrivance of a renegado; and having either taken or sunk all the ships in the harbour, he caused a bridge to be built over it with surprising expedition, by which means the city was laid open to an assault from that as well as from the other sides. A general attack was now made; and Constantine, aware that he could not long hold out against a mighty fleet and a numerous army, sent deputies to Mohammed, offering to acknowledge himself his vassal, by paying him yearly such tribute as he should think proper to impose, provided he raised the siege and withdrew. The tyrant answered that he was determined at all events to become master of the city; but if the emperor delivered it up forthwith, he would yield up to him Peloponnesus, and give other provinces to his brothers, which they might enjoy peaceably as friends and allies; but if he held out to the last extremity, and suffered it to be taken by assault, he would put him and the whole nobility to the sword, abandon the city to be plundered by his soldiers, and carry the inhabitants into captivity.

This condition was rashly rejected by the emperor, who thereby involved himself and all his subjects in a terrible calamity. The siege was renewed with more vigour than ever, and continued till the 25th of May; when a report having been spread in the Turkish camp that a mighty army was advancing in full march to the relief of the city, under the conduct of the celebrated John Hunniades, the common soldiers, seized with a panic, began to mutiny, and pressed Mohammed in a tumultuous manner to break up the siege; nay, they openly menaced him with death if he did not immediately abandon the enterprise and retire from before the city, which they despaired of being able to reduce before the arrival of the supposed succours. Mohammed was upon the point of complying with their demand, when he was advised by Zagan, a Turkish officer of great intrepidity, and an irreconcilable enemy to the Christian name, to deliver without loss of time a general assault; to which, he said, the soldiery, however mutinous, would not be averse, provided the sultan solemnly promised to abandon the city to be plundered by them. As this advice was best suited to the humour of Mohammed, he readily embraced it; and caused a proclamation to be published throughout the camp, intimating that he gave up to his soldiers all the wealth of that opulent city, and reserved for himself only the empty houses.

Constantinopolitan History. 1453.

The desire of plunder soon overcame the panic which had seized the Turkish army, and they unanimously desired to be led on to the attack. Constantine was now summoned for the last time to deliver up the city, with a promise of life and liberty; but to this he answered, that he had unalterably determined either to defend the city or to perish with it. The attack began at three in the morning on Tuesday the 29th of May. The troops first employed were those which the sultan valued the least, and he designed them for no other purpose than to tire out the Christians, who made a prodigious havock of that disorderly multitude. After the carnage had lasted several hours, the Janizaries and other fresh troops advanced in good order, and renewed the attack with incredible vigour. The Christians, summoning all their courage and resolution, twice repulsed the enemy; but becoming at last quite exhausted, they were no longer able to stand their ground, and the enemy broke into the city in several places. In the mean time, Justiniani, the commander of the Genoese and a select body of Greeks, having received two wounds, one in the thigh and the other in the hand, became so disheartened that he caused himself to be conveyed to Galata, where he soon afterwards died of grief. His men, dismayed at the sudden flight of their general, immediately quitted their posts and fled in the utmost confusion. However, the emperor, attended by a few of the most resolute among the nobility, still kept his post, striving with unparalleled resolution to oppose the multitude of barbarians that now broke in from every quarter. But being in the end overpowered with numbers, and seeing all his friends lie dead on the ground, "What!" cried he aloud, "is there no Christian left alive to strike off my head?" He had scarcely uttered these words, when one of the enemy, not knowing him, gave him a deep cut across the face with his sabre; and at the same time, another coming behind him, with a blow on the back part of his head laid him dead on the spot which he had so bravely defended. After the death of the emperor, the few Christians who were left alive betook themselves to flight; and the Turks meeting with no further opposition, entered the city, which they filled with slaughter and blood. They gave no quarter, but put all they met to the sword, without distinction. Many thousands took refuge in the church of St Sophia; but they were all massacred in this asylum by the enraged barbarians, who, prompted by their natural cruelty, the desire of revenge, and the love of booty, spared neither place nor person. Most of the nobility were, by the sultan's orders, cut off, and the rest preserved for purposes more grievous than death itself. Many of the inhabitants, among whom were several men of great learning, found means to effect their escape while the Turks were busied in plundering the city, and embarking on board some ships which were then in the harbour, they arrived safe in Italy; where, with the study of the Greek tongue, they revived the liberal sciences, which had long been neglected in the West. After the expiration of three days, Mohammed commanded his soldiers to forbear all further hostilities, on pain of death; and then put an end to as cruel a pillage and massacre as any mentioned in history. The next day he made his public and triumphal entry into Constantinople, and chose it as the seat of the Turkish empire, which it has continued to be ever since.

Constellation || Construction.

CONSTELLATION, in *Astronomy*, a system of stars seen near one another in the heavens. The stars are distinguished by their situation and position in respect to each other; and they are distributed into asterisms or constellations by astronomers, who, for the better distinguishing them, reduce the constellations to the forms of animals, or give them the names of remarkable personages.

The division of the stars by images and figures is of great antiquity, and seems to be as old as astronomy itself; for in the Book of Job (which is undoubtedly as old as the time of Moses) Orion, Arcturus, Mazzaroth, and the Pleiades are mentioned; and the names of many of the constellations are met with in Homer and Hesiod. See ASTRONOMY.

CONSTITUTION (Lat. *constitutio*, *con* and *statuo*, to set), in matters of policy, the established form of government in any country, state, or kingdom.

CONSTITUTION also denotes an ordinance, decision, regulation, or law, made by authority of any superior, civil or ecclesiastical.

Apostolical CONSTITUTIONS, a collection of regulations respecting the doctrine and discipline of the church, attributed to the apostles, and said to have been collected by Clemens Romanus, whose name they likewise bear

Constitution || Constitution.

It is the general opinion, however, that these Constitutions are spurious, and also that St Clement had no hand in them. They appeared first in the fourth century; but they have been much changed and corrupted since that time. They are divided into eight books, consisting of a great number of rules and precepts, relating to the duties of Christians, and particularly to the ceremonies and discipline of the church. Whiston, in opposition to the general opinion, asserts that they are a part of the sacred writings, dictated by the apostles at their meetings, and written down from their own mouths by St Clement, and intended as a supplement to the New Testament, or rather as a system of Christian faith and polity. The reason why the Constitutions are suspected by the orthodox, and perhaps the reason also why their genuineness is defended by Whiston, is, that they seem to savour of Arianism.

CONSTITUTION, in a physical sense, the particular temperament or condition of the body.

CONSTRICTOR, an appellation given to several muscles, on account of their drawing together or closing some of the orifices of the body.

CONSTRUCTION.

THE sense in which the term "Construction" is used in this place, is that in which it is employed in the supplement to ARCHITECTURE; purporting, however, rather fabrication than conformation.

The object of construction is to adapt and combine fit materials in such a manner that they shall retain in use the forms and dispositions assigned to them by the constructor. If an upright wall be properly constructed upon a sufficient foundation, the combined mass will retain its position, and bear pressure acting in the direction of gravity, to any extent that the ground on which it stands and the component materials of the wall can sustain. But pressure acting laterally has a necessary tendency to overturn a wall, and therefore it will be the aim of the constructor to compel, as far as possible, all forces that can act upon an upright wall to act in the direction of gravity; or else to give it permanent means of resistance in the direction opposite to that in which a disturbing force may act. Thus when an arch is built to bear against an upright wall, the constructor applies a buttress or other counterfort in a direction opposed to the pressure of the arch. In like manner the inclined roof of a building, spanning from wall to wall, tends to thrust out the walls; and hence the constructor applies a tie to hold the opposite sides of the roof together at its base, where alone a tie can be fully efficient, and thus compels the roof to act upon the walls wholly in the direction of gravity; or where an efficient tie is inapplicable, he adds buttresses or counterforts to the walls, to enable them to resist the pressure outwards. A beam laid horizontally from wall to wall, as a girder to carry a floor and its load, may sag or bend downwards, and tend thereby to force out the walls; or the beam itself may break. Both these contingencies are obviated by trussing, which renders the beam stiff enough to place its load on the walls in the direction of gravity, and strong enough to carry it safely. Or if the beam be rigid in its nature, or uncertain in its structure, or both (as cast iron is), and will break without bending, the constructor, by the smith's art, will supply a check and ensure it against the possible contingency.

Stability is then the aim of the constructor; but perfect and enduring stability is not to be attained with materials which are subject to influences beyond the control of man, and all matter is subject to certain influences of that nature. The influences with which the constructor has mostly to contend are heat and humidity; the former of which produces movement of some kind, or to some extent, in all bodies; the latter, movement in many kinds of matter; whilst the two acting together tend to disintegration or to decay in all materials available for the purposes of construction. These pervading influences the constructor seeks to counteract, by the selection and disposition of his materials accordingly. From the tenacity of wrought iron, and its almost plastic character in the hands of the smith, the constructor will employ it to tie together other more bulky but less costly and more rigid materials; but on account of its exceeding susceptibility of heat, and its consequent expansion and contraction, he will use wrought iron in short lengths only, unless where protected from great alternations of heat and cold. The rapid decay, too, of wrought iron when exposed to humidity, and especially to alternations of wet and dry, will teach the constructor not to expect enduring stability in his works if he makes them dependent upon wrought iron. Cast iron is brittle, and may not be exposed with impunity to transverse strain, especially if such strain be attended by action tending to induce vibration: it expands and contracts under the influence of heat, but it resists compression also in every direction, and if used in small bodies, is valuable as a means of connecting other materials. Timber, being practically unchangeable in the direction of its length from the mere absorption of either heat or humidity, and at the same time practically both inextensible and incompressible in that direction, and being also readily wrought and easily combined alike with itself and with iron, is a valuable material in the hands of the constructor; but it shrinks and swells in the direction of its thickness, and, in consequence, is subject to rapid decay when exposed to alternations of moisture and dryness; and although in many varieties timber is perdurable and unchangeable in form if it be kept either altogether free from moisture or always wholly wet, its quality of inextensibility is greatly diminished in value to the constructor on account of the comparatively slight resistance it offers to compressing power, and the comparative ease with which its fibrous structure is torn asunder. From this cause it cannot be grasped or otherwise held so that its power of resisting extension may be made available in any degree proportioned to its strength; whilst its quality of incompressibility in the opposite direction is of less value to the constructor for many purposes which require that

Construction.

quality in the material, because it absorbs moisture by the ends of the fibre more readily, and with a far more mischievous effect, than it does in the direction in which it is compressible. Hence timber rots more rapidly by the ends than by the sides.

Stone and brick, the other main available materials in general construction, keep their places in combination by means of gravity. They may be merely packed together, but in general they are compacted by means of mortar; so that although the main constituent materials are wholly incompressible, masses of either, or of both combined in structures, are compressible until the mortar has indurated to the same condition of hardness.

That kind of stone is best fitted for the purposes of general construction which is least absorbent of moisture, and at the same time free to work. Absorbent stone exposed to the weather rapidly disintegrates; and for the most part non-absorbent stone is so hard that it cannot always be used with a due regard to economy. The constructor therefore, when he can command fitting stone of both qualities, exposes a face of harder stone to the weather, or to the action which the softer stone cannot resist, and forms the main body of the structure of the latter so protected. The hard and the soft should be made to bear alike, and should therefore be coursed and bonded together by the mason's art, whether the work be of stone wrought into blocks and gauged to thickness, or of rough dressed, or otherwise unshaped rubble compacted with mortar.

Brick, if good, is less absorbent of moisture than any stone of the same degree of hardness, and it is a better non-conductor of heat than stone. As the basis of a stable structure, brickwork is more to be relied upon than stone in the form of rubble, when the constituents bear the relation to one another last above referred to, the setting material being the same in both; because the brick by its shaped form seats itself truly, and produces by bonding a more perfectly combined mass; whilst the imperfectly-shaped and variously-sized stone as dressed rubble can neither bed nor bond truly; the inequalities of the form being to be compensated for with mortar, and the irregularity of size of the main constituent accounted for by the introduction of larger and smaller stones.

The most perfect stability is to be obtained nevertheless from truly wrought and accurately seated and bonded blocks of stone, mortar being used to no greater extent than may be necessary to exclude wind or water, to prevent the disintegrating action of both upon even the most durable stone. When water alone is to be dealt with, and especially when it is liable to act with force, mortar is necessary for securing to every block in the structure its own full weight and the aid of every other collateral and superimposed stone in order to resist the loosening effect which water in powerful action is sure to produce.

In the application of construction to any particular object, the nature of the object will greatly affect the character of the constructions and the materials of which they are to be formed. The object of a breakwater is to check the run of the sea when it is acted upon with power. It may be that in some cases piles of timber driven into the bed of the sea, and made rigid by repetition or by combination, might have strength enough to withstand and to break the run of the sea; but there is a range between high and low tide throughout which the piles would be exposed alternately to opposite influences, either of which alone would do the timber little injury, but which acting in rapid succession will in a short time destroy what might otherwise have resisted the extremest force of the sea for ages. Timber failing in enduring usefulness, which it will the more rapidly if it be left in any degree dependent upon wrought iron; or if the depth and the run of the sea be too great for timber, stone is adopted. Large blocks of the densest stone may be tipped into the sea, and serve as a base to other blocks in succession until a mound, mole, or dike, be formed reaching above high-water level. This dike may have had such slopes given to it as experience had shown that heaped up blocks of rough-hewn stone would take on dry ground; but if, even while the work is yet in progress, a gale of wind occasion a great run of the sea, the half-raised breakwater will be converted into something little better than a shoal of rubble;—it having been overlooked that the blocks of stone, when immersed in water, had lost so much of their weight that far less force than was necessary to move them in air tumbled them about in the water as small pebbles are rolled on the sea-shore. The stones were uncombined, and every surface stone was exposed in a half floating condition to the force of the sea, while its fellows below became exposed as those above them were rolled away. The construction wanted rigidity. The water must be excluded from among the stones, so that the whole shall form one mass, from the level at which the run of the sea in a storm can first be felt, up to and above the highest high-water level at the place. By such a process, labour and skill will perform effectually, with a comparatively small body of stone, what a huge mass of crude material unskilfully dealt with had failed to accomplish.

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In a line of road, the object sought in constructing an embankment is a firm foundation to the roadway or the railway, by which the traffic may be carried on with perfect safety. The work that failed as a breakwater may form an enduring embankment on dry land. The loose blocks of stone which, when immersed in water, were too light to resist the force of the sea, will remain undisturbed by the trains rolling over them when heaped up in air, though unarranged by the art of the mason, if the stones be allowed to make such slopes as they will naturally form when dropped down from above as if dropped into the sea; or as a measure of dry sand tipped out upon an earthen floor will form its own slopes, so a rubble tipped embankment will take slopes and maintain them against any pressure from above. Such a construction is rigid in air, but subject to movement in water: the circumstances are different. But construction would nevertheless dictate the propriety of filling in the interstices between the rubble, to prevent water, as rain and snow, from passing through the embankment, and so to soften the ground beneath that the stones would sink into it, and thus produce movement in the otherwise rigid structure.

With these considerations would come also another. A small amount of skill in packing stone rubble will greatly reduce the quantity of material necessary to form such an embankment, by substituting less inclined slopes for the natural inclination of the dropped rubble. From merely packing dry rubble to laying it in courses,—and from the construction of a heavy mound of rubble to the construction of a series of piers and arches,—the steps are gradual; but safe structure and a stable foundation may be obtained by any of the means indicated. Circumstances must dictate the kind of construction proper in each particular case. The quiet traffic of a canal might seem to permit the use of constructions less carefully carried out than those which may be necessary to the carriage road, and more particularly to a railway; but while derangements may occur in the substructure of a railway without stopping its traffic, the canal must be so constructed as to prevent the possibility of defect, for the water is constantly and insidiously working to make defects, the existence of which may involve the safety of the surrounding country, as well as the interruption of its traffic. Hence canal works must be sound and secure constructions;—there is no tampering with water;—and the same rigorous attention to security should be given to railway constructions, which so often verge upon the dangerous.

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The railway or road embankment is more commonly made of clays and other plastic earths than of stone; and, as usually made, it is a formation rather than a construction. But an earthen embankment ought to be a construction in the sense in which a wall is a construction. It ought to be executed in layers, and not tipped in heaps.

The lateral spread of an earthwork embankment from its crest to its base will depend mainly on the character of the soil. This is to be ascertained by experiments upon the inclination at which it will stand; but as there are soft and yielding places over which earthwork embankments have to be formed, it may be that an embankment will require a wider base because of the yieldingness of the ground under it, than the soil of which the embankment is to be made would require for itself, even as a merely tipped deposit. On the other hand, it will be found in practice that the application of the principle of construction, as above stated, to the formation of earthwork embankments, gives the means of compelling the earth in any case to stand at much steeper slopes than it will without such disposition and working.

The converse of an embankment in a line of road of any kind, is a cutting, the matter cut out being the material of which the constructed embankment is formed. The sides of a cutting must be securely retained, and constructions of some kind may become necessary. They may be necessary from the peculiar character of the soil, or desirable for economy's sake, whether it be on account of the costliness of the site, or of the heavy earth-works involved to give the sides of a cutting such long slopes as the soil in the case may require. Constructions, that is to say, combinations of foreign materials disposed artificially, do become necessary both with or to embankments and in cuttings. Bridges over rivers or other water-courses, in the bottom of a valley so deep that the material from the nearest cuttings will not fill it, or fill it only at a cost greater than the cost of a bridge; or cuttings so deep, or in such a soil, that economy or stability dictate the employment of retaining constructions which shall be wholly independent of the soil in the work or in the slopes;—these involve considerations of the same nature and character as those which arise in the apparently complex design of Cologne Cathedral, or of the Abbey Church of Westminster.

Every piece of construction should be complete in itself, and independent as such of everything beyond it. A door or a gate serves its purpose by an application wholly foreign to itself; but it is a good and effective, or a bad and ineffective piece of construction, independently of the posts to which it may be hung.

Whilst the wheel of a wheel-barrow, comprising fellies, spokes, and axle-tree, is a piece of construction complete in itself, and independent as such of everything beyond it, an arch of masonry, however large it may be, is not necessarily a piece of construction complete in itself,—it would fall to pieces without abutments. Thus, a bridge consisting of a series of arches, however extensive, may be but one piece of construction, no arch being complete in itself without the collateral arches in the series to serve as its abutments, and the whole series being dependent thereby upon the ultimate abutments of the bridge, without which the structure would not stand.[1]

A bridge, of which the bridging way is formed upon arches of masonry, may be thus but one piece of construction; and in like manner, that paragon of constructive skill, the complete church, whether cathedral or otherwise, as built in the pointed style when that style was practised with perfect knowledge of and in full accordance with true constructive principles, is but one piece of construction. Like the long series of arches in a bridge, viaduct, or other such work, in which the piers are vertical supports to the bridging structure, and may be of no greater substance than is necessary to bear the weight coming directly by vertical pressure from the superincumbent structure and its possible load, but throwing all the pressure arising from weight acting laterally, or as thrust, upon terminal abutments;—nothing may be omitted, as nothing can be removed from the structure of the pointed-arch cathedral, or other church built in that style,—the whole system of which is bridge-like in construction,—without leaving something unsupported or unresisted that requires vertical support or lateral resistance. The western towers of a pointed cathedral form effective abutments to the long series of arches of the inner ranges over the piers which stand between the nave and the aisles on either side, whilst turrets or massive buttresses and deep porches upon the northern and southern transept fronts perform the same duty in respect of the arches of the transepts. The counteracting east end of the chancel forms a true constructive abutment to the arches of the chancel, whilst the tower, with, it may be, a spire upon it, at the intersection of the four grand compartments of the cross, gives, by its weight, abuttal to them all. The want of this last-named grand and essential body in the system is but too strongly marked in many of the English cathedrals by the iron bars which have been applied to tie in the arches of the nave, transepts, and chancel, and to relieve the piers upon which the transept arches bear at a higher level, from the thrust to which—being without the weight of a tower upon them—they have continually yielded.

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Transversely the weight and the thrust of the vaulted ceilings of the nave are brought up to, and thrown against, the piers of the clerestory, which stand upon the main piers or columns of the interior below, and are abutted by flying buttresses, which carry the thrust down to the pinnacle-weighted buttresses of the outer aisle walls which have already received the weight and thrust of the vaulted ceilings of the aisles themselves. Corbels in the walls, and spreading capitals upon shafts take the weight directly, and leave the walls and piers but little encumbered in the middle, so that the vertical structure is continued upwards without bearing upon the springing stones of the arches.

But it is not necessary that the arch employed should be the pointed arch to produce combinations as effective in construction as the most perfectly designed and extensively elaborated work of the kind referred to as models of constructive skill; the skill consists in a full and clear perception of the bearing and leaning of every part, and of the means necessary to support and counteract the bearings and the leanings within the reasonable limits of the work with reference to its object and purpose—to the end that the work may become complete in itself, and independent as a piece of construction of everything beyond it.[2]

An application of the principles of construction exhibited in the most perfect works of constructive skill ever executed, as above indicated, may be made in the rougher operations of mere practical utility. It has been intimated that the sides of cuttings through certain earths in the for-

[1] This illustration is not intended to apply to the widely distended masses of the older bridges, by which each pier becomes sufficient to abut the arches springing from it; but which, in providing for a way over a river, chokes up the way by the river itself, or compels the river to throw it down, or otherwise destroy its own banks.

[2] In making reference to the noble works of construction above referred to, and in which the art of the mason is mainly employed, as works exhibiting construction most fully and most truly, the HALL must not be passed over without remark.

Of all the great halls of the class to which Westminster Hall belongs, this hall is itself the most effective as a work of construction; and its effect is wholly produced by the magnificent roof which covers it. This roof is a piece of carpentry admirably designed to resolve it into a compact body to act upon the walls in the direction of gravity alone. But the object was not wholly attained, and of this

Construction.

mation of lines of inland communication, whether carriage-roads, railways, or canals, are sometimes required to be widened out to an inordinate extent because of the looseness or slipperiness of the soil, or otherwise to be retained or held upright by special constructions.

The expense of the first formation of a cutting under given circumstances is easily calculable, and so is the time within which the work may be effected. Experience has proved that there is for every soil a limit in depth beyond which it becomes more expedient to drift the required way, and construct a vaulted tunnel of sufficient dimensions, than to make an open cutting with the requisite slopes. Even when the first cost would not decide the question, the preference is nevertheless often given to the tunnel because of the greater security of constructed work.

A tunnel is expensive, not from the nature and extent of its constructions, but from the circumstances in which those constructions must be executed. The mere constructions are less than would be consumed by common retaining walls to the sides of a cutting not deeper than the height of an ordinary railway tunnel: the several parts of a tunnel derive support from each other, which is not the case with ordinary retaining walls, whose efficiency depends wholly upon the resistance which their own mass or weight and extent of base enable them to offer to the pressure of the body to be retained. If to two opposite retaining walls be given sufficient means of assisting one another, they may be at once reduced to one-third of the bulk they would otherwise require, and would then be as safe as the sides of a constructed tunnel, the strength of which, supposing the work to be properly executed, is only limited by the power of the setting material employed in the work to resist compression.

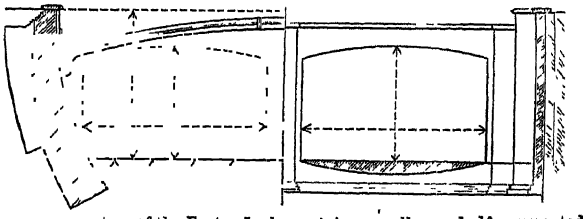
Before proceeding to the consideration of the means of enabling opposite retaining walls to assist each other, it may be worth while to consider, whether retaining walls are generally constructed so as best to adapt their components to the duty to be performed.

No one would place a buttress intended to resist the thrust of an arch, within the springing walls, or under the arch whose thrust is to be resisted; yet in the construction of retaining walls, according to the common practice, the counterfort is placed on that side which receives the pressure, where its utility is very questionable, except to keep the retaining wall from falling back against its load, which, from the transverse section generally given to such walls, they would be apt to do, if not so propped up by their counterforts. Wharf and quay walls, and the revetment walls of military works, may require a face unbroken by projections; but this is not the case with retaining walls for roads and railways, where a long line of projecting buttresses would be unobjectionable, the counterforts becoming but tresses and merely changing places with the vall.

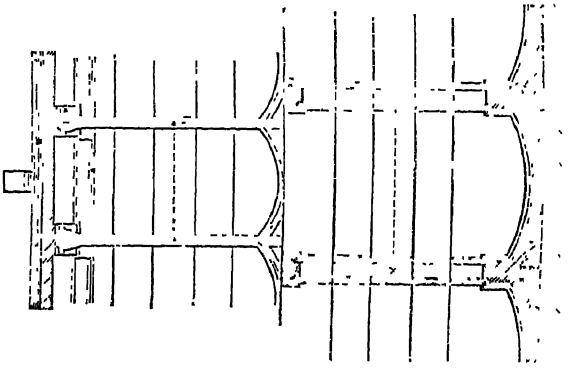
On account of the common practice of battering the faces of retaining walls in curved lines and of radiating the beds of the brickwork composing them from the centre of curvature in every part, the back of the wall must contain more setting material than the face, with the same quantity of solid brick; that is, if the work be bonded through. Counterforts must be built in the same courses, and consequently must have still thicker beds of compressible mortar than the wall; or the bond between the wall and its counterfort must be dropped, and the counterfort thus become utterly inefficient.

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The retaining walls in the cutting upon the line of the extension of the London and North-Western railway, from Camden Town to Euston Square, are, according to the common practice, built wholly of brickwork in radiating courses and with counterforts following their own contour. In this case the centre of gravity of the wall falls wholly behind its base; and the counterforts not commencing until the wall has reached one-third its height, render it still more dependent for support upon the ground it is intended to retain. It is well known that these extensive walls, though furnished with all the collateral works necessary to protect them from exposure to undue influences, and although set nearly one-fourth of their height in the ground, failed to a considerable extent. A system of strutting with cast-iron beams, across from the opposite walls, to make each aid the other, was applied to meet the emergency; but this is limited to the upper parts of the walls.



Transverse section of the Euston Incline retaining walls, one half as executed with cast-iron struts to counterforted and reclining walls, and the other half with the brick-built abutting beam to counter-arched retaining walls strutted at the toes of the springing walls by inverted arches.



Plan of the above showing the part as executed above the iron struts, with the rails passing underneath, and the other part at the level of the rails, with the inverts in plan under them.

Abutting struts from opposite walls, occurring at intervals only, leave the intermediate portions of the walls exposed to pressure from behind without support, unless these intermediate portions are so disposed as to communicate the pressure upon them to the struts. Hence a common retaining wall, abutted at intervals, would require these intervals to be more or less distant, in proportion to the strength of the wall between them. Instead, therefore, of a continuous wall on each side of the cutting, buttress walls should be placed at intervals, opposite to one another, and strutted apart at their toes by an inverted arch, and above, at a height sufficient for whatever traffic the cutting is to accommodate, by a built beam of brickwork, in vertical

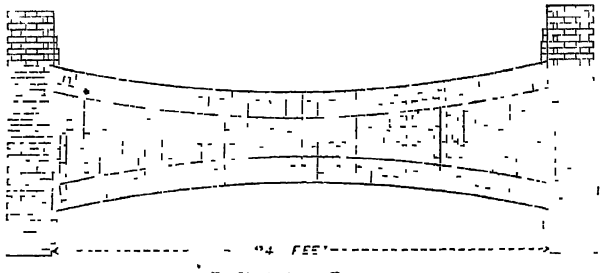
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the constructor was fully conscious; for whilst erecting massive walls on which to place his elaborate combination of timber, he threw up against the lateral walls a series of flying buttresses to check the tendency of the roof to spread under its own weight in the absence of a thorough transverse tie. These buttresses are supposed still to remain (*and it is to be hoped they will still remain*), though they are mostly incorporated in or encased by the recent erections on the flanks of the hall

The open or untied roof, of which that of Westminster Hall is so egregious an example, had its origin probably in the want of timber long enough to serve as tie-beams at the higher level of the collars in these roofs, or to reach across from wall to wall where it was sought to dispense with inner ranges of supports as columns and piers. But the great old roofs of this kind are placed upon stout walls well and safely abutted, whilst the puny modern imitations of such roofs are made temporarily safe—*and only temporarily so*—by the aid of straps and screws.

Construction.

courses, supported on an arch, and prevented from rising under the pressure by an invert upon it. This built beam will then be, as it were, a piece of walling turned down on its vertical transverse section, and will resist any pressure brought upon it through the buttress walls, to the full extent of the power of such a wall built vertically, to bear weight laid upon its summit;—the pressure would be applied in the line of the greatest power of resistance, and there would be no tendency to yield, except to a crushing force. Let such transverse buttress walls, so strutted apart, with the road between them, be the springing walls of longitudinal counter-arched retaining walls, which, being built vertically and in horizontal courses, but arched in plan, against the ground to be retained, will carry all the force exerted against them to their springing walls, and the springing walls or buttresses will communicate, through the struts, the power of resistance of each side to the other, and thus insure the security of both.



Built abutting Beams

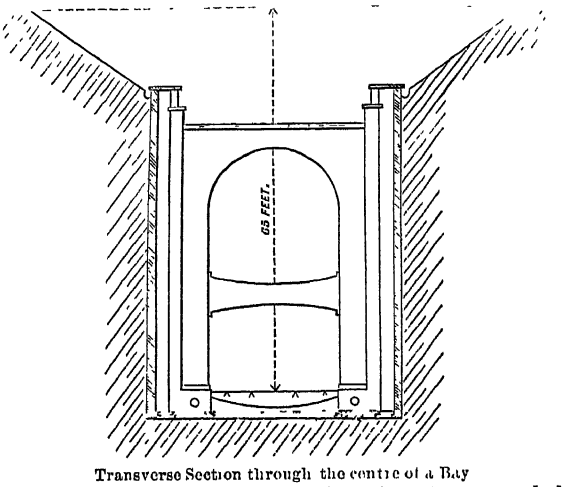
This arrangement may be carried to any extent in height, by repeating the abutting beam or strut at such intervals as the thrust to be resisted and the strength of the buttress springing-walls may require.

To constructions thus arranged, any requisite power may be given, by altering the quantity of materials in each part; the length of the buttresses transversely of the cutting,—the number of struts to each pair of buttresses,—or the length of the compartments. The thickness of the buttresses should be in proportion to their height and length, and their length should be in proportion to the flatness and weight of the struts with their arches, and to the space in height between any two of them, as well as to the magnitude of the thrust brought to them by the counter-arched retaining walls. The inverted arch below and the built beam above must, of course, have sufficient substance to enable them to resist, without yielding in any direction, the pressure brought to them through the buttresses; and the retaining walls themselves must have substance given to them according to their height,—to the pressure they are liable to receive from behind,—to the length of the compartments—and the extent of their flexure;—subject, of course, as to all these, to the nature of the materials, workmanship, and mode of structure.

The positive strength which such constructions should possess depends much, of course, upon the nature of the soil, and its susceptibility of being affected by external influences; but it depends, even in a greater degree, upon the manner in which the constructions can be applied to the ground they are intended to retain. A very slight power will retain at rest a body which the exertion of great force could not stop if once in motion; and a half-brick counter-arch, set in close contact with undisturbed ground, would hold safely up what three times the substance would not stop if there were space and opportunity for motion between the ground and the brickwork. It is impossible, therefore, to state precisely what is the least strength which the retaining constructions must have; but there can be no question that too much strength is better than too little, and it is generally cheaper to pay in materials than in labour to save materials.

Construction.

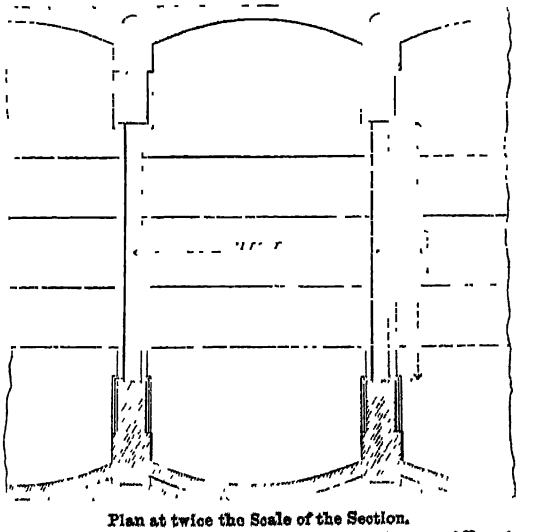
These diagrams represent a cutting 65 feet deep to the level of the rails. It is assumed, that the ground at the top



Transverse Section through the centre of a Bay

may stand for the first 15 feet at less than 2 to 1, and that it may, therefore, be cheaper to run out to that depth with slopes, leaving 50 feet from the rails, or about 52 feet in all, to be retained. As the bricklayer may follow up the excavator with bay after bay, his work lying mostly on the side and out of the way of the excavator, the latter would run out the spoil without interruption, his work being benched onwards and shored as he proceeded. As every compartment, with its buttresses, invert, abutting beams and counter-arches is complete in itself, the ground being backed against the counter-arches as the work rises, the shoring would come out, and be sent on for use on the forward benches.

The invert may be turned upon footings in half-brick rings, to get the largest quantity of solid resisting matter in the curved line. At a height from the surface of the rails sufficient for headway—assumed at 14 feet 6 inches—a 14-inch bonded arch is turned from buttress to buttress, springing from skewbacks on corbelled courses. Upon the back of this arch the abutting beam is built of brick on end and edge, bonded as a wall, with beds vertical and widening over the haunches of the discharging arch and under the similar inverted arch turned upon it; so that although the beam be in the centre but 21 inches deep, it presents an abutment at each end of three times that depth. The ob-



Plan at twice the Scale of the Section.

ject of the invert over the abutting beam is to stiffen it and to bring down and distribute the weight and pressure from the buttresses more effectually.

Construction.

The built beam, and its sustaining and stiffening arches, should be composed of particularly well-formed bricks of really good quality, set in Roman cement or other quick-setting mortar, that there may be no yielding to the pressure which must be immediately thrown upon this part of the construction.

Another built beam, of greater depth, because of the absence of any inverted arch to stiffen it, is thrown across over the back of a semi-circular arch, with its abutting ends extended in like manner.

To relieve the work from water, a drain being run along over the middle of the inverts, or side-drains being passed by ring culverts through the buttresses, drain-shafts are carried up at the backs of the buttresses against the springings of the counter-arches, to within a few feet of the surface. These shafts being steened with open joints at intervals to admit drainage water and communicating with the drains below, prevent the possibility of water lodging about the backs of the counter-arches, or even in the ground itself. The drain shafts should be semi-domed with bricks set dry and covered in, and the walls also backed up with good clean gravel, through which the surface water might percolate and pass freely down to the shafts.

The constructions are assumed to be of brickwork, for the obvious reason that the cases supposed being clay cuttings, brick is the material which would be most economical. But if masonry be cheaper, it may of course be used with the same effect. Where a cutting intersects loose beds of laminated stone, and particularly strata inclined to the horizon, so as to be unsafe with the ordinary slopes, such constructions are available; and in cases where the sides of the cutting will stand vertically or nearly so, as in chalk, it may be useful to apply similar constructions, though of slight character, to check the separation and fall of masses from the precipitous sides.

It is obvious, too, that these constructions present the means of security, when the stratum forming the base of any cutting is too weak to bear the weight of slopes, or of retained sides, without rising between them. Sheet-piling may be driven to any depth along the backs of the counter-arched walls so as to be retained at the head by the walls; and thus in effect the walls would be carried down to a safe depth, even through the weak stratum; whereas such piling at the toes of slopes is commonly found to be almost if not wholly useless, for the want of a stay to the head.

Embankments formed in the manner already described—that is, by a process of construction—may be, as previously stated, raised higher and with a relatively narrower base than if formed in the usual inartificial way; but there is a limit which may not be passed in heaping up compressible or otherwise yielding materials, how skilfully soever they may be disposed, and this will indicate the limit at which constructions proper may be introduced with economy, as in the converse case of retaining constructions to avoid insecure or expensively long slopes in cuttings.

The height to which the particular soil may be raised upon itself with safety and economy being determined, the greater height required is to be obtained, not by an endeavour to encase the bank by constructions extending laterally as retaining walls, but by bridge-like culverts built under the bank, or of so much of the bank as may be safely built of earth.

Construction.

Such bridge-like culverts may be composed with great advantage, both in respect of economy and of strength, in the manner suggested by the present writer for the upper works of Westminster Bridge, in the practical treatise on Bridge Building, forming part of the Theory, Practice, and Architecture of Bridges, published by Mr Weale in 1842. This involves a system of groining whereby that important element in construction—rigidity—is obtained, whilst the composition is but a variety of that which is embodied in the structure of the nave and aisles of the model of construction before referred to. Such substructed works may be rough but must be sound as work, and being covered with fifteen or twenty feet in depth of earth, they would not feel the vibrations which act so mischievously upon the lofty and costly viaducts in which railway-makers have exhibited their skill and taste to the cows and the crows, and which react both upon the upper works of the railway and upon the rapidly passing train in the shock felt throughout when the moving load passes the line between earthwork and masonry.

CONSTRUCTION AS APPLIED TO CIVIC STRUCTURES GENERALLY.

The ignitibility of timber, and the rapidity with which it burns when placed in circumstances so favourable to that effect as by its disposition in an erected building, have led to its prohibition for the purposes of the main inclosures of houses, and buildings generally, in London, and in some of our larger provincial towns. It is possible, however, so to protect timber employed in the inclosures and for the internal partitions and floors of buildings as to render mere dwelling-houses practically fire-proof. Whilst, however, the liability of timber to take fire and to burn may in a great measure be counteracted, and notwithstanding that this material combines the advantage of economy with security, stone and brick are undoubtedly better adapted for the main structure of a building. Brick or stone, or brick and stone together, with mortar as a setting material, ought to be employed, but in such manner only as to be free from dependence upon other and less trustworthy materials. The most perfect erections as buildings are those in the composition of which this principle has been understood and fairly practised. If adventitious aid be given to brick or stone walls by foreign materials, the materials ought to be at the least harmless. Iron in bulk is not a proper substance to incorporate with walls, because of its great expansibility by heat; but iron used in thin laminæ, as hoop-iron laid in walls in the bed-joints of the brick or stone, cannot be productive of any bad consequences whilst it is most beneficial in that form as a tie to the structure.

Bricks come ready shaped to the hands of the workman in a form the best adapted for the arrangement in the construction of a wall which, under the designation of bond, gives it such a degree of consistency that a weight placed upon the top is carried by the wall in every part throughout its whole thickness, and throughout a greater or less proportion of the length according to the height of the wall.[1]

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[1] Bond in brickwork is most conveniently and most effectively formed and maintained by disposing the bricks in their courses either endwise and lengthwise (technically, header and stretcher), alternately brick and brick, or course and course; that is to say, that the bricks in every course should be laid alternate header and stretcher, or that the courses should consist of all headers and all stretchers alternately. The former arrangement—alternate header and stretcher in the same and in every course—is known in this country as Flemish bond; and the latter—alternate courses of header and stretcher—is distinguished by the term English bond. Neat work in face can be produced more easily with Flemish bond, but English bond has the reputation of being the best bond structurally. But why these two arrangements should be distinguished by the names they bear is unknown; at least it is unknown to the present writer, who supposed, in common with most other people with whom he had conversed upon the subject, that alternate header and stretcher in the same course was the practice in Flanders, and generally in the neighbouring countries on the Continent, whilst the term English bond seemed to imply that the arrangement which bears that designation is peculiar to England. A visit made a few years ago to the countries where Flemish bond ought most to abound, if the name be properly applied, enabled the writer to observe what had

Construction.

Stone, on the other hand, comes to the workman without regular form; and with skill on his part to dispose and arrange the materials, good erections may be produced of rubble; for although the thickness of which walls may be built of rubble with safety will depend in a great degree upon the quality of the mortar, much depends also on the skill of the workman in bedding and bonding the stones. Under any circumstances, however, a wall so composed cannot, safely, be charged with heavy weights, nor be exposed to the vibrating action of floors, until the mortar shall have indurated to some extent; whereas a wall of brickwork is secure by the horizontal bedding of the bricks, and by the effect of the transverse bond which the alternation of header and stretcher almost necessarily produces. Stone, again, may be dressed to any shape, and so as to mould it to every variety of construction with the smallest possible quantity of mortar or cement. From blocks with rough hammer-dressed parallel beds, up to the most complete and perfectly wrought parallelopipeds adapted to any arrangement of bond that may be best adapted to the structure, and with combinations of rudely formed and perfectly formed pieces of stone, walls may be built of stone of greater strength than the best bricks can be made to yield, whilst stone walls are liable to be inferior in every respect to brick-built walls of ordinary quality.

Some combinations of the two kinds of materials have the effect, however, of making a better wall than could be produced by the main constituent in the form employed alone. A stone-rubble or pebble-built wall is greatly improved by one or two bonding courses of brickwork at short intervals; and a brick wall is improved and adapted for a higher purpose by thorough courses, at intervals, of good stone, wrought to bed and joint truly; whilst on the other hand, a wall substantially of stone-rubble or pebble, and faced with brickwork, is essentially an unsound wall; as in like manner a brick wall faced with wrought stone is liable to be weaker than the brickwork would have been without the stone.

With regard to the thicknesses of the walls of buildings, it is generally considered that these should be governed by the height of the structure; but they ought not to be determined by that condition alone. Chimney-breasts, or other buttress-like projections, built up with a wall, and extending to more than the thickness of the wall, make it in fact stronger in its transverse section, and justify less general thickness in the body of the wall, whilst window and other openings in a wall leave piers which ought to be of greater thickness than the mere height would require. But all returns, indeed, whether as chimney-breasts or as cross walls, built and bonded with a wall, tend to render unnecessary the full thickness which the height might require; whilst, as just intimated, the omission of portions of a wall for door and window openings should be compensated for by additional substance to the parts which remain.

Walls subjected to undue action, such as that arising from slight joists tailed into them, or that occasioned by inclined timbers, as under galleries in churches, chapels, and theatres, require to be of greater thickness than they otherwise would; whilst it is quite wonderful to what great heights brick walls may be built with safety, if they are well built, and exposed to no other action than direct vertical weight. When, indeed, such walls stand upon a sufficient foundation, direct vertical weight without motion is a means of security to the walls so long as the weight is reasonably within the power of resistance of the materials to crushing pressure. The object to be looked at, therefore—the walls being honestly built—is, as hereinbefore remarked, to make the weight to be imposed upon any wall act upon its solids vertically and steadily.

Construction.

Floors upon girders, or framed to strong trimmers—the girders or the trimmer-joists running into and bearing upon the piers or solids of the walls—are far preferable to what are termed single floors, of which each joist runs into the wall. Girders, as the basis of floors, render plates in the walls wholly unnecessary, by depositing the weight in the right places, without requiring plates to carry it on from the weaker to the stronger places; and being of necessity stout and rigid, they form a fair tie and strut to the walls into which their bearing ends are tailed.

Whether girders or trimmer joists be employed for placing the weight of floors upon the walls of a building in the safest manner, the bearing timbers ought to be placed upon pieces of stone as templates built into the walls, and be made to take a cog-hold of the templates, so as to enable them to tie and stay the walls by means of the cogs.[2]

It is by means of the girder bearing upon the solids of the walls, though with bad carpentry, that the French are able to carry up their soft stone rubble walls to heights that would certainly be unsafe if the walls were seamed with wooden plates, and shaken by floors of single joists;[3] and it is by means of the solidity given to the floors by the girders, and the solid bearings which the girders obtain, that the floors are able to carry the dead weight of matter which renders them practically fireproof, as hereinafter described, in addition to the moving weights to which the floors of buildings are necessarily exposed in use.

We can and do frame floors most effectively by carpentry alone; whereas the French do the work so badly, that no important bearing is, or indeed may be, trusted by them to the framed joint—dog-nailed stirrup straps of iron being always brought in aid. But the common practice with us is to use single or unframed floors, which carry the weight and the vibration to which floors are exposed into the walls, over voids as well as over solids; while the French frame their floors to or upon girders, by means of which the floors are brought to bear upon the solids of the walls. The walls are thus not only less exposed to vibratory action, but are both tied together and strutted apart with better effect by the stout girders stiffened by joists, than by joists which themselves require some foreign aid to stiffen them. Moreover, single floors of joists, unless trimmed at frequent

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never, to his knowledge, been remarked by any person who had published his remarks, and what was quite unknown to every one to whom he has stated, since his return, what he had observed. At Rotterdam and at the Hague, at Antwerp, at Brussels, and at Liège, at Cologne, at Mayence, and at Frankfort, and again throughout the north-eastern parts of France, brick walls are built according to the arrangement distinguished in England as English bond; and Flemish bond is unknown, at least no single example of it fell under the writer's observation in any of the towns and countries indicated, although his attention was called to the subject by the quay walls at Rotterdam before he set foot on shore.

[2] A cog-hold is best obtained through the agency of a chair of cast iron, which should, however, be itself cogged or joggled to a stone template laid in the wall under it, and be capped or covered by another broad flat stone, as an inverted template, with a joggle from the chair running up into it.

[3] The author, being at Paris in 1846, measured the thickness in the ground-floor story of a newly-built coursed-rubble party-wall, in the Rue de la Banque (the Gresham Street of Paris), and found it to be exactly 18 English inches in that part, whilst the total height of the wall was not less than 85 feet. The wall ran up of that same thickness through six stories, a height of not less than 65 feet, and was terminated by a gable of from 12 to 15 feet high, of the same kind of structure; and there was besides a vaulted basement story, throughout which the wall might have been 20 inches thick, as other similar walls then in progress to neighbouring buildings proved to be.

Construction.

intervals, when, indeed, they may be termed half-framed, are supposed to require plates of timber laid along the inside faces of outer walls and upon internal walls. This defect is avoided by our neighbours, who exclude all timber, except the bearing ends of girders, from their walls, and use framed floors.

When the walls of a building have reached their full height, the wall-plate comes into use legitimately—to cope the walls, in fact, and to form a curb as a base upon which to place the roof, which should deposit its weight, nevertheless, by means of its tie-beams upon the plates over the solids of the wall below, and which should, moreover, oversail, so as to cover and effectually shelter from the weather, the inclosing walls also.

In setting forth the structural advantages derivable from the use of girders as the bases of floors, it may be necessary to repeat the warning already intimated against the use of girders of a material of uncertain strength, and of treacherous character when exposed to transverse strain.

Cast iron is of uncertain strength, mainly because of the imperfections which the most skilful founders, with the best materials and every appliance at command, cannot always avoid, and which are most liable to occur in the production of complex forms in long lengths; whilst careless founding and rapid cooling are contingencies connected with the production of cast-iron girders—which are necessarily long and complex castings. Cast iron is treacherous, inasmuch as it is brittle and liable to be startled into fracture by impact trifling when compared with what it may have borne safely as a dead-weight.

Proving long metal castings by straining them upon their transverse section does but aggravate imperfections, and leave the casting weaker; whilst no dead-weight proof is proof as against blows or other action inducing vibration. It is only under circumstances which do not admit of concussive action upon the beam, or which prevent it from vibrating under any shock that may reach it, that cast iron can be safely used in beams of long lengths to carry heavy weights, without some appliance to mitigate, at least, the imperfections which this substance exhibits.

The application of wrought-iron tension bars as soles to beams and girders of cast iron, would prevent the most serious consequences from attending the failure of the casting, if the beam were also prevented by binders, or by other sufficient means from turning round when the blow produces an oblique fracture.

The foundation of a building of ordinary weight is, for the most part, sufficiently provided for by applying what are technically termed footings to the walls. The reason for a footing is, that the wall obtains thereby a bearing upon a breadth of ground so much greater than its own width or thickness above the footing, as to compensate for the difference between the power of resisting pressure of the wall and of the ground or ultimate foundation upon which the wall is to rest. It will be clear from this, that if a building is to be erected upon rock as hard as the main constituent of the walls, no expanded footings will be necessary; if upon chalk—upon strong or upon weak gravel—upon sand—or upon clay—the footing must be expanded with reference to the power of resistance of the stratum to be used as a foundation; whilst in or upon made-ground, or other loose and badly combined or imperfectly resisting soil, a solid platform bearing evenly over the ground, and wide enough not to sink into it, becomes necessary under the constructed footing. For this purpose the easiest, the most familiar, and, for most purposes, the most effectual and durable, is a layer of concrete, which may be formed so as to cover a surface large enough to obtain from the most yielding soil the amount of resistance to pressure required to support the weight of the intended building. It will be evident that upon a concrete foundation a footing or expanded base may or may not be required to a wall, according to the hardness of the concrete and the kind of wall to be built; but it is perhaps better to give the footing to the wall than to wait for the sufficient induration of the concrete to enable the wall to do without a footing; and better still, to lay the concrete of such height only with reference to the spread or extent of base beyond the toes of the footing, that the gravel of which the concrete is made would stand at in an uncombined condition.[1]

Construction.

Inasmuch, however, as some soils are liable to change in form, expanding and contracting under meteoric influences, as clays which swell when wetted and shrink when dried, concrete foundations are commonly interposed upon such soils to protect the building from derangement from this cause; or rather, to that effect walls are brought up from a level sufficiently below the ordinary surface of the ground of the cheaper material, concrete, instead of the more expensive brick or stone structure.

When concrete is used to obviate the yieldingness of the soil to pressure, expanse or extent of base is required to answer the end; and to this end the concrete, being widely spread, should be deep or thick as a layer, only with reference to its own power of transmitting to the ground the weight of the wall to be built upon it, without breaking across or being crushed. But when concrete is used as a substitute for a wall, in carrying a wall down to a low level, it is in fact a wall, wide only in proportion to its comparative weakness in the absence of manipulated bond in its construction, and encased by the soil within which it is placed.

Concrete, indeed, is at all times more safely to be regarded as a substance to be placed as a layer, than as a substance to be set up as a wall; for although excellent erections as walls may be made of concrete—as erections in the same form may be made of tempered clay—neither concrete nor tempered clay is to be regarded as a proper substance with which to form the lofty walls of buildings in towns.

SECURITY OF BUILDINGS AGAINST FIRE.

It is seldom that houses take fire from common accidents such as occur to the lighter moveable furniture and to drapery; but, for the most part, from the exposure of timber in or about the structure to the continued action of fire, or of heat capable sooner or later of inducing the combustion of timber; and as the source is most commonly in some stove, furnace, flue, pipe, or tube, for generating or for conveying heat, or for removing the products of combustion, much of the real danger to buildings from fire would be prevented by avoiding that degree of proximity between timber and all such things as can lead to its combustion.

With a view to lessen the danger to which buildings with timber in their structure are exposed from fire, it will be well to consider how far the timber, and wooden fittings commonly used, may be necessary either to the stability of the buildings, or to comfort and convenience.

So long as danger of fire is brought to buildings through pipes and tubes, the necessity must be admitted of guarding the combustible materials used in buildings from any chance of becoming ignited. When heat is produced and passed

[1] This is indeed the only safe practice in cases in which the full induration of concrete cannot be obtained before the wall or other structure to be raised upon it is begun to be built. Gravel poured dry upon the ground will resolve itself into a cone, having an angle of inclination to the horizon more or less acute according to the sharpness, or otherwise, of the sand and stones of which it is composed.

Construction.

through pipes in any manufactory, whether it be to act as power, or for drying or for warming, the fires used may be guarded, and the machinery which regulates the intensity of the heat to be transmitted may be under constant care; but even in such cases there can be no certain assurance that the heat shall not at some time arrive at the point of danger as it regards the ignition of combustible substances. But when heat is diffused throughout dwelling-houses by means of apparatus which is committed to persons unskilled in its use, and unconscious or careless of the danger which may arise from neglect, it seems impossible to lay down inflexible rules for distances from timber which shall render it safe from heated pipes. Twelve or fifteen inches may not be a greater distance than safety requires under some circumstances, whilst there are many cases in which the actual contact of such pipes with timber is hardly inconsistent with safety. When the air about the heated bodies is not confined, as it is between the joists and the floor and ceilings of an ordinary floor, a distance between timber and the heated surface equal to the longest diameter of any tube or pipe, will be found a safe distance if the temperature of the pipe does not exceed that of boiling water.

It is to be understood, at the same time, that a piece of wood will bear a powerful dead heat upon its sides for an indefinite period without igniting, unless a transverse section of the fibre, as at or around a live knot, or where a branch had been lopped, present itself to the action. It is by the end that a piece of wood exposed to powerful heat most readily ignites. The gases evolved in the substance of the timber by the action of heat applied to its surface expanding as they are evolved, are thrown out by the pores among the fibres at their ends, if the ends are near enough to the action to allow of this effect, with less power than may be enough to obtain vent for the inflammable gases laterally

The legislature in this country, when it has legislated upon such matters, has generally confined itself to making provision that the inclosing walls of buildings should be formed of incombustible materials. In providing of what least thicknesses such walls might be, these were generally determined with reference to the height of the building, and to the area to be inclosed, as an indication of the probable lengths of the walls; and this both for the purpose of promoting safety of structure, and of checking the spread of fire from building to building. As, however, in most cases greater thickness is required in the side wall of an ordinary dwelling-house in a town to render its structure secure, than is necessary to enable it to check the spreading of fire, such walls are frequently made of greater thickness than would be necessary to fulfil the objects which the legislature has had in view, if the walls were not supposed to extend the whole length of the two longer sides of a parallelogram without intermediate cross or return walls. A solid well-built brick wall, one brick or nine inches thick, between two ordinary dwelling-houses of five or six squares in area each, will prevent the communication of fire through it from one to the other.

But, in towns, ordinary dwelling-houses which occupy each an area of five or six squares are generally disposed in plan as parallelograms, having their opposite sides 18 or 20 feet, and 28 or 30 feet respectively in length, and are seldom carried up to less height than 35 or 40 feet; and walls of such lengths and heights could hardly be deemed safe if not more than one brick thick. Consequently, a greater thickness has been prescribed, as the least thickness of the walls of buildings of the sizes indicated. In the older Metropolitan Building Acts much greater thicknesses were prescribed for the walls likely to be the longer walls; whilst the only necessity for more than one brick arises from structural requisites, and not from any insufficiency of a wall of solid brickwork, one brick thick, as a means of preventing the spread of fire. But the requisites of the structure would be as well fulfilled by one-brick walls upon the long sides as by 1½-brick walls, if the ordinary internal cross partition for dividing a house into front and back rooms were built of brickwork, abutting upon, and at right angles to, the longer walls, and carried up coursed and bonded with them. That is to say, party-walls of one brick or nine inches in thickness, connected at their ends by 1½-brick or 13-inch front and back walls, and at or about the middle of their length by other 9-inch cross walls, would be at the least as strong as 1½-brick party-walls, though connected in the same manner at the two ends, but without the abutting and connecting cross-wall of brickwork. Instead, however, of such internal cross walls, hollow partitions of timber are commonly used in all stories above the basement story; and it is by these partitions, and by the light and highly inflammable wooden stairs, that fire extends itself rapidly throughout ordinary dwelling-houses; whilst the substitution of a brick wall for the cross timber partition would in most cases justify the abatement of a half brick of the thickness otherwise necessary to party-walls, and give an indestructible internal support to the floors, whereby also one of the means by which fire travels rapidly through a house would be removed. It is true that there must be openings as doorways, and fittings in them for doors, in such internal partition wall; but the wall could not carry fire up from floor to floor through its own heart, as the hollow wood-lathed quartering partition carries it. Doors and shutters, and door and window linings, in and against brick or stone walls, may take fire and burn in any story of an ordinarily built dwelling-house, without carrying it beyond the story in which the fire occurs; for a plastered ceiling of the most common description will resist the action of flame upon its surface for a long time, and plastering of really good quality, though upon wood laths, will keep fire off from the joists by which it is held up, almost without danger, so long as the fire acts upon the face only of the plastering. If, however, fire reach the joists through the agency of hollow quartering partitions, the enemy has turned the flank of the plastering, and the floors and skirtings above and behind it taking fire, the building almost inevitably falls a prey to the flames. Any step, indeed, from the hollow quartering partition towards a solid wall, is a step towards security. A brick wall is, perhaps, the best internal partition for all the purposes of strength and security from fire; and in small houses, which will not afford the expense of 9-inch walls, half-brick walls with 9-inch jambs at the doors, and short 9-inch piers on alternate sides of the partition, at intervals of three or four feet in length, will give sufficient strength; but even quartering partitions, if based upon brick walls, may be rendered nearly proof against fire by brick-nogging them, especially if care be taken to fill in with brickwork between the joists over the head of one partition and under the sill of another, as well as between the timbers of the partitions. Filling in between the joists, and up as high as the skirtings go, will do something, indeed, towards diminishing the dangerous tendency of even lathed and plastered timber partitions; whilst the adoption of the plan now commonly practised in Paris, in forming not only internal partitions, but the rearward external inclosures of buildings, would secure to the structure the structural efficiency of timber on end in carrying weight, and give the solid and incombustible character of a brick or stone wall to a partition or inclosure which is structurally of timber.

The plan referred to is, to frame and brace with timber quarterings much in the manner practised in England, except that the timber used in Paris is commonly oak, and is generally seasoned previously. The framed structure being complete, strong oak batten-laths, from two to three inches

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wide, are nailed up to the quarterings horizontally, at four, six, or even eight inches apart, according to the character of the work, throughout the whole height of the inclosure or partition; and the spaces between the quarterings, and behind the laths, are loosely built up with rough stone rubble, which the laths prevent from falling out until the next process has been effected. This is, to apply a strong mortar, which in Paris is mainly composed of plaster of Paris, which is there of excellent quality, laid on from both sides at the same time, and pressed through from the opposite sides so that the mortar meets and incorporates, embedding the stone rubble by filling up every interstice, and with so much body on the surfaces as to cover up and embed also the timber and the laths—in such manner, indeed, as to render the concretion of stone and plaster, when thoroughly set, an independent body, and giving strength to, rather than receiving support from, the timber.

Our brick-nogged partition is, in point of structure, nothing but through the aid of the timber; the plastering is merely spread out upon the surfaces of brick and wood, and is fragile in the extreme, and always liable to crack and drop off; whilst, on the other hand, according to the French practice, the mortar, meeting through the interstices of the rubble, becomes one consistent mass throughout the whole thickness of the partition. Our lathed and plastered partition is composed of the hollow framework of the timber quarters, with two slight thicknesses of mortar, as plastering, hung upon slighter laths, over and between which the flaccid mortar forms a key for itself; but all necessarily depends upon the timber, and fails with it wherever decay or fire may destroy it.

Only second in importance to the internal partition as a source of danger or as a means of safety, are the stairs; and the stairs are second in importance only when the partitions are made to carry the floors of the several stories. In England, and in London particularly, even when the steps and intermediate landings are of stone, it is but too common to find the passage from the street door to the foot of the stairs, and the floors which connect flight with flight at the several landings, either wholly of wood or of slight stone paving laid upon wooden joists or bearers. Any stone paving upon wooden joists will certainly retard the action of fire upon the joists, especially if assisted by a well-plastered ceiling; but in this, again, if the floors be not formed of wholly incombustible materials, the French practice as to floors would be better than ours.

In Paris stone stairs are far less common in modern houses than they are in London in houses of corresponding character and date; but wooden staircases in Paris are rendered almost as safe as common stone staircases are made with us, by a process similar in character to that applied to partitions and inclosures. The result is an almost incombustible structure. Wooden staircases formed between brick or stone walls, or between partitions of the kind above described, as commonly made in modern buildings in Paris, filled with a solid mass of concreted rubble, may perhaps be set on fire, but they can hardly burn.

It has been remarked that a mere plastered ceiling will resist the action of fire for a long time, although the plastering be upon wooden laths, and the laths nailed to joists of timber; and as fire does not readily act downwards, flooring boards may take fire from above without any immediately serious consequence to the joists under them, so long as there is no access of air from below. But our indoor plastering upon laths is commonly of the most fragile kind, and the slightest weight falling upon the back of a ceiling will make a breach through it, whilst our floors are commonly of deal laid upon fir joists, and are exposed to the action of fire from below directly the lathed and plastered ceiling has failed; if, indeed, the fire have not found its way to the joists under the flooring boards by the hollow lathed and plastered quartering partitions. In the timber inclosures and partitions, which economy induces the Paris builder to introduce as substitutes for walls, the timber is so embedded in and made part of a solid concrete, as to be protected from almost every casualty of which it is susceptible.

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But the French render their floors also so nearly fire-proof as to leave but little to desire in that respect, and in a manner attainable with single joists, as well, at the least, as with joists framed into girders. According to their practice, the ceiling *must* be formed before the upper surface or floor is laid, as the ceiling is formed from above instead of from below. The carpenters' work being complete, strong batten-laths are nailed up to the under sides of the joists, as laths are with us; but they are much thicker and wider than our laths, and are placed so far apart that not more, perhaps, than one-half of the space is occupied by the laths. The laths being affixed—and they must be soundly nailed, as they have a heavy weight to carry—a platform, made of rough boards, is strutted up from below parallel to the plane formed by the laths, and at about an inch below them. Mortar is then laid in from above over the platform, and between and over the laths, to a thickness of from two inches and a-half to three inches, and is forced in under the laths, and under the joists and girders. The mortar being gauged, as our plasterers term it, or rather, in great part composed of plaster of Paris, it soon sets sufficiently to allow the platform to be removed onwards to another compartment, until the whole ceiling is formed. The plaster ceiling thus produced is, in fact, a strong slab or table, in the body of which the batten-laths which hold it up are incorporated, and in the back of which the joists, from which the mass is suspended, are embedded. The finishing coat of plastering is then laid on. Such a ceiling will resist any fire that can act upon it from below, under ordinary circumstances; and it would be difficult for fire to take such a hold from above as to destroy the joists to which a ceiling so composed is attached, the laths and the under side of the joists being alike out of its reach; and consequently such a ceiling alone would diminish the danger from fire, although the floor above the joists were laid with deal boards. But a boarded floor in Paris is a luxury not to be found in the dwellings of the labouring classes, nor, indeed, are boarded floors to be found in any dwelling-houses but those of the more costly description. Whether the eventual surface is to be a boarded floor or not, however, the flooring joists are covered by a table of plaster above, as completely as they are covered by a plaster ceiling below. Rough battens, generally split and in short lengths, stout enough to bear the weight of a man without bending, are laid with ends abutting upon every joist, and as close together as they will lie without having been shot or planed on their edges. Upon this rough loose floor mortar of nearly similar consistence to that used for ceilings is spread to a thickness of about three inches; and as it is made to fill in the voids at the ends and sides of the floor-laths upon the joists, the laths become bedded upon the joists, whilst they are to some extent also incorporated with the plaster. The result is a firm floor, upon which, in ordinary buildings, paving-tiles are laid, bedded in a tenacious cement.

It must be clear that the timbers of a floor so encased could hardly be made to burn even if fire were let in between the floor and ceiling. But it has been already stated that the practice of making these almost fire-proof floors is connected with the use of walls which have no timber laid in them bedwise, and that the timber inclosures employed instead of walls, and the internal partitions, are rendered practically fire-proof, whilst the wooden staircase

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which economy dictates to the Parisian builders—the freestone which is used in building walls being altogether too soft for the purpose—is also rendered, in the manner already shown, almost unassailable by fire.[1]

It may be added in explanation of the statement that in Paris the practice of forming a table of plaster over the joists when tiles are to be used as the flooring surface, is employed also when a boarded floor is to supervene—that as the surfaces of the true joists lie under the mortar, a base is formed for the boards of what English carpenters would call stout fillets of wood, about 2½ inches square, ranged as joists, and strutted apart to keep them in their places, over the mortar table, to which they are sometimes scribed down, and that to these fillets, or false joists, the flooring boards are secured by nails; so that in truth the boarded floor is not at all connected with the structure of the floor, but is formed upon its upper coat of plaster. The wooden floor thus becomes a mere fitting in an apartment, and not extending beyond the room the floor might burn without communicating fire to the stairs, even if the stairs were readily ignitible.[2]

The necessity which arises with us of dividing the upper stories of houses into more rooms, as bed-rooms, than are commonly required in the lower stories, will be made an objection to any process that would render the partitions heavier; but it is not in the upper stories that the lathed and plastered partition is most dangerous in respect of fire. Generally the stairs may be inclosed by solid partitions throughout almost the whole height of an ordinary dwelling-houses without occasioning any inconvenience as regards the greater weight of such a partition; and generally, too, the partition which divides the front from the back rooms of such houses may be carried up throughout the whole height of a house without removing the bearing, if the house be judiciously disposed. But even if a partition rest upon a beam or girder, a very slight addition to the scantling of the timber will make up for the additional weight which the filling in of the partition would involve, if the materials of the core be well chosen; and it is well known that a piece of timber placed over a void as a brest-summer, and carrying a wall, resists the action of fire for a long time, and the longer if it be of oak or other hard wood. It is not necessary, however, that the timber employed in partitions and inclosures should be of oak; though it is desirable that main bearing timbers, in situations which render them most liable to be exposed to the action of fire, in the event of casualty, should be of such-like timber rather than of fir: but the quarterings, or partition timbers, which the plaster concrete wholly encases, may be of fir as safely almost as of oak.

The core used in Paris consists for the most part of chips and spalls arising in the process of dressing the soft freestone which is the main constituent of the walls of most buildings in that city. Almost any hard material, however, will furnish rubble fit for the purpose, which must be angular and irregular in form, so as to allow the mortar to pass freely through the rubble, and embed it all. Rubble of brick material, as broken burrs, or even of old bricks freshly broken, will answer very well; but if brickbats or shreds of plain tiles be used, care must be taken in packing not to bring flat beds together, or the mortar will not pass through and make a perfect concrete. Rubble of almost any kind may be used; but the kinds of stone which are themselves concretions, and present rough surfaces upon the fracture, afford the best, while schistose, or scaling slaty stones, are the worst for the purpose. But there is no better substance for coring partitions upon the plan described than clay burnt into a kind of brick rubble,—an excellent ingredient, indeed, in concrete for any purpose.

Construc. tion.

The same process applied to external inclosures will justify the use of timber in their structure in situations and under circumstances in which it may be properly prohibited when the timber is merely lathed and plastered, or even brick-nogged, for brick-nogging adds nothing, as already remarked, to the strength of a partition or an inclosure, but rather takes from it, being itself a source of infirmity. But chimneys and their flues ought not under any circumstances to be formed in an inclosure in which timber is employed as a part of the structure. Chimneys—with their congeners, stoves and furnaces—should be confined to walls of brick or stone; and as these almost always occur most conveniently in party-walls when buildings stand together, or in walls which, though not technically party-walls, are so near to other buildings, as to require to be similarly dealt with, inclosures of the kind indicated need not be desired, because it would not be prudent to form flues in them.

Under some circumstances, again,—that is to say, when any street of a town is so wide and the buildings to be built fronting to it are to be of such small elevation, as to make the communication of fire from one side to the opposite side so nearly impossible as, for all the purposes of security, to be so, if the buildings adjoining laterally are effectually separated from one another by sufficient walls, party or otherwise, and these project before the outside faces of the front and back inclosures so as effectually to prevent fire from passing round them,—the temperature of dwelling-houses may be much more easily maintained and regulated if the outside surface be boarded. Weather-boarding is a safe and economical, as well as a neat, wholesome, and equable outside casing for the fronts of a dwelling-house, if the boarding be backed up solidly, and the timber quarterings necessary to secure it be properly filled in between and behind with brick or stone work, or with rubble and concrete in the manner already described. Brickwork builds up badly with the raking braces of timber-framed inclosures, and the concrete described would not be so perfect with weather-boarding on one side as if the mortar were thrown in from both sides; but raking braces are less essential to inclosures which are filled in and backed with a heavy body of brickwork or concrete, than when mere lathing or even brick-nogging is to be employed on the inside. A nine-inch brick wall may, indeed, be very well built up with framed quarterings without raking braces, if the work be built between and around the quarterings, carrying, that is to say, the inner half-brick before the inside faces of the quartering, and so as to show on the inside a plain brick wall.

The foregoing remarks have been written with reference to the articles ARCHITECTURE, BUILDING, CARPENTRY, MASONRY, &c., to which, accordingly, the attention of the reader is directed. (W. H—G.)

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[1] It may be remarked here, with reference to the employment of any substance such as cinder, being of the nature of pozzolano, or volcanic scoria, in mortar, to form a floor in the manner above described (about three inches thick), that as all such mortars expand in setting, the walls of buildings may be forced out by the expansion of the plaster floors, if the whole surface of the floor in any story be at once covered with the mortar. A margin of four or five inches on every side should be left void until the expansion has taken place, when the floor may be completed with an assurance of close joints, and without injury to reasonably stable walls.

[2] The most recent practice in Paris, in respect of floors, is to form the structure of slight wrought-iron bars rolled to the form known with us as T and L iron, and to fill in with the same strong plaster between, below, and above the iron, and so to form a slab of plaster from 6 to 8 inches thick, according to the bearing and the depth of the iron bars—the bars being enveloped in the plaster as the bottom laths are when the structure is of timber.

Consualia || Consul.

CONSUALIA, in *Roman Antiquity*, an annual festival in honour of the god Consus or Neptune, but different from those other feasts of the same deity which were called *Neptunalia*. They were introduced with a magnificent cavalcade or procession on horseback, because Neptune was reputed to have first taught men the use of horses.

Evander is said to have first instituted this feast, and it was re-established by Romulus under the name of Consus, because it was some god under the denomination of Consus who suggested to him the rape of the Sabines; and it was probably with a view to the achievement in question that he established the festival. To this feast all his neighbours were invited; when, taking advantage of the opportunity, he carried off the women.

The consualia were of the number of feasts called sacred, as being consecrated to a divinity. Originally they were not distinguished from those of the circus; and hence it is that Valerius Maximus says the rape of the Sabines was effected at the games of the circus.

Plutarch observes that, during the days of this solemnity horses and asses were left at rest, and were dressed up with crowns and other ornaments, on account of its being the feast of Neptunus Equestris. According to Festus, the cavalcade was performed with mules, it being an opinion that this was the animal originally used in drawing the car.

Servius gives us to understand that the Consualia were celebrated on the 13th of August; but Plutarch, in the life of Romulus, places them on the 18th, and the old Roman calendar on the 21st of that month.

CONSUBSTANTIAL, a theological term of the same import with co-essential, denoting something of the same substance with another. It is generally used to designate the relationship subsisting between the Father and the Son, as an equivalent to the term ὁμοούσιος, adopted by the councils of Antioch and Nice to express the orthodox doctrine more precisely, in opposition to the errors of Arius. (See ARIUS). Sandius and others maintain that the word consubstantial was unknown till the time of the council of Nice. It was, however, proposed to the council of Antioch, and rejected there, according to Athanasius, only because it was supposed to imply the idea of a pre-existent matter.

CONSUBSTANTIATION, a term descriptive of the doctrine held by the Lutheran Church regarding the presence of Christ in the eucharist; according to which they maintain that, after consecration, the body and blood of our Saviour are substantially present, together with the substance of the bread and wine. This is otherwise called *impanation*.

CONSUEGRA, a town of Spain, on the Amargulla, province of and 36 miles S.E. of the city of Toledo. Pop. about 5000, principally engaged in the manufacture of coarse woollens. It contains various Roman inscriptions and antiquities; and on a neighbouring hill are remains of its ancient castle.

CONSUL (ὕπατος), the highest ordinary magistrate of the Roman republic. It is probable that the word is compounded of *con* and *salio*, and is formed like *exsul* and *præsul*, so that *consules* signifies those who go together. They were anciently called *prætores*, *imperatores*, or *judices*.

From the abuse of that power which had been vested in the kings, the Romans were induced not only to expel the hated Tarquins from the city, but even to abolish the monarchical form of government altogether. Brutus and his companions, after the rape of Lucretia, made the people swear that no king should ever again reign at Rome. The state was henceforth ruled by two supreme magistrates called consuls. The consular office was instituted after the expulsion of the kings, B.C. 510, and continued, with few interruptions, till the establishment of the empire—a period of nearly 500 years. The leaders of the revolution which had expelled the kings were first raised to this rank. All the royal insignia were preserved except the crown. Twelve lictors preceded them alternately. The elder of the two, or he who had most children, or who had been first elected, had the *fasces* first, the other meanwhile being preceded by a public officer called *accensus*, and followed by the lictors. Sometimes they agreed to enjoy the *fasces* in alternate days, but generally in alternate months. By the law of Poplicola, the axe was taken from them and their *fasces* were lowered when they entered the assemblies of the people. A cloak with a scarlet border, and an ivory staff, were badges of their office. On public occasions they used a seat of ornamented ivory called the curule chair. Consul.

The popular excitement and tumult, which forms so formidable an objection to the elective form of government, was particularly conspicuous in the early days of the Roman consulship. From the great power which they originally possessed in the state, the patricians succeeded for a long time in retaining the consulship among themselves. It was not till the year B.C. 445 that the plebeians acquired sufficient courage and strength to make any attempts to acquire the right of being elected to this office. Having once begun the struggle, however, they maintained it for the space of 80 years with a spirit and resolution which made even a foreign war desirable as a relief from internal contests. Livy relates that for five years (B.C. 375–371) the opposition raised by the plebeians, under the guidance of the tribunes L. Licinius Stolo and L. Sextius, was so formidable that neither consuls nor any other magistrates could be appointed, and there was what he expressly calls a *solitudo magistratuum*. At length the patricians, after attempting an evasion by the appointment of five military tribunes, were compelled to accede to the Licinian law, by which it was ordained (B.C. 367) that in all time coming one of the consuls should be a plebeian. L. Sextius was the first plebeian consul. But the power which was effectual in the passing of the law was not equal to its enforcement, for in B.C. 355 both consuls were patricians; and, as was often the case with Roman laws, it was found necessary to re-enact it. This time, however, the demands of the plebeians increased; and not satisfied with having one consul, they tried to add a clause ordaining it to be lawful for the people to elect both consuls from their own number. Although the attempt was successful, no example of the appointment of two plebeian consuls occurs till the year B.C. 215. The honour seems for the most part to have been equally divided between both orders. The first foreigner who obtained the consulship was Cornelius Balbus, a native of Cadiz, and a man of extraordinary wealth.

The legal age for enjoying the consulship was 45; but this regulation was not strictly observed. Pompey was made consul in his 36th year, M. Valerius Corvus in his 23d. T. Quinctius Flaminius was created consul before he was 30, Scipio Africanus the elder at 28, and the younger at 38. It was necessary for candidates to have discharged the inferior duties of quæstor, ædile, and prætor, before they were eligible; and a regulation was made that they should be present at the election in a private capacity. It was also enacted that no one should be made consul a second time till after the lapse of ten years. But we find cases in which all these conditions were disregarded. Some were elected who had not previously borne any curule magistracy; and others were appointed in their absence. Some continued in office more than a year, as Marius, who was seven times consul without intermission; and others were elected before the allotted time had elapsed.

The election of consuls was made by the Comitia Centuriata in the Campus Martius. The assembly at which they were elected was always convoked and presided over by a consul, dictator, or interrex. It generally took place in the month of July, that an opportunity might be afforded for investigating the conduct of the successful candidates before they entered on their office, and that they might

Consul. have time to become conversant with their duties. From their appointment to the day of their induction they were called *consules designati* or consuls-elect, and had the privilege of being first asked their opinion in the senate. The day upon which they assumed office was repeatedly changed. It seems originally to have been the ides of September, when, in the rude days of Roman history, the consuls used annually to fix a nail in the temple of Jupiter Capitolinus to mark the year; but as it sometimes happened, when one died before the term of his office had expired, that another was immediately chosen to fill his place, the year of his successor was naturally finished before the usual time, and this necessitated a repeated change in the days of their appointment and induction. Sometimes, too, civil commotions prevented the election taking place at the usual time. As the consul whose year was completed could not in such cases discharge any of the consular duties, it was customary for the senate to nominate a temporary magistrate called Interrex. His authority being limited to five days, a succession of interreges had frequently to be chosen before tranquillity was restored. At length (B.C. 154) it was enacted that consuls and all the ordinary magistrates, with the exception of the tribunes of the people, should begin their duties on the 1st of January. That day was marked by peculiar solemnities. At day-break the consuls arose and consulted the auspices. Afterwards the senate and people waited upon them at their houses, and then, with the new magistrates clad in their state robes at their head, they all marched in solemn procession to the capitol. There victims were offered, and prayers presented for the safety and prosperity of the Roman people. After the conclusion of the religious rites a meeting of the senate was held, and the new consuls first exercised their functions by consulting it about the performance of religious ceremonies. Within five days after their induction they were obliged to swear, as they had done at their election, that they would strictly observe the laws; and at the close of their consulship they were required to take a similar oath declaring that they had done nothing contrary to the constitution.

The power of the consuls appears at first to have been similar to that of the kings; but in process of time several distinctions arose which combined to render the consular authority inferior to the regal. The office of high priest, which had been discharged by the kings, was in the time of the consulship executed by a special magistrate, called *rex sacrorum*, or *rex sacrificulus*. The power of life and death was afterwards denied to the consuls, and the symbolic axe removed from the *fasces*. While there was only one king, there were two consuls. The obvious design of the Romans in dividing the consulship was that their power might be weakened, and the safety of the people made more secure by the resistance which the ambitious designs of the one would receive from the other. For the same reason they elected them annually, and thus prevented that insolence of authority which the long continuation of it is apt to produce. They were restrained from illegal measures still farther by fear of punishment when their term of office had expired; for the people had reserved to themselves the right of bringing them to trial for misconduct. The Valerian law weakened their authority by decreeing that no magistrate should scourge or put to death a Roman citizen who appealed to the people. Even the decision of one consul could be repealed by the other. But it was the creation of the tribunes of the people that especially contributed to limit their prerogatives, and strengthen the cause of liberty. And as additional magistracies were instituted, many of their old privileges were taken from them. Their judicial power was transferred to the prætors, and their censorial to the censors; while other duties originally discharged by them devolved upon ædiles and other new magistrates.

But notwithstanding these limitations, the power of the consuls was at all times very great. As civil magistrates they were at the head of the government, and all others, with the exception of the tribunes of the people, were subject to them. They assembled and presided over the senate and *comitia centuriata;* they introduced subjects of deliberation, proposed laws, and executed the decrees of both senate and people. The laws proposed by them generally received their name. The year was called after them. They gave audience to embassies, and communicated with other states. Before the establishment of the prætorship and censorship, they discharged the highest judicial functions, and superintended the assessment of the citizens. They had the right of summoning and enforcing the presence of any one they pleased. Every person was bound to turn out of the way, dismount, rise up, uncover the head, or show some similar token of respect, when they passed. The consul Acilius ordered the curule chair of the prætor Lucullus to be broken in pieces for a breach of this regulation. As military commanders they had absolute authority. They had the power of life and death over the lives of their soldiers; and accordingly they had axes in their fasces when in the field. When any great danger threatened the state, the consuls were invested by the senate with extraordinary powers, which made them supreme in the city as well as out of it. Accordingly, in the early days of the republic, when the patricians were in sole possession of the consulship, and wished to subdue any outbreak of the plebeians, they feigned that some powerful enemy was marching against the city, and thus succeeded in obtaining extraordinary powers for the consuls. This being accomplished, the lives of all the citizens were at the mercy of their party. Consul.

After the consuls had resigned their office, they were commissioned by the senate to assume the government of provinces under the title of proconsuls. It was the prerogative of the senate to determine the provinces for the consuls, although it was left to themselves to decide by lot or agreement which of them each should receive. When the time arrived for a proconsul to set out for his province, he was furnished by the senate with the troops appointed for him, and everything requisite for his command. Surrounded by a train of friends, and a numerous personal staff, he marched out of the city with great pomp. He was bound to travel direct to his province; and the towns through which he passed had to supply him with necessaries for his journey. Within his province he had the command of the troops, and could employ them as he pleased. He was supreme judge both in criminal and civil causes, and could inflict the punishment of death—except on Roman citizens, who could appeal to Rome. Justice was generally administered at circuit-courts, held once a-year in the principal towns. The proconsulship continued likewise for one year only, but it was often prolonged by a decree of the senate

Under the empire, the consuls were superseded by the emperors. The title indeed remained, and all the ceremonies were performed with exactness, and perhaps even with more magnificence than formerly. It would seem as if they attempted to conceal the loss of real power by the trappings of external pomp. The day of their induction was even more than ever a day of note in the city. Sitting on curule chairs, which were placed on lofty chariots, arrayed in rich dresses in imitation of those which used to be worn by generals in a triumph, with shoes of cloth of gold upon their feet, and sceptres in their hands, they passed through the city, scattering money among the crowd, and bestowing gifts upon their friends. Their first duty, however, no longer consisted in consulting the senate about the religious duties of the state; but in formally returning thanks to the emperor for their election. The emperors had arrogated the right of assuming the consulship to themselves, or disposing of it as they thought proper. Julius Cæsar was dictator and consul at the same time. Augustus made himself

Consuls. consul thirteen times during his reign. Vespasian proclaimed himself perpetual consul. And in bestowing it upon others, they were not content with having one pair of consuls for one year. Desirous to conciliate as many of their friends as possible, they greatly shortened the duration of the office. It was held generally for two months, which allowed twelve consuls during one year. But sometimes it lasted only a few weeks, a few days, or even a few hours, according to the pleasure of the emperor. There happened to be twenty-five consuls in the year A.D. 189. But those who entered upon their office on the 1st of January were held in greater respect, and gave their names to the year. They were called, as in the time of the republic, *consules ordinarii;* while those who were raised to the office at other times were termed *consules suffecti*, or *consules minores*.

While the republic lasted, the time that elapsed between the election and ordination of consuls was short, generally from July to January. In the time of the emperors, ordination was sometimes deferred several years. The Triumvirs in B.C. 39 nominated consuls for eight succeeding years. In this way the title of *designatus* was frequently enjoyed long before the actual consulship. Caius, the grandson of Augustus, was consul designatus for five years. Nero was fourteen years old when he was nominated consul designatus, and twenty when he became consul.

Besides these different kinds of consuls, all of which existed in the republic, we find another class peculiar to the later days of the state—honorary consuls. These enjoyed the titles and badges of consuls, but nothing more. They possessed their honours, though altogether free from their duties. All the consuls, in truth, during the period of which we speak, may with propriety be termed honorary, for the substance of their power had been taken from them. They had become the mere slaves of the emperors, although they still continued the formal discharge of their functions. Nevertheless, even in this degraded condition, the consulship was always regarded with veneration, and considered the highest dignity to which a Roman citizen could aspire. (J. T. G.)

Consuls, *Mercantile*, are appointed by the Secretary for foreign Affairs, and are under the direction of the Foreign Office. They are sent to the various countries that have commercial relations with Great Britain. The office of consul seems to have originated in Italy about the middle of the twelfth century; and after the establishment of the various trading companies in England and France they were generally established over Europe. The duties assigned to British consuls are these:—To make themselves acquainted with the laws that regulate commerce, to give advice and assistance to British subjects when required, to make annual returns of the trade with the principal ports of their consulate, and quarterly returns of the prices of agricultural produce, to attend to the interests of the British navy, take charge of wrecks, to watch, protect, and promote British interests generally, and to see that justice is dealt to British subjects. A consul has also to report to the government any attempts at illicit trading made in violation of the laws of his own country, or of the country in which he resides, and to keep them duly informed in regard to the appearance of infectious disease within the limits of his consulate. Consuls occasionally partake of a certain kind of diplomatic character; and in Turkey, according to an ancient treaty and certain bye-laws of the Levant Company, they enjoy extensive judicial powers. Various opinions have been expressed in regard to the propriety of such an arrangement; but in the peculiar circumstances of that country it seems indispensable that justice should only be administered to British subjects by a responsible British officer. Similar judicial powers, however, are guaranteed in Sweden to the American consulate, but this is an exception to the general rule.

They nominate vice-consuls where they consider it necessary; but before these are permitted to act, they must receive the sanction of the Secretary of State, and after their appointment they can only be dismissed with the same sanction. Consuls.

All the consuls holding a royal commission are British subjects, but many of the vice-consuls are not such.

The emoluments of the consuls arise from salaries from the crown, and fees fixed by act of parliament,—these arising principally from notarial acts, certificates connected with shipping, &c. An account of the amount of these receivable by each consul is transmitted to the Foreign Office annually or half-yearly. In most cases it is small; but in some, such as at Constantinople and New York, it is very considerable, being in the first L.1700 for the year 1847, and in the latter L.1230,—the salaries being L.1600 and L.800 respectively.

The whole consular establishment was revised by Lord Palmerston in 1831. In 1852 it consisted of 241 consuls and vice-consuls, exclusive of the consular staff in China, receiving salaries the aggregate amount of which was L.101,199. There were also 257 vice-consuls discharging their duties without salaries.

Previously to the general peace in the year 1814, the greater part of the British consuls abroad, who held commissions from the crown, were merchants at the respective places of their consular residence. Many of such consuls had no salary from government. Their emoluments consisted of fees, which they levied upon the tonnage of British ships, and upon the value of their cargoes. This mode of remunerating consuls having created dissatisfaction amongst the commercial classes, a new system was introduced in 1826, and an act of parliament was passed to abolish all consular fees on tonnage and cargoes, and to enable the crown to give remunerating salaries to consuls. According to the system founded upon the act of 1826, it was determined "that British consuls should not be in any way concerned, directly or indirectly, in commercial pursuits." This system was acted upon, with some few exceptions, until 1832, when a very considerable reduction was made in the salaries assigned to the consuls, and "permission was given to engage in mercantile pursuits," in order to indemnify them for the loss occasioned by the reduction of salary. This permission, however, is not indiscriminate, and the principle on which it is granted is somewhat arbitrary; but the practice is sufficiently prevalent to enable us to regard the act of 1826 as reversed—restriction "to engage in mercantile pursuits" being made the exception instead of the rule.

The advantage in permitting consuls to trade is this, that in consideration of the profits accruing to them as traders a lower salary may be given to them as consuls. This is met, however, by the obvious disadvantage, that if they have any political duties to perform, those political duties are not so well performed by a person who is liable to the imputation, however unfounded, of making his political actions subservient to his personal and commercial interests. In many cases jealousy has likewise been expressed by other traders and merchants in the same place, who, suspecting that the consul-merchant reaps undue advantage from information derived through his office, use means to deprive him of the information to which for statistical purposes he is entitled. It is therefore only in cases where these disadvantages are not likely to be in formidable disproportion, that liberty may be granted to the consul to engage in trade; but it were better, to prevent the interests and honour of his country from being endangered by his commercial character and fortunes, that this liberty should in every case be refused. The repeal of the act of 1826 is, therefore, very questionable in point of commercial policy.

Consuls.

List of Consuls-General, Consuls, and Vice-Consuls, with their respective Salaries for the year 1854.

Consuls.

Residence.	Rank.	Salary.
RUSSIA—		
St Petersburgh	Consul	L.750
Archangel	Do.	300
Riga	Do.	500
Wiborg	Do.	150
Warsaw	Consul-general	1,000
Odessa	Do	750
Do.	Vice-consul	80
Ismail	Do.	200
Taganrog	Consul	200
Kertch	Vice-consul	200
SWEDEN—		
Stockholm	Consul	500
Gottenburg	Do.	400
NORWAY—		
Christiania	Consul-general	600
DENMARK—		
Elsinore	Consul	700
Do.	Vice-consul	100
Copenhagen	Do.	150
St Thomas	Consul	200
PRUSSIA—		
Danzig	Consul-general	700
Memel	Vice-consul	200
Pillau	Do.	50
Stettin	Do.	50
Konigsberg	Do.	60
Cologne	Consul	100
HANS TOWNS—		
Hamburg	Consul-general	1,500
Do.	Vice-consul	300
Bremen	Do.	150
Lubeck	Do.	150
Cuxhaven	Do.	100
SAXONY—		
Leipzig	Consul-general	750
FRANKFORT—		
Frankfort	Consul	350
NETHERLANDS—		
Amsterdam	Consul	300
Rotterdam	Do.	500
Middleburg	Vice-consul	100
Batavia	Consular Agent	200
Surabaya	Do.	200
Samarang	Do.	200
BELGIUM—		
Antwerp	Consul	500
Ostend	Do	300
FRANCE—		
Paris	Consul	100
Dunkirk	Do.	400
Calais	Do.	400
Boulogne	Do.	400
Havre	Do.	650
Caen	Vice-consul	50
Cherbourg	Consul	500
Granville	Vice-consul	100
Brest	Consul	500
Nantes	Do.	300
Charente	Do	300
Bordeaux	Do.	450
Bayonne	Do.	300
Marseilles	Do.	550
Toulon	Vice-consul	50
Corsica	Consul	200
Martinique	Do.	100
ALGIERS—		
Algiers	Consul	800
Oran	Vice-consul	400
Bona	Do	100
Philippeville	Do.	100
SPAIN—		
Madrid	Consul	200
Bilbao	Do.	350
San Sebastian	Vice-consul	100
Vigo	Consul	400
Cadiz	Do.	500
San Lucar	Vice-consul	150
Malaga	Consul	300
Carthagena	Do.	400
SPAIN—		
Alicante	Consul	L.300
Barcelona	Do.	400
Mahon	Vice-consul	300
Teneriffe	Consul	500
Havana	Consul-general	1,000
St Jago de Cuba	Consul	300
Porto Rico	Do.	800
Manilla	Do.	1,000
PORTUGAL—		
Lisbon	Consul	600
Do.	Vice-consul	300
Loanda	Do.	50
Oporto	Consul	500
Madeira	Do.	300
St Michael's	Do.	400
Fayal	Vice-consul	100
Terceira	Do.	100
C. Verde Islands	Consul	400
SWITZERLAND—		
Geneva	Consul	50
SARDINIA—		
Genoa	Consul	400
Nice	Do.	200
Cagliari	Do.	250
TUSCANY—		
Leghorn	Consul	350
ROMAN STATES—		
Ancona	Consul	350
Do.	Vice-consul	50
TWO SICILIES—		
Naples	Consul	400
Do.	Vice-consul	100
Gallipoli	Do.	100
Otranto	Do.	25
Palermo	Consul	400
Messina	Do.	200
AUSTRIA—		
Venice	Consul-general	700
Trieste	Vice-consul	100
Fiume	Do.	100
GREECE—		
Patras	Consul	700
Syra	Do.	400
Piræus	Do.	350
Missolonghi	Vice-consul	150
TURKEY—		
Belgrade	Consul-general	800
Bucarest	Agent & Con.-gen.	900
Jassy	Consul	700
Galatz and Ibrail	Vice-consul	250
Constantinople	Consul-general	1,500
Do.	Vice-consul Cancellier	400
Do	Vice-consul	300
Do.	Phys. and Surg.	300
Dardanelles	Consul	300
Enos	Consular Agent	40
Salonica	Consul	350
Monastir	Do.	500
Janina	Do.	550
Do.	Vice-consul Cancellier	150
Prevesa	Vice-consul	70
Scutari	Do.	130
Varna	Consul	500
Brussa	Do.	350
Smyrna	Do.	700
Do.	Vice-consul Cancellier	200
Do.	Chaplain	250
Do.	Surgeon	200
Adalia	Vice-consul	100
Macri	Do.	50
Rhodes	Consul	400
Scio	Vice-consul	100
Mytilene	Vice-consul	200
Crete	Consul	300
Erzeroom	Do.	600
Trebizond	Vice-consul	200
TURKEY—		
Diarbekir	Consul	L.400
Batoom	Do.	250
Samsoon	Vice-consul	200
Tarsous	Do.	250
Moussul	Do.	250
Damascus	Consul	600
Aleppo	Do	500
Alexandretta	Vice-consul	300
Beirout	Consul	500
Do.	Vice-consul	150
Jerusalem	Consul	550
Jaffa	Do.	300
Jedda	Vice-consul	150
EGYPT—		
Egypt	Agent & Con.-gen.	1,800
Alexandria	Consul	600
Do.	Vice-consul Cancellier	300
Do.	Surgeon	100
Cairo	Consul	400
Damietta	Vice-consul	60
Suez	Do.	200
TRIPOLI—		
Tripoli	Consul	600
Do.	Vice-consul	300
Bengazi	Do.	400
Mourzouk	Do.	200
Ghadames	Do.	200
TUNIS—		
Tunis	Agent & Con.-gen.	1,600
Do.	Vice-consul	450
Susa	Do.	300
MOROCCO—		
Tangier	Agent & Con.-gen.	1,600
Do.	Vice-consul	350
Mogador	Do.	100
Tetuan	Do.	100
Rabat	Do.	100
PERSIA—		
Tabreez	Consul	500
Tehran	Do.	500
Asterabad	Do.	500
ABYSSINIA—		
Massoah	Consul	500
UNITED STATES—		
Portland	Consul	300
Boston	Do.	200
New York	Do.	500
Philadelphia	Do.	500
Baltimore	Do.	500
Norfolk	Do.	300
Charleston	Do.	500
Savannah	Do.	300
Mobile	Do.	450
New Orleans	Do.	500
Galveston	Do.	300
California	Do.	300
Cincinnati	Do.	400
MEXICO—		
Mexico	Consul	250
Vera Cruz	Do.	500
Tampico	Do.	500
San Blas	Do.	300
Mazatlan	Vice-consul	150
Acapulco	Consul	400
GUATEMALA—		
Guatemala	Consul-general	1,000
SALVADOR	Vice-consul	200
NICARAGUA—		
Realejo	Vice-consul	200
COSTA RICA—		
San Jose	Vice-consul	200
HONDURAS	Vice-consul	200
MOSQUITO—		
Grey Town	Consul	600
Blewfields	Vice-consul	200
HAYTI—		
Port-au-Prince	Consul-general	200
Do.	Vice-consul	500

Contagion ‖ Contarini.

Residence.	Rank.	Salary.
ST DOMINGO—		
St Domingo	Consul	L.600
NEW GRANADA—		
Bogotá	Consul-general	1,600
Do.	Vice-consul	400
Carthagena	Consul	1,000
Panama	Do.	1,200
Sta Martha	Vice-consul	400
Rio Hachi	Do.	300
VENEZUELA—		
Caracas	Consul-general	1,200
La Guaira	Vice-consul	200
Puerto Cabello	Do.	200
Maracaibo	Do.	200
Bolivar	Do.	200
EQUADOR—		
Guayaquil	Consul	1,000
Do.	Vice-consul	200
PERU—		
Lima	Consul-general	1,700
Callao	Consul	200
Islay	Vice-consul	500
Arica	Do.	300
Paytá	Do.	100
BOLIVIA—		
Sucre	Consul-general	1,200
CHILE—		
St Jago	Consul-general	1,600
Valparaiso	Consul	300
Concepcion	Vice-Consul	250
CHILE—		
Coquimbo	Consul	L.300
Caldera	Vice-Consul	250
BUENOS AYRES—		
Buenos Ayres	Consul-general	1,600
Do.	Vice-consul	500
Paraguay	Consul	700
MONTE VIDEO—		
Monte Video	Consul-general	1,400
Do.	Vice-Consul	500
BRAZIL—		
Rio de Janeiro	Consul	800
Maranham	Do.	300
Pará	Do.	450
Pernambuco	Do.	500
Maceio	Vice-consul	200
Bahia	Consul	800
Paraiba	Do.	400
Do.	Vice-consul	200
Rio Grande do Sul	Consul	800
St Catharine's	Do.	500
SANDWICH ISLANDS—		
Woahoo	Consul-general	800
GEORGIAN OR WINDWARD ISLANDS—		
Tahiti	Consul	500
SOCIETY OR LEEWARD ISLANDS—		
Raiatea	Consul.	500
NAVIGATORS' ISLANDS—		
Samoa	Consul.	350
BORNEO—		
Sarawak	Commissioner and Consul-general	L.500
COMORO ISLANDS—		
Johanna	Consul	150
SHERBORO' RIVER—		
	Consular Agent	250
LIBERIA—		
Monrovia	Consul	500
BIGHT OF BENIN—		
Lagos	Consul	500
BIGHT OF BIAFRA—		
Fernando Po	Consul	500
CHINA—		
Hong Kong	Superintendent of Trade	4,000
Do.	Secretary	700
Canton	Consul	1,800
Do.	Vice-consul	750
Whampoa.	Do.	750
Amoy	Consul	1,200
Do.	Vice-consul	750
Foo-chou-foo	Do.	800
Ningpo	Do.	800
Shanghai	Consul	1,500
Do.	Vice-consul	750

Besides these there are in China, at each consular station, several salaried assistants and interpreters; and elsewhere nearly 260 vice-consuls, discharging their duties without salaries from the British government.

Contingent ‖ Conventicle.

CONTAGION (from *contagio*—*con* together, and *tango* to touch). This term is used to express the propagation of diseases of a specific nature from one individual to another, and also the matter by which this propagation is effected. In the latter sense contagion is a morbific agent, *sui generis*, which on being introduced into the blood, produces a definite train of morbid phenomena, and communicates to the blood the property of generating a similar poison, capable of originating a similar disease if introduced into the blood of another individual. Diseases so propagated are termed *contagious*, and the matter by which they are propagated is called *contagious matter*, or simply *contagion*.

Strictly speaking, the term contagious ought to be limited to those diseases which are alone propagated directly by actual contact of the body which receives the poison with that which produces the poison. It has, however, become customary to class under the same term diseases which are also propagated by means of the poison of the contagion being diffused through the air. Contagious diseases, therefore, are divisible into two great classes,—1st, those which are alone capable of being propagated from person to person by the direct application of the contagious matter—immediate or contactual contagion; and 2d, those which are communicable in this way, and also through the medium of the air—mediate or remote contagion. To the first class belong itch, ringworm, syphilis, cow-pox, &c. To the second belong smallpox, scarlet fever, measles, typhus fever, &c.

The term *infection* is frequently and improperly confounded with, and used synonymously for, the term contagion. But this term is not properly applicable to diseases, but to the effects produced by *malaria* or effluvia arising from marshes, or that from decaying animal and vegetable substances.

CONTARINI, ANDREA, a doge of Venice of a very illustrious family, who in 1380, though then 80 years of age, led the fleet of his country against that of Genoa, and saved the republic, which was then in imminent peril.

Another of the Contarini family, Ambrogio, was ambassador of the state to the Schah of Persia in 1473. He returned to Venice in 1477, and wrote a curious and seemingly faithful account of what he had seen and collected during his residence in Persia. This work was published at Venice in 1524, under the title of "Itinerario nell' anno 1473 al'Usum Cassan Ré di Persia." Many other men eminent in arms and in literature have sprung from the noble family of Contarini.

CONTINGENT, in politics, is used to denote the proportion of troops, money, &c., furnished by each state in a confederation, according to compact, for the general behoof.

CONTINUED BASS, in *Music*. See MUSIC.

CONTOURNIATED (Ital. *contornato*, turned about), in *Numismatics*, a term applied to medals of which the edges appear as if turned in a lathe.

CONTRABAND. See NEUTRALITY.

CONTRE in *Heraldry*, an appellation given to several bearings, on account of their cutting the shield contrary and opposite ways. Thus we meet with contre-bend, contre-chevron, contre-pale, and the like, when there are two ordinaries of the same nature opposite to each other, so that colour may be opposed to metal, and metal to colour.

CONTRITION (Lat. *contritio*, from *conterere*, to break or bruise), among divines, is used to denote that sincere sorrow for sin resulting from the reflection of having offended an infinitely holy and benevolent God, and attended with a sincere resolution of reformation. It is distinguished from *attrition*, which is applied to grief for sin arising from fear of punishment—the lowest degree of repentance.

CONTROL (French *contre*, and *rôle*, a roll or list), is properly a double or counter register of acts, issues, and the like, of the officers or commissioners in the revenue, army, or other departments, in order to perceive the true state, and to certify the truth thereof, and the due keeping of the acts subject to the enregisterment.

CONTROLLER, an officer appointed to control or oversee the accounts of other officers, and, on occasion, to certify whether or not things have been controlled.

CONVENTICLE (Lat. *conventiculum*, dim. of *conventus*), properly denotes a cabal or secret assembly of a part of the monks of a convent, to form a brigue or party in the election of an abbot. From the abuse of these assemblies, the word has come into disrepute; and now stands

Convention ‖ Convex.

for any mischievous, seditious, or irregular assembly. The term conventicle is said to have been first used in a contemptuous sense for the meetings of the followers of Wicliffe; and it has since been applied in England to the religious assemblies of petty sects, and of dissenters in general from the established church.

CONVENTION (Lat. *conventio*, from *convenire*, to come together), a treaty, contract, or agreement between two or more parties, military commanders, &c.

CONVENTION is also the name given to an extraordinary assembly of the estates of the realm, held without the king's writ; as the assembly which restored Charles II. to the throne. Such also was the convention of estates in 1688, which, upon the flight of James II., declared that he had abdicated the throne, and that the right of succession had devolved to King William and Queen Mary;—upon which the assembly expired as a convention, and was converted into a parliament.

CONVENTION of Estates, in Scotland, previous to the Union, was partly of the nature of a parliament, but differed in this, that the former could only propose taxes, whereas parliament could both impose taxes and make laws.

CONVENTUAL, belonging to a convent. Hence, one that lives in a convent; a monk or nun.

CONVENTUS JURIDICI, were courts of justice established in the Roman provinces, with an extent of jurisdiction circumscribed within certain limits of district, and to which all who were included might repair for justice. *Conventum agere* is to hold a court of justice.

CONVERGING or *CONVERGENT Lines*, in *Geometry*, are such as continually approach nearer to one another, or whose distances become still less and less. These are opposed to divergent lines, the distances of which become continually greater. Lines which converge one way diverge the other.

CONVERGING Series, in *Mathematics*, are series of which each succeeding term is smaller than the preceding, and which consequently tend to a certain limit: in opposition to *diverging series*, in which the terms gradually increase. See SERIES.

CONVERSANO, an episcopal city of Naples, province of and 20 miles S.E. of the city of Bari, with about 9000 inhabitants. It has a castle, cathedral, several convents, diocesan seminary, hospital, and foundling asylum; and trades in wine, oil, almonds, and cotton.

CONVERSE, in *Mathematics*, an opposite proposition; as, after a conclusion has been drawn from something *assumed*, the order is inverted, and the conclusion is made the supposition or premises, and thence is drawn the conclusion previously assumed. Thus, if two sides of a triangle be equal, the angles at the base are equal; and, *conversely*, if these angles be equal, the two sides are equal.

CONVERT, a person who has undergone conversion from one opinion or practice to another.

CONVERT is chiefly used in respect of change from one religion, or religious sect, to another. Converts with relation to the religion espoused are denominated *apostates* with regard to that which they have relinquished.

The Jews formerly converted to Christianity in England were called *conversi*. Henry III. built them a house in London, and allowed them a competent subsistence for life. This house was called *domus conversorum*; but as their numbers increased, they became a burden to the crown, and accordingly were distributed among the monasteries. After the expulsion of the Jews under Edward III. the *domus conversorum* was given for the custody of the rolls.

CONVEX (Lat. *convexus*, arched), a term applied to the exterior surface of any gibbous or rounded body, as a bowl; in opposition to the hollow inner surface of such body, which is said to be *concave*.

Convexity and concavity are of particular importance in catoptrics and dioptrics, as applied to lenses and mirrors. A lens when convex on both sides is said to be *convexo-convex*—otherwise termed a double-convex lens; when plane on one side and convex on the other, *plano-convex*; and when convex on one side and concave on the other, *convexo-concave*, or *concavo-convex* if the convex surface be a portion of a smaller sphere than the concave side. See OPTICS.

Conveyancing ‖ Convocation.

CONVEYANCING, the art of preparing writings to effect the transference or conveyance from one person to another of any piece of property or valuable right. It is sometimes applied in a restricted sense to the cumbrous forms which the feudal system has rendered necessary for the transference and tenure of landed property. When left to shape itself by individual practice, without legislative intervention, there were several causes rendering such conveyancing cumbrous and complex. The theory of the feudal tenures and hierarchy remaining unchanged throughout the social revolution which had virtually abolished superiority and vassalage, and brought land out of feudality into ordinary commerce, it became necessary to retain the feudal ceremonies of the middle ages, and to adapt them by fictions and explanations to modern exigencies. Hence, eight years have not yet passed since, in Scotland, when a field was bought and sold, a party of men assembled on it, and went through the old form of symbolic investiture by the delivery of so much earth and stone from the superior bailiff to the vassal's attorney, who took instruments and had the whole recorded at length by a notary of the empire. In England, from the want of the general system of registration known in Scotland, the complexities of conveyancing had become so inextricable, that one of the most approved forms of transference was a fictitious suit and judgment of possession called a fine and recovery. To these innate sources of complexity must be added the timidity of conveyancers, who, afraid to commit themselves by attempting to abbreviate or reconstruct the forms which they find in existence, repeat them with additions from time to time as new circumstances must be provided for. Hence, to keep conveyancing within rational bounds, the legislature must interfere from time to time to sweep away excrescences, and provide brief and simple forms. This, however, is a task which cannot be easily accomplished, since it requires the very highest legal skill to adjust simple forms to all exigencies, and anticipate the various shapes in which property may fall to be dealt with. This service has been on various occasions performed by distinguished lawyers; and, while it is productive of the greatest benefits to society, it is one of the public services least susceptible of popular appreciation. In 1834 the act abolishing fines and recoveries created a reform of this kind in the conveyancing of England, and a series of statutes passed in 1847 purified and simplified the conveyancing of Scotland. (J. H. B.)

CONVOCATION, a term applied ambiguously both to purely ecclesiastical assemblies and to meetings of the clergy of a more political character. At the present day the distinction is not sufficiently recognised, and consequently meetings of the clergy for their own internal government and that of the church in its purely spiritual relations, are apt to be confounded with *convocation*, in a much stricter and more modern sense. From the earliest times until the reign of Henry VIII., the English Church, like all churches in Christendom, exercised the power, by means of its bishops, of convening the clergy; and what every bishop did in his own diocese, the archbishops had power to do in their provinces; they called together first the bishops, and afterwards their inferior clergy, as occasion required. These meetings constituted the diocesan synods and the provincial councils, and were confined entirely to the transaction of the spiritual affairs of the church. Afterwards the papal power introduced another element; and by means of legates sent from Rome,

Convolution.

national church councils were formed. In all these respects England only acted as other churches did, exhibiting the order of universal Christianity.

But besides these assemblies, there were two others peculiar to ourselves, and springing out of our own peculiarities of government. These were of a mixed character, contemplating the good of the realm, as well as the interests of the church, and they were originated by the fact, that large possessions of land and money gradually fall into the hands of ecclesiastics. The first was the meeting of the bishops in parliament to consult and legislate with the laity; the second was the assembling of the clergy to tax themselves, that their large property might bear a portion of the public burdens. In Saxon times the church was expected to contribute largely to the service of the state, and the meetings called to grant these aids were called CONVOCATIONS. This part of the constitution was more clearly defined and settled in the reign of Edward I., who wished to make the clergy a third estate, so that the bishops should not only sit in the parliament for temporal purposes, but also with the inferior clergy in convocation. After many struggles from the indisposition of the clergy to meet on the authority of the king, the two ecclesiastical synods were agreed upon, under the summons of each of the archbishops: there the clergy sat, and made canons, by which each respective province was bound, and gave aids and taxes to the king. This convocation had great freedom, and was endowed with considerable powers; but its authority was much lessened by the statute of 25th Henry VIII., which made the king's consent necessary not only to give validity to any act, but also to enable the convocation to proceed to business. Thus the clergy form a convocation by the writ of summons; but they cannot form a council or act as such without the king's license to do so. This state of things continued until 13th Charles II., cap. 4, when the clergy gave their last subsidy, and were afterwards taxed by a land-tax and poll-tax; and in 1664 the clergy waived the right of taxing their own body, and permitted themselves to be included in the money bills prepared by the commons. They then received the right to vote for knights of the shire, if freeholders, like the laity,—a power they did not before possess.

It is thus evident, that although convocation meets at the assembling of parliament, it no longer possesses the functions for exercising which it was first called into existence. *Stat magni nominis umbra;* and even if the sovereign should give it power to proceed to business, it could only act as in the ancient provincial council. It thus appears that, the ancient forms remaining without their power, the church is really less at liberty to act than it should be, according to all theories of ecclesiastical government. It is still in the power of the archbishops and bishops to convene their clergy for religious purposes; and it is nothing but the lingering in a spot and among circumstances venerable with a hoar antiquity, and the use of a name long since inapplicable, that encumbers the government of the Church of England. As a theory, surely none can deny the desirableness of any religious body meeting to transact its own business; and in practice it would probably be found that the evils of synodical action predicted by many are no greater than what are incident to all deliberative bodies.

Those who wish to gain full information on the subject of convocation, in both its historical and moral bearings, should consult Burns' *Ecclesiastical Law,* and Bishop Wake's *Authority of Christian Princes over their Ecclesiastical Synods asserted: with particular respect to the Convocations of the Clergy and the Realm and Church of England.* The latter work, from the interest attached to this question, is exceedingly scarce and dear. (H. B.)

CONVOLUTION (Lat. *convolvo,* to roll together, roll round), the act of rolling or winding together; a winding motion proper to some plants, as the convolvulus, the claspers of vines, &c.

Convoy ‖ Cook.

CONVOY (French *convoyer;* Lat. *veho,* to carry, bring along;) in naval affairs, one or more ships of war employed to accompany and protect merchant ships against pirates, or the enemies of the state in time of war.

CONVOY, in military matters, a body of men who guard any supply of money, ammunition, or provisions, conveyed by land to a town, army, or the like, in time of war.

CONWAY. See ABERCONWAY.

COOCH BAHAR, a raj or native state of Hindustan, in the province of Bengal, situated between the twenty-sixth and twenty-seventh degrees of north latitude. It comprehends an area of 1364 square miles, and is bounded on the N. by Bhootan, on the E. by the district of Goalpara, on the S. and S.W. by the British district of Rungpore, and on the W. by that of Dinajepore. There is a gradual slope of the surface from N.W. to S.E., as indicated by the flow of the rivers in that direction. Of these the principal are the Durlah and the Neelcomer, with its tributaries the Manchee and Toresha. Towards the S.W. the country is in a highly improved state and very fertile, producing abundant crops of rice, wheat, barley, indigo, cotton, tobacco, and the opium poppy. The betel-nut, the semmel, and the banyan tree, thrive well, and attain to great luxuriance. In approaching the northern frontier, the country partakes of the character of the tract extending along the base of the mountains of Bhootan, being in many places ill cultivated or totally waste. It is, moreover, extremely unhealthy, the land being low and marshy, interspersed with deep woods, and everywhere almost choked with a coarse vegetation of rank grass, reeds, and fern.

It was about the year 1018 that the sultan Mahmoud penetrated into the country of which Cooch Bahar formed a part. It was also frequently plundered by the Afghan governors of Bengal, but it always recovered its independence. In the year 1578 a Mogul army overran the country, and laid the rajah under contributions. About seventeen years afterwards, the prince voluntarily became a vassal of the Emperor Acbar. During the reign of Aurungzebe, the rajah of Cooch Bahar not only threw off his allegiance, but actually wrested from the imperial yoke several districts. This insult was speedily avenged by the emperor, who, sending his lieutenant, Meer Jumla, in 1661, into the country, took the capital, and changed its name to Alumgeernagur; and at the same time the bigotry of the Mussulmans was so intense that they destroyed the Hindu temples, broke in pieces a celebrated image of Vishnu, and converted the son of the rajah. In 1738 Cooch Bahar was invaded and plundered by Sayid Ahmed, military governor of Rungpore. The rajah was compelled to take refuge in the mountains; and another portion of the country was annexed to Bengal. In 1772 it was invaded by the chief of Bhootan, who laid claim to it, and, meeting with little resistance from the natives, rapidly gained possession of the country. The aid of the British being solicited by the expelled rajah, two battalions of native infantry were sent to the aid of the inhabitants; and the invaders were not only driven back, but the Bhootan chief, alarmed for his own safety by the advance of the Company's troops into his own dominions, was soon compelled to sue for peace. Cooch Bahar is one of the states under the protection of the East India Company, its rajah paying an annual tribute equal to a moiety of his revenues. The town of Cooch Bahar, situate on the river Toresha, 45 miles north of the town of Rungpore, is in Lat. 26. 16., Long. 89. 29. (E. T.)

COOK, CAPTAIN JAMES, the celebrated navigator, was born Oct. 27, 1728, at the village of Marton, Yorkshire, where his father was an agricultural labourer and farm-bailiff. Before the age of thirteen he was apprenticed to a haberdasher at Straiths, near Whitby; but having quarrelled with

Cook. his master, he went as an apprentice on board a collier belonging to the port, and was soon afterwards appointed mate.

Early in the year 1755, Cook joined the royal navy, and served on board the Eagle of sixty guns. Having distinguished himself as an active and diligent seaman, he was, on the recommendation of Sir Hugh Palliser his commander, successively appointed master of the Grampus sloop, of the Garland, and the Mercury; in the last of which he served in the St Lawrence, and was present at the capture of Quebec. He was employed also in sounding and surveying the river, and published a chart of the channel from Quebec to the sea. After this expedition he was appointed master of the Northumberland; and while in this situation he eagerly studied mathematics and astronomy. In 1762, he was present at the recapture of Newfoundland; and the same year he returned to England. Early in the following year, Cook was employed in surveying the coasts of Newfoundland; and in 1764 he was appointed marine surveyor of Newfoundland and Labrador.

While in this capacity, Cook published in the *Philosophical Transactions* an Observation of an Eclipse of the Sun, which he had made at one of the Burgeo Islands, near Cape Ray; and the accuracy of his results, as compared with similar observations at home, obtained for its author the character of an able astronomer.

In the mean time, a spirit for geographical discovery, which had gradually declined since the beginning of the seventeenth century, began to revive; and Cook's former services pointed him out as a fit person to conduct an expedition which was then projected for the purpose of making observations on the impending transit of Venus, and prosecuting geographical researches in the South Pacific Ocean.

For this purpose he received a commission as lieutenant, and set sail in the Endeavour, a vessel of 370 tons, accompanied by several scientific gentlemen, among whom was Sir Joseph Banks. On the 13th April 1769 he reached Otaheite, where he erected an observatory, and succeeded in making the necessary astronomical observations.

From Otaheite Cook sailed in quest of the great continent then supposed to exist in the South Pacific, and reached the islands of New Zealand, which had remained a *terra incognita* since the time of their first discovery. His attempts to penetrate to the interior, however, were thwarted by the continued hostility of the natives; and he had to content himself with a voyage of six months' duration round the coast, in which he traced the existence of a narrow channel dividing the territory of New Zealand into two large islands. From New Zealand he proceeded to New Holland, and on the 28th April came in sight of Botany Bay. On account of the hostility of the natives, his discoveries here also were confined to the coast, of which he took possession in the name of Great Britain. The prosecution of this voyage was attended with the most imminent dangers, which on several occasions threatened the entire loss of the ship and crew.

From New Holland he sailed to New Guinea, establishing the complete separation of the two islands; and thence to Batavia, where his ship, greatly shattered and disabled, had to put in for repairs. During their stay the pestilential nature of the climate caused an extraordinary sickness among the crew, of whom 30 died before the vessel reached St Helena. Arriving in England June 11, 1771, Cook was immediately raised by the king to the rank of captain.

Shortly after his return, the existence of a great southern continent began to be matter of renewed speculation, and Cook was again appointed to conduct an exploratory expedition in higher southern latitudes than those which he had formerly traversed. For this purpose he was placed in command of the Resolution, a ship of 462 tons burden, and a smaller ship called the Adventure, with a complement in all of 193 men. Setting sail from Plymouth July 13, 1772, he reached Madeira on the 29th of the same month, and after touching at the Cape of Good Hope, he made his traverses in the specified latitudes, but without discovering land. Satisfied that no land existed within the limits of his researches, he abandoned the investigation on the 17th Jan. 1773, and sailed for New Zealand. Cook.

After wintering among the Society Islands, Cook again set out to explore the same latitudes further to the eastward, between Lat. 60° and 70°; and afterwards steering northward, he navigated the southern tropic from Easter Island to the New Hebrides, and discovered the island named by him New Caledonia. After a third traverse in still higher latitudes, he at length gave up all hope of finding land, and returned to England, where he arrived July 30, 1774. On his return, he was immediately raised to the rank of post captain, appointed captain of Greenwich Hospital, and soon afterwards unanimously elected a member of the Royal Society; from whom he received the prize of the Copley gold medal for the best experimental paper which had appeared during the year.

During the absence of Cook in the southern seas, the attention of government had been turned towards the discovery of a north-west passage in the arctic regions; and while it was thought unfair to appoint him immediately to the command of a third laborious expedition, every effort was made to enlist his services for the purpose. Stimulated by the glowing descriptions of the results likely to follow from the discovery, he at length volunteered to conduct the expedition, and his offer was willingly accepted.

Two ships, the Resolution and the Discovery, the latter under the command of Captain Charles Clerke, were speedily equipped and placed under his care. His instructions were, to sail first into the Pacific through the chain of the newly discovered islands which he had recently visited, and on reaching New Albion to proceed northward as far as Lat. 65°, and then to endeavour to find a passage to the Atlantic by the high northern latitudes, between Asia and America. To aid in the expedition, several ships were fitted out to attempt a passage on the other side from the Atlantic to the Pacific Ocean. Setting sail from the Nore June 25, 1776, he cruised for a considerable time in the South Pacific, discovering several small islands; and in the spring of 1777, judging it too far advanced in the season for attempting the navigation of the northern seas, he bore away to the Friendly Islands. Here he continued for several months, and only set sail for the north in January 1778. On his passage from the Friendly Islands, he discovered a group which he named the Sandwich Islands, after the Earl of Sandwich, who had taken great interest in the expedition. After circumnavigating these, and laying down their position in a chart, Cook reached the coast of America in March 1778; and following the coastline northward, penetrated into the bay afterwards known as Cook's Inlet. Disappointed of a passage in this direction, he sailed for Behring's Straits, where he found the passage again intercepted by an impenetrable wall of ice. Returning to winter at the Sandwich Islands, he discovered Mowee and Owhyhee, at the latter of which he met his tragical death. During the night of the 13th February 1779, one of the Discovery's boats was stolen by the natives; and Cook, in order to recover it, proceeded to put in force the usual expedient of seizing the person of the king until reparation should be made. Having landed on the following day, a scuffle ensued with the natives, which compelled the party of marines who attended him to retreat to their boats. Cook was the last to retire; and as he was nearing the shore he received a blow from behind which felled him to the ground. He rose immediately, and vigorously resisted the crowds that pressed upon him; but as the boat's crews, partly from confusion and partly from the distance at which they were compelled to act, could render

Cooke || Coomassie.

him no assistance, he was soon overpowered. His body was left in possession of the natives, and on the return of the crews only the bones could be recovered. These were carefully put into a coffin, and committed to the deep with the usual honours, Feb. 21, 1779.

Captain Cook was a man of plain address and appearance, but looked well, and was upwards of six feet in height. His head was small; and he wore his hair, which was brown, tied behind. His face was full of expression; his nose well shaped; his eyes small, quick, and piercing; and his eyebrows prominent, which gave his countenance altogether an air of austerity. But notwithstanding his appearance, it was impossible for any one to excel him in kindness of disposition; as is evident from the whole tenor of his behaviour both to his own men and the many savage tribes with whom he had occasion to interfere.

As a navigator, the merits of Captain Cook were of the very highest order. His sagacity, decision, and perseverance, enabled him to overcome all difficulties; while his humanity and sympathetic kindness rendered him a favourite with his crews. His valuable researches into the nature and use of antiscorbutic medicines have proved of the highest utility to the navy of his country. The account of his first voyage was published under the care of Dr Hawkesworth, but his second was chronicled directly by himself. A narrative of his third voyage was published from his notes by Lieutenant King. Distinguished honours were paid to his memory both at home and by foreign courts; and a suitable pension was settled upon his widow.

After the death of Cook, the command of the expedition devolved on Captain Charles Clerke; and after an unsuccessful attempt to penetrate the Polar Sea in the following summer the ships returned to England in Oct. 1780.

COOKE, Sir Anthony, tutor to Edward VI., was born in 1506, and was descended from Sir Thomas Cooke, lord mayor of London. He is supposed to have been educated at Cambridge, where he soon became eminent for his learning and piety. He had four daughters, whom he educated in the same manly studies with the prince. Of these, Mildred was afterwards married to Lord Burghley; Anne to Sir Nicholas Bacon, lord keeper of the great seal; Elizabeth to Sir John Russell, son and heir of the earl of Bedford; and Catharine to Sir Henry Killigrew. Sir Anthony lived in exile during the persecution under Mary; but returned on the accession of Queen Elizabeth, and died in 1576.

COOKSTOWN, a town of Ireland, county of Tyrone, and barony of Upper Dungannon, on the Ballinderry, 14 miles north of Dungannon. The town consists of one long wide street planted with trees on each side. It has a large Gothic parish church, neat market-house, court-house, linen-hall, and union workhouse. Its principal trade is in linens. Pop. (1851) 2993, exclusive of 296 in workhouse.

COOMASSIE, in Africa, the capital of the Ashantee country, is situated upon the side of a large rocky hill, and is nearly surrounded by a marsh. It is built in an oblong form, and is about four miles in circumference, exclusive of the suburbs, which are about half a mile distant, and were formerly connected by streets with the city. Four of the principal streets are half a mile long, and from 50 to 100 yards broad. A long and wide street runs through the middle of the town; and here the palace and other residences of the royal family are situated. At the back of it there is a small grove, into which are thrown the bodies of all the victims sacrificed in the barbarous rites of the Ashantee superstition. The town is supplied with water from the marsh, which contains springs. The existence of this swamp, however, is highly injurious to the place, giving rise to a putrid exhalation, which envelopes the town in a dense fog, and thus engenders disease. The markets of Coomassie are plentifully supplied with the various necessaries of life. Pop. estimated by Bowdich at about 15,000.

Coomta || Cooper.

COOMTA, in Hindustan, a seaport-town in the British district of Canara, within the limits of the presidency of Madras. The place is of importance from its presenting greater natural advantages as a port than most others on the western coast of India, between Bombay and Cochin. It has accordingly been selected as the port of shipment for the cotton wool produced in the southern Mahratta country and the [illegible] of Bellary. These districts contain the principal cotton marts of the south of India, and an easy communication between them and the coast has been recently opened by means of an excellent road measuring upwards of 130 miles in length. A headland protects the roadstead from the N.W. wind, which usually prevails during the shipping season, and hence the bay is comparatively calm at that time of the year. It is however exposed to the S.W. monsoon, after the commencement of which it is unsafe for country vessels to remain there. Distance from Bombay S.E. 328 miles. Lat. 14. 26., Long. 74. 29. (E. T.)

COONOOR, in Hindustan, one of the minor sanitary stations on the Neelgherry hills, within the limits of the presidency of Madras. The site is about 6000 feet above the level of the sea, and from its inferior elevation the settlement presents to the invalid an intermediate station with a more temperate climate, previous to exposure on the higher level of Ootacamund. Coonoor is situate on the crest of the hills at the head of the magnificent ghaut or pass of the same name, and is distant ten miles from the commencement of the ascent at the base of the hills. From Coonoor to Ootacamund, a farther distance of ten miles with a gradual rise of 1700 feet, there is an excellent road. The mean annual temperature at Coonoor is given at 62°, the annual rainfall at 55 inches. Distance from Coimbatore N. 26 miles. Lat. 11. 21., Long. 76. 56. (E. T.)

COOPER (Dutch *kuiper*), an artificer who makes casks and coops, tubs, barrels, and all kinds of wooden vessels which are bound together with hoops.

The art of the cooper is of great antiquity, and soon attained all the perfection which it at present possesses.

There are some countries, however, in which it is as yet unknown; and in others, from the scarcity of wood and other causes, earthen vessels and skins lined with pitch are used for containing liquors. The Latin word *dolium*, usually translated a cask, was employed by the Romans to denote earthen vessels used for the same purposes. The word *dolare*, to chip with an axe, to hew, from which *dolium* is derived, and the word *dolarius*, a cooper, may naturally enough be applied, the former to the construction of casks, which are made of several pieces of wood planed and fitted for joining together, and the latter to the artificer himself.

Pliny ascribes the invention of casks to the people who lived at the foot of the Alps. In his time they lined them with pitch. From A.D. 70, in the time of Tiberius and Vespasian, the art of constructing vessels of different pieces of wood seems to have been well known. Indeed, previous to this period, Varro and Columella, in detailing the precepts of rural economy, speak distinctly of vessels formed of different pieces, and bound together with circles of wood, or hoops. The fabrication of casks, on account of the great abundance of wood, was probably very early introduced into France. It is uncertain when this art was first practised in Britain; but it seems not improbable that it was derived from the French.

The figure of a cask is that of two truncated cones, or rather conoids, joined together; for the lines are not straight, as in the cone, but are curved from the vertex to the base. The part of greatest circumference is called the belly of the cask. In the choice of wood, old, thick, and straight trees are preferred, from which thin planks are hewn, and then formed into staves. In France the wood is prepared in winter: the staves and bottoms are then formed, and they are

Cooper. put together, or, in the language of the artificer, the cask is mounted, in summer. Planing the staves is one of the most difficult, and at the same time most important parts of the work. In dressing staves with the plane, the workman is directed to cut across the wood, in order probably to prevent the instrument following the course of the fibres, which may not always be in the same plane with the surface of the stave, and thus render it of unequal thickness.

In the formation of the staves, it ought to be recollected that each must constitute part of a double conoid. It must therefore be broader at the middle, and gradually become narrower, but not in straight lines, towards the extremities. The outside of the staves across the wood must be wrought into the segment of a circle, and it must be thickest near the middle, growing gradually thinner towards the ends. Great experience is requisite for the nice adjustment of the different curves to the size and shape of the cask; but less attention is paid to the rounding or dressing of the inside of the stave.

After the staves have been dressed and are ready to be arranged in a circular form, it might be supposed necessary, for the purpose of making the seams tight, to trim the thin edges in such a manner that the contiguous staves may be brought into firm contact throughout the whole joint, or sloped similar to the arch-stones of a bridge. But this is not the practice usually followed by the artificer. Without attempting to slope them so that the whole surface of the edge may touch in every point, he brings the contiguous staves into contact only at the inner surface; and in this way, by driving the hoops hard, he can make a closer joint than could be done by sloping them from the outer to the inner side. In this, perhaps, and in giving the proper curvature to the staves, consist the principal part of the cooper's art. Machinery is now frequently employed in preparing the staves.

COOPER, *Antony Ashley*, first Earl of Shaftesbury, was the son of Sir John Cooper, Bart., of Rockburn, Hampshire, and was born at Wimborne, St Giles, July 22, 1621. He inherited the patrimonial estates when only ten years of age, and was entered at Exeter College, Oxford, in 1636. After studying law for a short time at Lincoln's Inn, he was chosen one of the representatives of Tewkesbury, when only nineteen, and took his seat in the short parliament of 1640. Although zealously attached to the royal interest, he did not sit in the long parliament. Having incurred the suspicions of the court during his government of Weymouth, he joined the parliamentarian party, accepted a commission during the civil war, and signalized himself by storming Wareham and reducing the surrounding country. As member for Wiltshire he took his seat in Barebone's parliament; and though avowedly hostile to the measures of the protector, he formed one of his council of state. He continued his opposition unmolested for several parliaments, and after the death of Cromwell he joined his enemies in depreciating his memory. After the deposition of Richard Cromwell, Sir Antony lent his whole energies to the party who favoured the Restoration, and was one of the commissioners sent over to Breda with an invitation to the king. For his services on this occasion he was appointed chancellor of the exchequer, and made a privy-councillor; and these honours were quickly followed by his elevation to the peerage as Baron Ashley of Wimborne, St Giles. In his new situation he made himself conspicuous by the indelicate zeal with which he prosecuted his duties as commissioner for the trial of the regicides; but his fortunes, which rose with every tide of politics, gained him admiration even from the party which he had betrayed. With Clarendon he stood in the same relation in which he had formerly stood to Cromwell, resisting the favourite measures of the ministry, but never with such violence as to endanger his office or damage his chance of promotion. In this way, though opposing the Uniformity Bill, the French connection, and the Dutch war, he secured to himself a seat in the treasury; and ultimately sacrificing his views on the question of the French alliance to the inclination of Charles, he became one of the most powerful members of the famous Cabal administration. (See BRITAIN, vol. v., p. 425.) In 1672 he was created Earl of Shaftesbury, and soon after raised to the post of lord high chancellor; but in 1673 he was dismissed from office, and on the fall of the Cabal he, along with Buckingham, made peace with the opposition, and appeared at the head of the stormy democracy of the city. Throwing himself into the current of the anti-popish agitation, he made the alleged martyrdom of his dismissal from office a means of swelling his influence with the people; and in the following sessions of parliament he found himself surrounded by a band of faithful supporters. The government, outvoted in the house, had recourse to frequent prorogations; and when at length compelled to meet for pressing business, Shaftesbury contended that such frequent interruptions amounted to a virtual dissolution. For this he was ordered humbly to beg the king's pardon, and refusing, was committed to the Tower. At the intercession of the lords he was soon after released, and in the trials of Titus Oates and his confederates he found a golden opportunity of gratifying his revenge, and extending his popularity. In the new council formed under Temple, Shaftesbury was appointed lord president, and had the honour of carrying through parliament the famous *Habeas Corpus* Act. He was, however, soon after dismissed from office; and placing himself at the head of the exclusionist party, he cited the Duke of York before the court of king's bench as a popish recusant. The trial failed, but the commons eagerly took up the cause, and the danger was averted only by repeated prorogations, which allowed time for a Tory reaction. In 1681 the government resolved to strike a decisive blow by bringing Shaftesbury to trial for his life. Fortunately for him the jurymen before whom he was arraigned were citizens of London, where the Whigs were still dominant, and the bill was thrown out. Foreseeing, however, that the ruin of his party was at hand, after a fruitless effort to raise an armed rebellion, he retired to Holland, where he died Jan. 21, 1683. In regard to the character of Shaftesbury we have the contemporary portraits of Butler and Dryden. The one depicts his wondrous versatility and perfidious restlessness; and dwells especially on his dexterity at every change of fortune in extricating himself from the snares in which he left his associates to perish. The other, writing at the close of his career, has blended these with the equally characteristic traits of implacable revenge, and boldness amounting to temerity.

> Of these the false Achitophel was first;
> A name to all succeeding ages cursed;
> For close designs and crooked counsels fit;
> Sagacious, bold, and turbulent of wit;
> Restless, unfixed in principles and place;
> In power unpleased, impatient of disgrace;
> A fiery soul, which, working out its way,
> Fretted the pigmy-body to decay,
> And o'er-inform'd the tenement of clay.
> A daring pilot in extremity;
> Pleased with the danger, when the waves went high
> He sought the storms; but for a calm unfit,
> Would steer too nigh the sands to boast his wit.
>
> *Absalom and Achitophel*, 150-162.

Shaftesbury left behind him the *Memoirs of his own Time*; but the MS. is said to have been destroyed by his friend Locke, to whom it was confided. His Life was drawn up and published by his grandson, under the editorial care of Dr Kippis and B. Martin. It has since been reprinted.

COOPER, *Anthony Ashley*, third Earl of Shaftesbury, and grandson of the preceding, was born in 1671, at Exeter House, London, where his grandfather then resided. In 1683 he was sent to Winchester school; but the memory of his grandfather subjected him to frequent insults, and he

Cooper. prevailed on his father to travel with him abroad. In 1689 he returned to England; and after an interval of five years spent in study, he was elected member of parliament for Poole. In the House of Commons he distinguished himself principally by the share which he had in promoting "the act for regulating trials in cases of high treason;" but his health was so much impaired by his attendance, that in 1698 he was induced to resign his seat and retire to Holland, where he enjoyed the friendship of Bayle, Le Clerc, and other learned men. During his absence there appeared at London an imperfect edition of his *Inquiry concerning Virtue*, surreptitiously taken from a rough sketch made when he was twenty years of age. He succeeded in buying up the impression before many copies were sold, but this circumstance induced him to complete the treatise, which afterwards appeared in the second volume of the *Characteristics*. Soon after his return to England, he became Earl of Shaftesbury, on the decease of his father. In the House of Lords he exerted himself in supporting the measures of King William, and would probably have been made secretary of state, but for the declining state of his health. He was, however, often consulted by the king on matters of the highest importance; and amongst other things he had the principal share in composing the celebrated last speech of King William, delivered Dec. 31, 1701. On the accession of Queen Anne he retired to private life; and in 1703 paid a second visit to Holland. It was during this tour that, in reference to the extravagancies of the French prophets, he wrote the *Letter concerning Enthusiasm*, which was published in 1708. His *Moralists*, a philosophical rhapsody, appeared in January 1709; and in the May following his *Sensus Communis*, an essay upon the freedom of wit and humour in a letter to a friend. In 1710 was published his *Soliloquy, or Advice to an Author*. While thus employed in literary composition, the declining state of his health rendered it necessary for him to try the benefit of a warmer climate. Accordingly, in 1711, he proceeded to Naples, where, after a brief interval of comparative convalescence, in which he was able to resume his literary pursuits, he died Feb. 15, 1713.

The first complete edition of the *Characteristics* was published in 1711; but after his death there appeared a more elegant edition, containing his final corrections, and embellished with prints designed by himself. In the three volumes of the *Characteristics of Men, Manners, Opinions, and Times*, he included the whole of his works which he intended for the public eye. Not long before his death he commenced to write a discourse on painting, sculpture, and the other arts of design, but his premature death prevented him from making much progress in the undertaking. He had a high esteem for the works of the great English divines, and wrote a preface to a volume of Dr Whichcot's Sermons published in 1698. For an account of his ethical system and a critique on his works, see Sir James Mackintosh's *Preliminary Dissertation* to this work.

COOPER, *Sir Astley*, Bart., the celebrated surgeon, was the fourth son of the Rev. Dr Cooper, and was born at the village of Brooke, in Norfolk, Aug. 23, 1768. It is said that in early youth he was less distinguished for any precocity of intellect or love of study than for his vivacity and good humour. In his choice of surgery as a profession he seems to have received a bias from a circumstance that could scarcely fail to make a considerable impression on his youthful mind. One day he found a boy with his thigh severely lacerated by a cart-wheel, which had laid open the femoral artery, so that he was in danger of bleeding to death. With much presence of mind, young Astley Cooper bound his handkerchief tightly around the upper part of the thigh, and thus succeeded in arresting the circulation in the vessel until professional assistance could be procured.

In August 1784 he was sent to London and placed under Mr Cline, surgeon to St Thomas's Hospital, one of the most celebrated surgeons of the time. As he became early impressed with the necessity of a correct knowledge of anatomy, he assiduously attended the dissecting rooms, and seems to have profited largely from the lectures of the celebrated John Hunter. In 1787 he visited Edinburgh; and on his return was appointed demonstrator of anatomy at St Thomas's Hospital. In 1791 he was permitted to deliver part of the course of lectures on anatomy and surgery then given by Mr Cline. This year he married; and in the spring of 1792 visited Paris. The outbreak of the revolution on the 10th August obliged him to return to London, when he delivered a course of lectures on surgery distinct from the course of anatomy, with which it was then generally associated. He was also this year appointed professor of anatomy to Surgeons' Hall; a situation which he again filled in 1794 and 1795. In 1800 he was appointed surgeon to Guy's Hospital, on the death of his uncle William Cooper. Two years previously he had published a volume of papers entitled "Medical Records and Researches;" and in 1802 he received the award of the Copley medal for two papers read before the Royal Society of London on the effects resulting from the destruction of the membrana tympani. He was elected a fellow of the Royal Society in 1805. Having taken an active part in the formation of the Medico-Chirurgical Society, he published in the first volume of its Transactions an account of an unsuccessful attempt to tie the carotid artery. In 1804 he brought out the first, and in 1807 the second, part of his great work on Hernia; the operation for which, on account of the defective knowledge of the local anatomy, was then frequently unsuccessful. So greatly did this work add to his reputation, that in 1813 his annual professional income rose to L.21,000 sterling. He was soon after appointed professor of Comparative Anatomy to the Royal College of Surgeons; and in 1817 he performed one of the most remarkable operations of surgery, that of tying the aorta. In the following year, along with Mr Travers, he commenced publishing a series of *Surgical Essays*, but only two parts of the work appeared. In 1820, having been called to attend on George IV. (although he held no official appointment at court), he removed a stratomatous tumour from the head of the king. About six months afterwards he accepted a baronetcy, which, as he had no son, was to descend to his adopted son and nephew, Astley Cooper. In 1822 he was elected one of the Court of Examiners of the College of Surgeons; and the same year he brought out his great work on *Dislocations and Fractures*. In 1827 he was elected president of the Royal College of Surgeons; but grief for the loss of his wife, and his own previous ill health, induced him to resign his practice, and retire to his estates at Gadesbridge. He soon, however, tired of a country life; and returning to London, resumed his practice in the following year, when he married again, and was appointed sergeant-surgeon to the king.

In 1829 appeared the first part of his *Treatise on the Anatomy and Diseases of the Breast*, the publication of which extended to the year 1840. In 1830 he was elected a vice-president of the Royal Society; and in 1832 he published his *Anatomy of the Thymus Gland*. In 1837 he visited Edinburgh, when the freedom of the city was voted him, and he was entertained at a public dinner given by the Royal College of Surgeons. He also received the honorary degree of LL.D. from the University of Edinburgh.

For about a year previous to his death, Sir Astley was subject to frequent attacks of giddiness, accompanied with difficulty of breathing, which gradually increased till the 12th Feb. 1841, when he died at the advanced age of 73. He was interred, by his own desire, beneath the chapel of Guy's Hospital; and a colossal statue by Bailey was erected to his memory in St Paul's Cathedral.

Cooper. COOPER, *James Fenimore*, the American novelist, son of Judge Cooper, was born at Burlington, New Jersey, Sept. 15, 1789. At the age of thirteen he became a student in Yale College, and speedily distinguished himself by his classical acquirements. In 1805 he entered the American navy as a midshipman, and continued in that service for six years. This was the school in which he obtained that nautical knowledge which is conspicuous in his works, and in which he laid the foundation of his spirited descriptions of naval life. In 1810 he quitted the service, and settled on his patrimonial estate at Cooper's Town. He then married, and thenceforward devoted himself to literary pursuits. He had previously published *Precaution*, a novel, which fell nearly still-born from the press. This, however, did not discourage him; and in the fifteen succeeding years he poured forth other creations of his fancy, with almost unprecedented exuberance, as in *The Pioneer*, *The Pilot*, *Lionel Lincoln*, *The Last of the Mohicans*, &c. In 1826 he first visited Europe, where he remained a considerable time; and there he produced some of his most popular novels, as *The Bravo*, *The Red Rover*, and *The Prairie*. Everywhere in Europe he was cordially received by men of letters and by the public.

On returning to his native country he continued his literary avocations, and among other works he produced *The Pathfinder*, *The Destroyer*, *The Two Admirals*, *Wing and Wing*, works that well sustained his reputation; but some of his later productions exhibited strong marks of decaying powers. It is creditable to Cooper that the moral of his tales is always good, and that he proved himself the friend of virtue; and if he wants the exquisite knowledge of human nature that we recognise in Scott, he exhibits the same admiration for purity and magnanimity. (T. S. T.)

COOPER, *John Gilbert* (1723–1769), a miscellaneous writer, descended from a decayed family in the county of Nottingham, where his father was high sheriff in 1739. He was educated at Westminster school, and at Trinity College, Cambridge. His first attempts at authorship consisted in the publication anonymously, in 1745, of a poem entitled *The Power of Harmony*, and in contributing under the signature of Philalethes several essays and poems to Dodsley's *Museum*. These were soon after followed by the *Life of Socrates*, compiled chiefly from Xenophon and Plato. In 1754 Cooper published his *Letters on Taste*, and in the following year *The Tomb of Shakspeare, a Vision*. In 1756 he assisted Moore in writing for the *World*, and published a variety of occasional pieces, including a translation of Gresset's *Ver-Vert*. His poems were afterwards collected and published with a preface by Dodsley.

COOPER, *Samuel*, a miniature painter of surpassing excellence, was born in London in 1609. He appears to have united great spirit and expression with careful finish. Among his finest productions is the head of Cromwell, engraved by Vertue, and the portrait of a Mr Swingfield, which gained him the highest applause and patronage at Paris, as well as in Holland, where he resided for some time. After the Restoration he returned to London, and was much employed by the court of Charles II. Cooper died there in 1672, and was buried in the church of St Pancras, where there is a monument to his memory.

COOPER, *Samuel*, F.R.S., was deservedly celebrated for the variety and extent of his surgical information. He was admitted a member of the Royal College of Surgeons in 1803, and soon afterwards entered the army and became staff surgeon. In 1807 he obtained the Jacksonian prize for an elaborate *Treatise on the Joints*; and in 1832 he delivered the annual oration in memory of the founder of the Hunterian Museum. In 1835 he was appointed an examiner, and in 1845 was elected president, of the Royal College of Surgeons. For 17 years he was connected with the London University College and Hospital, and obtained great popularity as a teacher. On the death of Mr Liston, in 1847, a misunderstanding arose between Mr Cooper and the senate in regard to the appointment of a successor, which induced him to resign his appointments. He retired to his country residence at Shipperton, where he died Dec. 3, 1848, in the 68th year of his age. He is the author of *First Lines of the Practice of Surgery*, and of a *Dictionary of Surgery*. Cooper || Coorg.

COOPER or COUPER, *Thomas* (1517–1594), bishop of Winchester in the reign of Queen Elizabeth, was born at Oxford. In 1540 he was elected fellow of Magdalene College; but on the accession of Mary he resigned his fellowship, and applied himself to the study of medicine. Having taken the degree of bachelor in that faculty in 1556, he continued to practise as a physician at Oxford till the accession of Elizabeth, when he resumed the study of divinity, and became a distinguished preacher. He was afterwards appointed dean of Christ-Church and vice-chancellor of the university, having previously taken the degrees of bachelor and doctor in divinity. In 1569 he was made dean of Gloucester, and in the following year bishop of Lincoln, whence in 1584 he was translated to the see of Winchester. He wrote, 1. *The Epitome of Chronicles*, from A.D. 17 to 1560; 2. *Thesaurus Linguæ Romanæ et Britannicæ*, and *Dictionarium Historicum et Poeticum*, 1565, folio, which was highly valued by Queen Elizabeth, and procured his promotion; 3. *A Brief Exposition of the Chapters of the Old Testament usually read in the Church on Sundays*, 1573, 4to; 4. *An Admonition to the People of England*, 1589, 4to; besides some miscellaneous Sermons.

COORG, a mountainous and woody district of Southern India, among the western Ghauts, situated between the kingdom of Mysore and the British province of Malabar. This country lies between Lat. 11. 56. and 12. 45., Long. 75. 25. and 76. 13., and extends about 60 miles from N. to S., and 35 from E. to W., with a superficies of 1420 square miles. The mountains produce sandal wood of the very best species, teak timber, rice, pepper, and some other spices. The woods also abound with elephants and ferocious animals, especially tigers. Previous to its conquest by the British, the country had been governed by a line of rajahs of the Nair caste of Hindus, who are mentioned in history as early as the year 1583. The ascendency of the last family of these rulers dates from the year 1632. Its princes retained their independence till the year 1773, when Hyder Ali, who had in vain attempted to subdue them, found an opportunity for interfering in a dispute about the succession, and, by the destruction of one of the parties and the captivity of the other, took possession of the country. Upon Tippoo's accession to the sovereignty, he ordered the royal prisoner to be removed from Bednore to the fort of Periapatam; whence having made his escape in the year 1778, his faithful subjects crowded to his standard, and drove the armies of Tippoo from his dominions. In the war which the British declared against Tippoo in the year 1791, they found the rajah of Coorg a useful auxiliary; and upon the termination of hostilities, it was determined to transfer his tributary dependence from Tippoo to the power whose interests the rajah had so zealously served. This was accomplished by the treaty of 1792. The change, however, though beneficial to the ruling family in Coorg, did not secure the permanent advantage of its subjects. After a time it was discovered that, under a succeeding rajah, oppression and misgovernment had been substituted for the calamities of war. At length the tyranny of the rajah became intolerable. In 1832 fugitives from his vengeance appeared within the British territories, and implored the protection of the ruling authorities. These parties were not criminals; and as the object of their flight was not to elude the claims of justice, but solely to withdraw from the violence of tyranny, the asylum which they sought was ac-

Coote || Copais.

corded to them. The claim of the rajah to their surrender was disregarded, but at the same time negotiations were set on foot by the British government to explain to the rajah the grounds of their refusal, and to remove any unfavourable impression which it was calculated to produce. These, however, were relinquished upon the detention by the rajah of the British emissary, and recourse was had to arms. The result may be briefly told. Coorg was subdued and annexed to the British dominions, and a stipend of L.6000 a-year bestowed upon the chief. The population in 1836 has been officially returned at 65,437. Since the annexation of the territory to the British empire, its revenue has improved, cultivation has been extended, and the general prosperity of the country is stated to have steadily increased. The rajah is now (1854) in this country, where his daughter is to be educated in the Christian faith; the Queen and Sir James Weir Hogg, chairman of the East India Company, having been sponsors at her baptism. (E. T.)

COOTE, SIR EYRE, a celebrated general, was born in Ireland in 1726. He served against the rebels in 1745; and afterwards went to the East Indies, where he became commander-in-chief, and gained several distinguished victories. He died at Madras in 1783; and a monument has been erected to his memory in Westminster Abbey. See HINDUSTAN.

COOTEHILL, a town of Ireland, county of Cavan, on a small river of the same name, 28 miles W.N.W. of Dundalk. The town consists chiefly of four wide streets; and has a market-house, court-house, bridewell, a neat parish church, Roman Catholic chapel, and several places of worship for other bodies. It has also an active trade in linen and agricultural produce. Pop. (1851) 2105, besides 1101 in workhouse.

COPAE, a town of Bœotia. See COPAIS.

COPAIBA, or BALSAM OF COPAIVA, is the fluid resinous exudation of various species of Copaiferæ, which are tall handsome trees, belonging to the natural order *Leguminosæ*, and are chiefly natives of the tropical parts of South America and of the West Indies. The juice is properly a turpentine and not a balsam, as it contains no benzoic acid. It is obtained from deep incisions made into the trunks of the trees during the wet season, or immediately afterwards. The juice which flows from the incisions is collected in calabashes, after which the incisions are closed with wax or with clay. The balsam obtained differs somewhat in colour, consistence, acridity, quantity of volatile oil, &c., according to the species of trees from which it has been obtained, and the season of the year at which it has been extracted. Two kinds are principally met with in the English market—the Brazil and the West Indian. The Brazil copaiba, which is the most esteemed, is rather thinner in consistence than new honey, is transparent, pale wine-yellow in colour, has a peculiar resinous not unpleasant odour, and a mild, slightly aromatic, oily taste, which soon becomes acrid and bitter. The West Indian copaiba is of thicker consistence, darker in colour, is less agreeably aromatic, and has a more acrid, bitter taste When the balsam is subjected to distillation along with water, it yields a volatile oil, which possesses all the valuable properties of the copaiba, and a resinous residuum. The volatile oil seems identical in composition with oil of turpentine. Copaiba, both in its state of balsam and of essential oil, acts as a stimulant to the mucous surfaces, and is consequently chiefly employed in cases where there is an excessive secretion from these surfaces. Hence in chronic bronchitis, in gonorrhœa, and some other diseases, it is largely prescribed, and is found to be a valuable remedy—its action in some being considered quite specific. The best is the production of *Copaifera guianensis*, and *C. Langsdorffii*; the West Indian chiefly of *C. officinalis* or *Jaquini*.

COPAIS, an extensive lake in Northern Bœotia, so called from the town of Copæ, at its northern extremity. This lake is mentioned in the ancient classics under many names. By Homer it is called *Cephissis*, from the name of the river Cephissus, which falls into it; while by other writers it is called *Onchestus*, *Orchomenos*, *Haliartus*, &c., from the towns of those names on its shores. The waters of the lake are deepest at its northern extremity, on which Copæ stands, and since they were never dried up there in the hottest summer, as they generally were in the neighbourhood of the other towns, the title *Copais* was gradually recognised as the most appropriate. The lake itself was formed by the waters of the Cephissus, which, instead of flowing into the sea by an open channel, spreads itself over an extensive tract of low-lying country, surrounded on every side by lofty mountains. Four principal catavothra serve to draw off the superfluous waters of the Copais into the sea; but as these were found to be sometimes insufficient, two great artificial tunnels were constructed at a very early period at the depth of more than 100 feet below the ground, and with shafts let down into them at regular distances. By means of these tunnels the bottom of the lake was originally kept dry, and either served as pasture ground for immense herds of cattle, or yielded valuable corn crops to the inhabitants of the cities on its banks. In course of time the tunnels were choked up, and though attempts were made by Alexander the Great to clear them out, they were never again rendered fully serviceable. In consequence of this neglect, the waters of the river were gradually allowed to accumulate, and now form, according to the description of Colonel Mure, "a large yellow swamp, overgrown with sedge reeds and canes, through which the river may be distinguished oozing its sluggish path for several miles. Even where the course of the stream could no longer be traced in one uninterrupted line, the partial openings among the reeds in the distance appeared but a continuation of its windings. Nor is the transition from dry land to water in any place distinctly perceptible; the only visible line of boundary between them, unless where the mountains stretch down to the shore, is the encroachment of the reeds on the arable soil, or the absence of the villages with which the terra firma is here studded in greater numbers than usual."

Copal.

COPAL, a pure resin which exudes from the *Rhus copallinum*, a tree which is a native of Mexico; and also from the *Elæocarpus copalifer*, an East Indian tree, as well as from some unascertained trees on the Guinea coast. Copal occurs in lumps of various sizes, and it has different shades of colour and degrees of transparency, from the palest and most transparent greenish-yellow hue, to a dark and somewhat opaque brown. It is too hard to be scratched by the nail, and hence the durability of the varnish prepared from it. It breaks with a conchoidal fracture, and possesses neither sensible taste nor odour. Copal forms one of the most valuable varnishes we possess, but it is extremely insoluble in the various menstrua while in its ordinary state. It is soluble in ether, and the solution may be mixed with alcohol without precipitating it. It is insoluble in boiling alcohol of the strength 0·825, but one and a half parts of anhydrous alcohol digested for 24 hours with one part of copal dissolves it completely; that portion of the copal which is insoluble in alcohol being soluble in a saturated solution of that portion which is soluble in the anhydrous alcohol. Camphor, however, possesses the peculiar property of enabling alcohol to dissolve copal in the cold. Pure caoutchoucine acts very feebly on copal even at the boiling temperature; but equal parts of this fluid and of alcohol of 0·825 strength, according to Dr Ure, readily dissolve copal without the aid of heat, forming a perfectly liquid varnish. Fresh rectified oil of rosemary dissolves the East Indian copal in any proportion; but it will not dissolve the West Indian, or more properly the Mexican, copal. Spirit of turpentine only dissolves from one to two per cent. of raw copal. When copal is melted by means of heat its solvent properties are greatly altered, and it then dissolves freely

Coparcenary || Copenhagen.

in alcohol and in turpentine—a property that is turned to account in the preparation of most of the varnishes made with this resin. See VARNISH.

COPARCENARY, the share or quota of a coparcener.

COPARCENERS (*con*, together, *particeps*, partner) or PARCENERS, such as have equal portions in the inheritance of their ancestor.

COPE, an ecclesiastical vestment, usually worn by chanters and subchanters when officiating in solemnity. It reaches from the shoulders to the ankles. The word also signifies anything spread or extended over the head, the roof of a house, &c.

COPENHAGEN (in Latin *Hafnia*), the capital of the Danish kingdom, was only a fishing village about the middle of the twelfth century when Valdemar I. made a present of it and some adjoining lands to Axel Hvide, renowned in Danish history as Absolon, bishop of Roeskilde, afterwards archbishop of Lund. In 1168, this prelate erected a castle on the spot where the Christiansborg palace now stands, and which was after him called Axel-huus. This castle protected the haven from the pirates who at that time infested the Baltic, and hence the town acquired its earliest name of *Havn* (the haven). As its trade increased it became a place of great resort for merchants, and took the name of *Kiöbmændhavn* (the haven of merchants), which has been contracted into *Kiobenhavn* its present nane. Bishop Absolon bestowed the castle and town with the lands of Amager on the see of Roeskilde. In 1254, Bishop Erlandsen of Roeskilde granted it municipal rights and privileges, and these were confirmed and augmented in 1284 by King Eric Glypping. The town having become of great importance and the most suitable for the royal residence, attempts were made by several kings to obtain it from the see of Roeskilde. But it was not till after a struggle of nearly two centuries that an arrangement was come to in 1443, and Copenhagen was made the royal residence and capital of the kingdom. The numerous fires and bombardments to which this city has been subjected have left no traces of its earlier buildings. It has been thrice destroyed by fire, and most of the present edifices have been built since the last fire in 1795. In 1801 Nelson here gained a great victory over the Danish fleet, and compelled Denmark to abandon its alliance with Napoleon against England. In 1807 it was bombarded by a British army under Lord Cathcart, when great injury was done to the city, and all the ships and military stores were conveyed to England.

Copenhagen is situated at the southern extremity of the Sound, which is here about 20 miles broad; in N. Lat. 55. 42., E. Long. 12. 34. The principal part is on the east coast of the island of Zeeland; the smaller called Christianshavn stands on the north coast of the island of Amager or Amak, and is separated from the former by a narrow arm of the sea, forming an excellent harbour. It is surrounded by ramparts and moats, and defended by 24 bastions besides outworks, and towards the sea by the strong citadel of Frederickshavn. The walls inclose a circuit of 5 miles, including the harbour and docks. With the exception of a few of the public buildings, the architecture of the city is totally devoid of beauty or picturesque effect; the houses are plain uninteresting structures, built of brick and stucco. The Zeeland portion of the city is divided into two nearly equal parts by the Gothers Gade, a street extending almost north and south from the city ramparts to the Strömmen or channel which separates Zeeland from Amager. The western division or old town consists for the most part of narrow winding streets, but contains the university and several of the finest churches, and the Castle Island, on which stand the Christiansborg palace, exchange, Thorwaldsen's museum, &c. The new town or eastern division is regularly built with wide streets; the southern and finest part being called Frederickstad. Christianshavn is united with the rest of the city by two bridges. Copenhagen contains 258 streets, and 17 public squares. The land entrances are the East, North-West, and Amager gates. The chief public squares are Amalienborg Plads or Fredericks Plads, a handsome octagon formed by four palaces of uniform size and design, and having in the centre an equestrian statue of Frederick V.; Kongens Nytorv (the King's new market), an irregular square, the largest in the city, with an equestrian statue of Christian V. in the centre, remarkable only for its size; the Gammel and Nytorv (old and new market) with a small fountain in the centre; the Slotsplads on which stands the Christiansborg palace, chapel royal, exchange, and chancery buildings. The citadel called Frederickshavn, standing on the north side, is a fortress of great strength. It is a regular polygon with 5 bastions, and is connected with the city by an esplanade. The ramparts of the town and citadel are planted with trees, and form agreeable promenades. Copenhagen.

The royal palace of Christiansborg, originally built by Christian VI., but afterwards destroyed by fire in 1794, has since been rebuilt on a scale altogether disproportioned to the extent or wealth of the kingdom. Over the principal entrance are two bas-reliefs by Thorwaldsen, representing Minerva and Prometheus, Hercules and Hebe, Jupiter and Nemesis, and Æsculapius and Hygeia. The Riddersal (knights' hall) is a magnificent apartment, 120 feet long, 44 feet high, and 50 feet wide, with a gallery supported by Corinthian columns. In the great entrance hall is the Triumphal March of Alexander into Babylon by Thorwaldsen. In the upper part of the building is the Royal Gallery of Paintings, containing about 1000 pictures, including many valuable specimens of the Flemish, Dutch, and Italian schools. The Royal Museum of Northern Antiquities, instituted in 1807, and now (1854) under the able direction of Mr Wörsae, occupies a suite of seven rooms in the north wing of the palace. It contains from 7000 to 8000 objects, and is particularly rich in weapons of all kinds, ornaments, &c. The palace also contains the council chamber and apartments in which both chambers of the diet hold their sittings. The large exterior court on the W. side of the palace forms a riding ground, and is inclosed on both sides by regular buildings with piazzas, containing the court theatre, stables, and riding-house. In connection with the palace is the royal library, containing an extensive collection of rare books and valuable MSS. amounting to about 400,000 volumes; and the chapel, adorned with works by Thorwaldsen and Bissen.

The palace of Rosenborg, supposed to have been planned by Inigo Jones, was erected in 1604. It is an irregular building in the Gothic style, with a high pointed roof, and flanked by four towers of unequal dimensions. It contains the coin and medal cabinet, a fine collection of Venetian glass, the famous silver drinking horn of Oldenburg, the regalia, and other objects of interest as illustrating the history of Denmark. The Riddersal, a spacious room, is covered with tapestry representing the various battles of Christian V., and has at one end a massive silver throne. The gardens are open to the public, and form an agreeable promenade. They were formerly much more extensive and contained numerous summer-houses, but they have now only a small pavilion and a fountain.

The palace of Charlottenborg, on the Kongens Nytorv, is a huge desolate-looking building, built in 1672. Frederick V. made a grant of it to the Academy of Arts; and the garden was in 1788 given to the university for a botanical garden.

The four palaces on the Amalienborg were built for the residence of four noble families; but on the destruction of Christiansborg in 1794 they became the residence of the king and court, and so continued till the death of Christian

Copenhagen.

VIII. in 1848. Prindsens palace originally belonged to a rich merchant, but was purchased by Frederick IV., and was the residence of Christian V. and Frederick VI. when crown princes. It now contains the Royal Museum of Art, the Ethnographical Museum, and other public collections. The chancery buildings, immediately adjoining the Christiansborg, and united to it by a corridor, consist of a large main building erected by Frederick IV., and of three others since added. Here are deposited the privy archives of the state and of the royal family. The town-hall and court-house (built 1805-1815) contains the municipal council chamber, the police and criminal courts, the pass office, &c. The exchange, situated on the Castle Island, is surmounted by a remarkable spire, formed of four dragons, with their heads pointing to the four points of the compass, and their bodies entwining each other till their tails come to a point at the top.

The museum of Thorwaldsen, built 1837-46, is in the Egyptian style of architecture, 230 feet in length, 125 feet in breadth, and 46 feet high, and consists of two stories. In the centre is an open court, 116 feet long and 50 feet broad, containing the artist's tomb. The exterior walls are decorated with groups of figures of coloured stucco, illustrative of events connected with the formation of the museum. Over the principal entrance is the chariot of Victory drawn by four horses, executed in bronze from a model by Bissen. The front hall, corridors, and apartments, are painted in the Pompeian style, with brilliant colours and with great artistic skill. The museum contains about 300 of Thorwaldsen's works; and in one apartment is the furniture of that artist's sitting-room, arranged as it was found at the time of his death in 1844.

The university is attended by about 1000 students, and has 34 professors, ordinary and extraordinary, divided in five faculties—theological, juridical, medical, philosophical, and mathematical. In 1851 an English, and in the following year an Anglo-Saxon lectureship, was established. All the professors are bound to give a series of lectures, which are open to the public gratis. It was founded by Christian I. in 1479, and possesses considerable endowments. The present stately edifice was completed in 1836. Connected with the university are several foundations for the assistance of poor students. The principal of these is the regent's charity, affording free residence and a small allowance to 100 students. Among the other scientific institutions may be mentioned the Royal College of Surgeons, Royal Veterinary College, Polytechnic School, Military Academy, Military High School, Naval Academy, botanic garden, and the observatory. The university library contains about 100,000 volumes, besides a large collection of valuable MSS. Both this and the Royal Library are entitled to a copy of every book published in Denmark. The Classenske Library contains about 35,000 volumes, chiefly on scientific subjects. The Athenæum reading room is well supplied with European newspapers and periodicals, and has a library of about 40,000 volumes.

The principal church or cathedral, the Fruekirke (Church of our Lady), was almost entirely destroyed in the bombardment of 1807, but has since been completely restored. The works of Thorwaldsen, by which it is adorned, constitute its chief attraction. In the pediment is a group in *terra cotta* of 16 figures, representing John the Baptist preaching in the wilderness; and over the entrance within the portico a bas-relief of Christ's entrance into Jerusalem. In a niche behind the altar is a colossal marble statue of our Saviour; and magnificent marble statues of the twelve apostles adorn both sides of the church. Nearly opposite the preceding is St Peter's church, built in a *quasi* Gothic style, and with a spire 260 feet high. The round tower of Trinity Church is 115 feet high, and is considered to be unique in Europe. It was constructed from a plan of Tycho Brahe's favourite disciple Longomontanus, and has on the summit an observatory which now is not used. It is ascended by a broad inclined spiral way, up which Peter the Great is said to have driven in a carriage and four. The church of our Saviour has a curious steeple 300 feet high, ascended by an external spiral staircase. The lower part of the altar is composed of Italian marble, with a representation of Christ's sufferings in the garden of Gethsemane. The organ is considered the finest in Copenhagen. The Marble Church, intended to have been an edifice of great extent and magnificence, was commenced in the reign of Frederick V., but after twenty years a stop was put to farther proceedings, and it is now little more than a melancholy ruin. The dome was to have risen 264 feet above the ground, the walls inside and outside of polished Norwegian marble, and the whole was to have been finished on the grandest scale. The church of St Nicholas, one of the oldest in the city, was almost destroyed by the fire of 1795. It has not been rebuilt, but the tower which escaped has been converted into a watch tower, where a watchman is stationed to give alarm on the appearance of fire.

Copenhagen.

Among the literary and scientific associations may be mentioned the Danish Royal Society, founded in 1742, for the advancement of the sciences of mathematics, astronomy, natural philosophy, &c., by the publication of papers and essays; the Royal Antiquarian Society for diffusing a knowledge of northern and Icelandic archæology, by the publication of Icelandic sagas, with commentaries, glossaries, &c.; the Society for the Promotion of Danish Literature, by the publication of works chiefly connected with the history of Danish literature; the Natural Philosophy Society; the Royal Agricultural Society; the Danish Church History Society; the Industrial Association; several musical societies, &c. There are asylums for the blind, deaf and dumb, orphans, and lunatics, the Royal Charity School, general, military, and naval hospitals, lying-in hospital, &c. The Academy of Arts was founded by Frederick V. in 1754, for the instruction of artists, and for disseminating a taste for the fine arts among manufacturers, operatives, and others. Attached to it are schools for the study of architecture, ornamental drawing, and modelling. The principal theatre is the Royal, on Kongens Nytorv, capable of containing about 1200 persons. The royal court theatre is elegantly fitted up, and can accommodate about 800 spectators. The Vesterbroe's theatre, outside the Western gate, is seated for about 1400 persons. The Casino, built in 1846, was originally planned for a variety of diversions, of which dramatic performances were only to form a subordinate part. The ground floor was laid out as a bazaar, refreshment room, &c.; the pergola on the first floor was arranged as a winter garden; and the two saloons were fitted up for concerts, masquerades, &c. This, however, proved a failure, and the large saloon is now converted into a theatre, capable of containing about 2300 spectators; while the small saloon, seated for from 600 to 700 persons, is usually let for concerts, &c. The Trivoli gardens, immediately beyond the Western gate, form the favourite place of resort in the summer evenings. The amusements include concerts, pantomimes, gymnastic feats, and other performances.

The trade of Copenhagen has latterly increased considerably, particularly the corn trade with England. At the commencement of 1852, 297 merchant vessels of about 35,000 tons burden belonged to the port. The harbour is large and commodious, capable of containing 500 merchant vessels besides the navy; and by the aid of canals, large vessels can come almost to the centre of the town. The entrance is commanded by the powerful batteries of Trekroner and Sextus. The principal imports are timber, pitch, and tar, chiefly from Norway and Sweden; flax, hemp, masts, sailcloth, and cordage, from Russia; tobacco from America; wines and brandy from France; coal, earthen-

Copernican System || Copernicus

ware, iron, steel, and salt from England; and West India produce. The principal exports are corn, rape-seed, butter, cheese, beef, pork, horses, cattle, wool, hides, skins, bones, grain-spirits.

The manufactures of Copenhagen are not important, but are making considerable advances. There are extensive cloth and calico factories, foundries, and iron-works; also breweries, distilleries, tanneries, sugar refineries, &c. Pianofortes, clocks, watches, surgical and mathematical instruments, tobacco, chocolate, porcelain, are among its other productions. The royal China factory is celebrated for its models of Thorwaldsen's works in biscuit China. The population of Copenhagen was (1769) 92,571; (1801) 100,975; (1834) 119,292; (1840) 120,819; (1845) 126,787; and (1850) 129,695; of which last 60,592 were males, 69,103 females, including a Jewish population of 2500. The climate is damp, changeable, and unhealthy; which, added to the almost total want of sanatory regulations, renders the mortality greater here, it is said, than in any other town of Europe with the exception of Vienna.

COPERNICAN SYSTEM (so called from its author Copernicus), that system of the universe in which the sun is supposed to be at rest in the centre, while the planets, with the earth, move in ellipses round him. See ASTRONOMY.

COPERNICUS, NICOLAS, was born at Thorn, in Prussia, on the 19th February 1473. Zernecke, in his *Chronicle of Thorn*, affirms that he was the son of a peasant serf, and that his name was Zopernick; but the commonly received opinion is, that he was descended from a family of distinction in that part of the Prussian territory; and, indeed, the circumstances of his education are incompatible with the supposition of his having been of servile origin. The first elements of learning he acquired in his paternal mansion, where he seems to have been initiated in the rudiments of Greek and Latin; and he then went to prosecute his studies at Cracow, where he applied himself to philosophy and medicine, and ultimately took the degree of doctor in the latter department of science. But having, from his earliest years, evinced a strong passion for the mathematics, he followed with avidity the lessons which he received, and soon signalized himself by uncommon proficiency therein. He also studied astronomy, and familiarized himself with the use of the instruments then employed in astronomical observations. At that time, Regiomontanus enjoyed the highest reputation as an astronomer; and so much was Copernicus dazzled with the lustre which this celebrated man had shed upon the science of which he was accounted so great a master, that the young enthusiast resolved to undertake a journey into Italy for the purpose of visiting him; and, in order that he might profit to the utmost by his tour, he applied himself to painting and design, in which he made considerable progress. At the age of twenty-three he set out for Italy, and passed some time at Bologna, where he attended the prelections of the astronomer Dominico Maria, and also made some astronomical observations. He then proceeded to Rome, where he was kindly received by Regiomontanus, and honoured with his friendship, as he had previously been with that of Professor Maria at Bologna. Here he was appointed to a chair of mathematics, which he filled with much distinction, continuing at the same time to extend both his knowledge and his reputation. But after some years he returned to his native country, where he was most favourably received on account of his great acquirements, combined with the simplicity and amenity of his manners. At length he took up his residence at Frauenburg, where his uncle, Bishop of Warmia, procured him a canonry. But owing to the conflicting claims and unjust pretensions of others, this situation did not immediately afford him the leisure and tranquillity which it promised, and he was for some time involved in ungrateful disputes and vexatious contentions. His clear right, however, aided by his firmness and constancy, soon carried him through all his difficulties; and he afterwards enjoyed that peaceful calm alike congenial to his disposition, and favourable to the pursuit in which he had so zealously embarked. Having accomplished this object, he then divided his time into three portions, one of which he employed in assisting in the divine offices, another in dispensing medical advice gratuitously to the poor, and a third in the prosecution of his favourite studies. The house which he then occupied is still to be seen at Allenstein, with the perforations which he had made in the walls of his chamber in order to observe the passage of the stars across the meridian; and there are also shown the remains of a hydraulic machine, similar to that at Marly, which he had constructed for the purpose of raising the water of a rivulet for the supply of Frauenburg. But although he lived in a state of retirement and seclusion, devoted to his clerical duties and the pursuits of science, this did not prevent him from undertaking the administration of the temporalities of the bishopric, which was several times confided to him during vacancies of the see; a trust which required both probity and courage, and which he executed in a manner highly honourable to his character. He had, in fact, to defend the rights and privileges of the bishopric against the encroachments of the Teutonic knights, who were then very powerful; and this duty he discharged without being either dazzled by their authority or intimidated by their threats. We mention this, foreign as it may seem to the object of a notice like the present, in order to show that the spirit of study and contemplation was, in his character, united with firmness and constancy; qualities which are not less necessary than genius for attacking and subverting prejudices, hallowed, as it were, by the belief or the credulity of ages.

Copernicus

Copernicus had seen and conversed with the most celebrated astronomers of his own time. He knew the labours of the ancients, and he was also astonished at the complication of their systems, no less than the discordance and want of symmetry which these supposed in the arrangement of the universe. He therefore determined to re-examine all these systems, to study them comparatively, to distinguish in each whatever might seem most probable as well as natural, and to try whether it might not be possible to combine the whole in a single system, at once more symmetrical and more simple. Amidst the variety of hypotheses which thus engaged his attention, two forcibly struck his mind, and therefore deserve particular attention;—that of the Egyptians, who made Mercury and Venus revolve round the sun, but who nevertheless carried Mars, Jupiter, Saturn, and the Sun himself, round the earth;—and that of Apollonius Pergæus, who chose the sun as the common centre of all the planetary movements, but who made that luminary revolve round the earth like the moon; an arrangement which afterwards became the basis of the system of Tycho Brahé. The circumstance which particularly fixed the attention of Copernicus on these hypotheses was, that they represented admirably the limited excursions of Mars and Venus around the sun, and explained their movements, direct, stationary, and retrograde; an advantage, indeed, which the hypothesis of Apollonius extended even to the superior planets. Thus the astronomical systems were already to him only playthings of fancy. He had tried them by the test of experiment and observation; he had found the conditions which it was necessary they should satisfy; and as he knew the means by which alone they were to be judged of, the most difficult part of his discovery was already made. On the other hand, he saw that the Pythagoreans had removed the

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earth from the centre of the system, and had there placed the sun; and hence it appeared to him that the system of Apollonius would become more simple and symmetrical by only changing this circumstance; namely, rendering the sun fixed in the centre, and making the earth to revolve around him. He had also perceived that Nicetas, Heraclides, and other philosophers, in placing the earth in the centre of the system, had ventured to give it a movement of rotation round its axis, in order to produce the phenomena of the rising and setting of the stars, and the alternations of day and night; nor could he fail to be even more forcibly struck with the bold conception of Philolaus, who, removing the earth from the centre of the system, had not only given it a movement of rotation round an axis, but also a movement of annual circulation or revolution round the sun: and although it might then appear difficult, and even absurd, to displace the earth from the centre, in order to make it a simple planet, nevertheless, as he observed that the astronomers had hitherto conceived themselves at liberty to imagine circles in the heavens to represent the celestial phenomena, he thought that he might in like manner be permitted to try if he could invent some other arrangement which would establish a more simple order in the movement of the heavenly bodies. And thus, taking in each system whatever was true, and rejecting whatever was false and complicated, he at length composed that admirable whole, which is now called, after him, the *Copernican System*, and which is, in reality, the true arrangement of the planetary movements, such as it has been established by evidence which can never be shaken.

About the year 1507 Copernicus began to digest the ideas of which we have here traced the gradual formation, and to write down his discoveries; but, as has been already observed, he did not confine himself to general appearances, nor remain satisfied with their accordance or conformity to the great law which he had thus detected. He felt that, to prove his system, it was necessary to enter into detail, and even to calculate particular phenomena, in order to deduce therefrom tables of all the celestial motions; and thus to afford the means of predicting them with all the simplicity and precision which the grandness of the conception itself, and the first trials which it had undergone, seemed equally to promise. This was the labour of his whole life. He set himself to make observations;[1] he collected and combined those which had been made by others; and, in particular, he studied to deduce from his theory those phenomena of the system of the world which had hitherto appeared the most complicated, such as the stations and retrogressions of the planets, and the precession of the equinoxes. Lastly, when he conceived that he had accumulated sufficient observations and proofs, he undertook to expound the whole of his discoveries, in a work divided into six books, and entitled *De Orbium Cœlestium Revolutionibus*, in which he unfolds his ideas nearly in the order in which we have here endeavoured to present them, and subjects the whole of astronomy to the dominion of a single principle or law. It appears that this work was completed about the year 1530, when Copernicus had attained the age of fifty-seven; and it certainly forms one of the proudest monuments of genius and sagacity, happily united with patient thinking and persevering research, which any age or country has produced.

The fame of his discoveries had already been bruited abroad; the most celebrated astronomers became impatient to see them fully developed, and he was pressed to publish them to the world; but, resisting all importunities, he still deferred, correcting daily the data with which more exact observations furnished him, and adding whatever further reflection supplied: perhaps, also, he was afraid to endanger his peace, by submitting himself to the judgment of his contemporaries; and this apprehension was unhappily but too well founded. There is nothing so confident in itself, or so intolerant, as ignorance. Show the truth to men, and if the object interest them but little, they will perhaps pardon your doing so; but if you wish to root from their minds an opinion which they have long admitted without question, and believed without inquiry, be it a prejudice ever so groundless and untenable, the fact of their having constantly admitted it is of itself sufficient to offend their pride, perhaps even to arm their hostility, against him who may have proved himself more cautious or more sceptical than themselves. Of this we have a striking example in the case of Copernicus. Whilst the most distinguished men of learning and science, the only proper judges in such matters, ranged themselves on the side of the new discoveries, the common herd were discomposed by them, and attempted either to denounce them as extravagant, or to represent them as absurd and chimerical. Copernicus, in fact, was about to be publicly ridiculed in a comedy, as Socrates had been by Aristophanes; but the respectable character of this great man, perhaps also the silence which he had hitherto observed, preserved him from this insult, and he who had so unworthily attacked him became an object of general contempt. After this need we be astonished that Galileo and Descartes were persecuted, and that even Newton should have hesitated to give his great discoveries to the world? Nevertheless, Copernicus seems to have felt that, in delaying longer the publication of his researches, he would be leaving the field open to ignorance; and that the exposition of truths so evident, accompanied with proofs so numerous and palpable, would be the best means of refuting the charges which presumptuous ignorance had by anticipation brought against his opinions. Accordingly, he permitted his friends to publish his book, which he dedicated to Pope Paul III.; in order, as he says, that he might not be accused of seeking to shun the judgment of enlightened men, and that the authority of his holiness, if he approved of the work, might protect him from the baleful tooth of calumny.

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The work was printed at Nuremberg, under the superintendence of Rheticus, one of the disciples of Copernicus. The impression had just been completed, and the first copy transmitted by Rheticus to his great master and friend, when Copernicus, who had all his life enjoyed the most perfect health, was attacked with dysentery, followed almost immediately by a paralysis of the right side, which again was accompanied with loss of memory and an obscuration of the understanding. In this melancholy state he lingered for several days. On that of his death, and only a few hours before he expired, the copy of his work sent by Rheticus arrived, and was placed in his hands. He saw it, touched it, and seemed conscious what it was; but, after regarding it for an instant, relapsed into a state of insensibility, which soon terminated in death. He died on the 24th May 1543, at the age of seventy. His tomb, which is not distinguished from that of the other canons, was, in 1581, adorned with a Latin epitaph by Bishop

[1] In 1540, Tycho Brahé sent Olaus, one of his pupils, to measure at Frauenburg the height of the pole on the tower where Copernicus had made his observations. He also preserved with religious care the parallactic instrument, composed of two wooden rules, divided each into 1414 parts, which Copernicus had himself constructed for his own use.

Cophti || Copiapo.

Cromer, the Titus Livius of Poland; and in 1800 a small monument was erected in honour of the illustrious discoverer of the true system of the heavens. The first work in which the labours of Copernicus were formally announced, in contradistinction to the notions which had hitherto prevailed, was a letter published by Rheticus, and entitled *Ad Clar. V. d. Schonerum de Libris Revolutionum eruditiss. viri et Mathematici excellentiss. Rev. Doctoris Nicolai Copernici Torunnæi, Canonici Warmiensis, per quendam juvenem Mathematicæ studiosum, Narratio prima*, Dantzic, 1540, 4to; reprinted, with an eulogium, at Basil, 1541, 8vo. The works of Copernicus are, 1. *De Revolutionibus Orbium Cœlestium, libri VI.* Nuremberg, 1543, small folio; reprinted at Basil in 1566, with the letter of Rheticus, and also included in the *Astronomia Instaurata* of Nicolas Muler, Amsterdam, 1617 and 1640, 4to; 2. A treatise on trigonometry, with tables of sines, entitled *De Lateribus et Angulis Triangulorum*, Wittemberg, 1542, 4to; 3. *Theophylactici Scholastici Simocattæ Epistolæ morales, rurales, et amatoriæ, cum versione Latina.* In 1521, Copernicus presented to the states of his provinces a work on money; and several manuscript treatises of his are still preserved in the library of the bishopric of Warmia. His life has been written by Gassendi, and immediately follows that of Tycho Brahé.

Chronique de Thorn, Berlin, 1727; Lalande, *Bibliographie Astronomique*, p. 63; *Annales des Voyages*, tome i. p. 361; *Biographie Universelle*, v. COPERNICUS. (J. B—E.)

COPHTI, COPTI, or COPHTS, a name given to the Christians of Egypt, who belong to the sect of Jacobites, or rather Cobites, and are descended from the ancient native population of the country.

Critics are divided as to the origin and orthography of the word. Some write it Cophti or Copti, others Cophtites, Cophtitæ, Copts, and so on. Scaliger derives the name from Coptos, the ancient metropolis of the Thebaid. Kircher, however, maintains that the word originally signifies "cut" or "circumscribed," and that it was given to these people because of their practice of circumcising; but this is evidently absurd, as circumcision could neither be a distinction nor a reproach in a country where the rite was generally practised. Scaliger afterwards changed his opinion, and derived the word from Αἴγυπτος, (*quasi dicas* Αι-ΓΟΠ-τος) Egypt, by retrenching the first syllable; and this is the true etymology, GOP or KOP being manifestly the basis or root of the word which the Greeks wrote Αἴγυπτος, and probably at first Ἀιγοπτος. An account of the state of the Coptic population of Egypt is given under EGYPT.

COPHTIC, or COPTIC, the language of the Cophts, being the language of the ancient Egyptians, mixed with a little Greek, and written in letters which are chiefly Greek, though fashioned on the model of the enchorial, demotic, or civil characters of the country. It has a form and construction peculiar to itself, having no inflections of the nouns or verbs, but expressing number, case, gender, person, mood, and tense, and forming the possessive pronouns by means of letters and particles prefixed.

Kircher was the first who published a grammar and vocabulary of the Cophtic. More lately we have a "Compendious Grammar of the Egyptian Language," Lond. 1830; "Lexicon Egyptiaco-Latinum," Oxon. 1825; "Lexicon Linguæ Copticæ," Turin, 1835. The only books extant in Cophtic are translations of the Scriptures, or of ecclesiastical offices, and others that relate thereto, as grammars and dictionaries.

COPHTIC *Liturgies.* Of these there are three; one attributed to Basil, another to St Gregory, and a third to Cyril. They have been translated into Arabic, for the use of the priests and people.

COPIAPO, a town of Chile, the capital of a department of the same name in the province of Atacama, on a cognominal river, 50 miles from its mouth in the Pacific. Pop. about 5000. The neighbourhood is rich in minerals, as silver, copper, lead, iron, bismuth, cobalt, antimony, arsenic, and quicksilver. Its port, Caldera, at the mouth of the river, is now one of the stopping places for the Pacific Company's steamers. It has a good landing wharf and mole, with 24 feet water, at which vessels of 1200 tons may discharge cargo. In 1851 3,030,874 oz. of silver were exported. There is a railway between Copiapo and Caldera. The exports of metals from Copiapo for 1853 are estimated at no less than 10 millions of dollars; and no copper is sent under a yield of 25 per cent. from the ores. See an account of the mines of Copiapo in the Royal Geographical Society's Journal for 1853; also the article CHILE.

Copiata || Copper.

COPIATA, under the western empire, signified a gravedigger. In the first ages of the church there were clerks destined for this employment. In 357, Constantine made a law in their favour, exempting them from the lustral contribution levied upon all traders. During his reign also they were first called *copiatæ*, *i. e.* clerks destined for bodily labour, from κοπιάω to toil. Before that time they were called *decani* and *lecticarii*; probably because they were divided into decades or tens, each of which had a bier or litter for the carriage of dead bodies. Their place among the clerks was the next in order before the chanters.

COPPER (including its alloy brass) and iron are the first metals named in the most ancient authentic history of the world, as having been made use of by man. Tubalcain was "an instructor of every artificer in brass and iron." The words *Æs* and χαλκὸς (usually translated brass) of the ancient Romans and Greeks were used indifferently to apply to the pure metal copper (as when they spoke of their money) and to its alloys with other metals, as when they spoke of their brazen statues, or of their defensive and offensive armour, in which case the copper was alloyed with tin. The enormous statue of the Sun, known by the name of the Colossus of Rhodes, was composed entirely of bronze (see COLOSSUS): and many others are mentioned, which prove that the ancients were at least as well acquainted with the difficult art of working in brass as we are at the present day.

In a pure state, copper is a very brilliant metal, and susceptible of a high polish. It is of a fine red colour, differing in this respect from every other metal except titanium. Its specific gravity varies, according to its density, from 8·584 to 8·9. According to Brard, the cubic foot of melted copper weighs.....545 lb.
Of native metal.....600 lb.
Of copper medals.....620 lb.
In a native state, it is not an uncommon mineral. It occurs in arborescent groups, very beautifully crystallized, in Siberia, imbedded in limestone, and in very considerable masses. In the cabinet of Ajuda, near Lisbon, a mass of native copper is said to be preserved, of the enormous weight of 2617 pounds (Brard). In Cornwall it occurs in many of the mines, and also in the island of Anglesea; and in the island of Nalsoe, one of the Feroe group, it occurs very beautifully crystallized, along with zeolite, imbedded in amygdaloidal trap.

Metallic copper is used for culinary vessels in many parts of Europe; but for this purpose the inner surface of the vessel should be tinned. Large vessels for distilling, brewing, dyeing, and the like processes, are made of copper. The making of these vessels constitutes the ordinary business of the coppersmith.

Copper rolled into sheets is employed for covering the wooden work of the roofs of churches and large edifices in Germany, Sweden, and other countries. It is a costly covering, and does not possess any commensurate advantage over lead.

A modern, and now a very extensive use of sheet-copper, is for the sheathing of ships. That part of the hull of a ship that is in the water is covered with sheet-copper. This covering preserves the wood from the attacks of the *teredo*, and thereby gives the ship the advantage of passing more rapidly through the water, as the copper bottom remains always smooth; for sea-weed and shells will not take root and attach themselves to copper, as they do to bare planks, owing to the galvanic effect produced by the action of sea water. As this action, however, produces a rapid decay of copper, it was proposed by Sir Humphry Davy to neutralize it by applying metallic protectors—an object which he accomplished; but as this also deprived the copper of the effect it was intended to produce, and allowed the molluscous tribes to attach themselves, the protecting process was abandoned.

Its malleability and ductility are very considerable. A wire of 0·078 of an inch diameter will support 302 pounds avoirdupois.

Copper bolts are used for fastening the planks and timbers of ships. This is a great improvement in ship-building. A copper-fastened ship or boat is preferable to one with iron fastenings, because the copper bolts remain unaltered by rust, and endure longer than the wood which they hold together, particularly when used in the state of alloy, which preserves it from waste by neutralizing the galvanic action.

For the frames of delicate dipping needles and magnetic compasses, copper is employed; as it has been found that the brass generally used in philosophical instruments sometimes contains iron, which of course might affect the magnetic needle.

Copper is drawn into wire, used for the communication with the bells in houses, and for other purposes.

Small pipes for conveying coal-gas from the level of the street to the aperture by which the gas issues, were formerly made of copper or of brass, till superseded by pewter. These pipes were fitted on an iron cylindrical mandril, and a cylindrical ring drawn over the outside. By this means copper and brass tubes are drawn out. The brass tubes for telescopes are drawn out in the same manner.

Copper may be plated; that is, its surface may be covered with a layer of silver, by rubbing the surface with a mixture of nitrate of silver, muriate of soda, and acidulous tartrate of potass (cream of tartar). But the method practised at Birmingham is the most permanent and effectual. A plate of copper, with a plate of silver applied to it, and borax placed in the interstice, is heated to a particular degree, which it requires the skill of the workman to know; a degree of heat, in short, near that at which copper and silver melt. The two metals thus heated, and in contact, are then taken out of the furnace and passed through rollers. There is a fusion and combination of the adjacent surfaces; and their adhesion is perfected by the pressure of the rollers. Copper thus plated is manufactured at Birmingham into candlesticks, teapots, buttons, buckles, and a variety of other articles.

Standard silver coins contain a small proportion of copper, for the purpose of giving them hardness. This proportion is regulated by government in the several countries of Europe, and varies in different states. The combination of gold and copper in various proportions is used for making rings and other trinkets.

Copper is gilded by applying on its surface an amalgam of gold with mercury. Bronze ornaments are gilded in the same way.

Copper united with zinc forms brass: when alloyed with tin it forms bronze. This combination is hard and brittle if the proportion of tin be great; but when the proportion of tin is small, the bronze is soft, and possesses tenacity so as not to be easily broken. The ancients employed hard bronze, containing much tin, in making sword blades, spear heads, hatchets, and cutting instruments. Bronze cramps are found in ancient buildings in Egypt. Statues and bas-reliefs, culinary vessels, and a variety of other articles of soft bronze, are to be seen in different collections of antiquities. In modern times soft bronze is used for casting canon and statues.

Copper melted with a large proportion of tin constitutes bell-metal, which is hard and brittle. The metal of which the Chinese gongs are made is composed of the same ingredients; and it has the property of being in some degree malleable at a certain stage of its cooling, for their gongs are covered with marks of the hammer.

The most common ore of copper, from which the chief supplies of that metal are derived, is the yellow copper ore, or copper pyrites, essentially a combination of copper with sulphur and iron. There are, however, numerous other ores of copper in which the metal is in combination with oxygen, carbonic acid, various other metals, &c.

Copper in its varied artificial combinations, as in that of verdegris (acetate of copper), blue vitriol (sulphate of copper), Scheel's green (arsenite of copper), verditer (carbonate of copper), &c., is largely used in the arts of dyeing, painting, enamelling, glass and porcelain colouring, &c.

The salts of copper are poisonous; and from the facility with which copper utensils become oxidated, their use should be as prescribed as possible. One or two of the salts of copper are occasionally used in medicine; and the sulphate of copper has been found to be one of the most efficacious emetics in croup, checking the disease and preventing the effusion of the fibrinous matter into the trachea. This salt is also used as a lotion in the treatment of ulcers, &c.

Quantities of Copper Ore imported into the United Kingdom for home consumption in 1851, *with the Duties charged thereon.*

Countries.	Quantities. Tons. cwts qrs. lbs.	Duties. L. s. d.
Holland,	202 8 0 0	10 2 5
France,	1,026 11 1 27	51 6 9
Spain,	1,085 11 0 12	54 5 7
Italy,	3 0 0 20	0 3 1
Algeria,	891 18 0 9	44 11 11
West Coast of Africa,	11 13 3 2	0 11 8
British Posses. in S. Africa,	144 0 0 0	7 4 0
British Territories in E. Indies,	87 3 2 24	4 7 3
South Australia,	4,157 10 2 24	207 17 10
New South Wales,	991 2 0 19	49 11 1
Victoria,	664 13 3 12	33 4 9
Van Diemen's Land,	199 4 0 0	9 19 3
New Zealand,	209 18 0 0	10 9 11
British N. America & Colonies,	728 11 1 23	36 8 7
Cuba,	20,871 2 0 0	1,043 11 4
Chile,	3,154 15 1 8	157 15 0
Bolivia,	245 0 0 0	12 5 0
Peru,	1,054 0 3 13	52 14 3
Other Parts,	54 18 0 23	2 15 2
	35,783 2 3 11	1,789 4 10
Deduct quantities exported subsequently to the payment of duty and over-entered,	289 11 0 19	Repaid, 29 6 4
Total,	35,493 11 2 20	L.1,759 18 6

In 1853 the duty on copper ores and on wrought copper was repealed.

COPPER, as a mineral. See MINERALOGY.

COPPER-SMELTING. Copper seems to have been known from the earliest times. The great beauty which copper ores in general possess, and the ease with which the metal is obtained from these by fire, may have brought it early into notice. That the metal was obtained by fusion at a very early period, is indicated by the following sentence in the Book of Job (xxviii. 2)—

"Copper is molten out of the stone."

Copper is often found in nature in the metallic state, and occasionally in considerable quantity, such as the masses recently found at Lake Superior; but the principal source is from ores; the metal in them being in combination with other matters, such as oxygen, sulphur, carbonic acid, &c., forming an extensive variety of minerals of distinct forms and character, and of great scientific interest.

The principal sources of copper ore in this country are Cornwall and Devonshire: great quantities, however, are imported from Ireland, Cuba, Chile, and Australia. The average quantity of ore raised in this country during these last five years is about 155,000 tons, yielding about 12,000 tons of metal; and the quantity imported about 60,000 tons, yielding about 10,000 tons of metal. The ores are mostly all taken to Swansea and neighbourhood, where the principal smelting-works are situated.

The ores are divided by the smelter into two general classes—those containing sulphur, and those having little or no sulphur. The former are subdivided according to certain qualities which they are known to possess, such as having much silica, iron pyrites, tin, arsenic, &c.: some consideration is also given to the quantity of copper they contain. The object of these arrangements and classifications of ores in the yard is to enable the operative smelter to select from and make up a constant working mixture, having the following characters:—

1. That the copper in the mixture be not under 9 nor above 13 per cent.: if under the former, it is unprofitably poor; if over the latter, the slags have a tendency to contain copper, creating a loss.

2. That after being calcined for an ordinary length of time, it will fuse easily without the necessity of adding flux, giving a clean and easily fused slag.

3. That the mat or coarse metal obtained from fusion contain as nearly as possible 30 per cent. of copper. And

4. That the mixture do not contain ores having impurities calculated to make the copper of a lower quality than is desired. There is no definite or fixed rule to guide the smelter in these classifications, except a practised eye in distinguishing the character of ores, and the report of the assayer.

The mixture of ores being selected according to these rules, it is carried to hoppers on the top of a large reverberatory furnace, termed the calcining furnace, and then let down into the hearth, where, after drying a little, it is spread equally over the bottom, and covered to a depth of from six to eight inches. The quantity of ore put in varies, according to the size of the furnace, from three tons to six tons. The fire of the furnace is kept low at first: after two or three hours the ore on the surface becomes visibly red, the heat is gradually increased to a yellow red; but this heat only penetrates to the depth of about two inches, consequently the ore has to be stirred and turned over by means of long iron paddles every hour, so as to expose a new surface to the action of the air and fire. This calcination lasts generally nine hours; but when ores are known to be stiff, containing much silica and sulphuret of iron, twelve hours are allowed. The following changes and chemical actions take place: the sulphur is partly burned off by combining with oxygen and forming sulphurous and sulphuric acids, and partly volatilized as sulphur uncombined; arsenic is volatilized either as metal or oxide; the copper and iron lose a part of their sulphur and combine with oxygen, forming oxides.

When the ore is sufficiently calcined, it is let down into the *cubs* or vaults beneath, by openings in the floor. Water is added to the hot ore in the cubs to prevent dust and assist further oxidation; the ore is then removed to a yard, and there stored up, ready for the fusing furnace. The following analysis of ore, before and after calcining, will give an idea of the changes that have taken place.

Before Calcination.		After Calcination.	
Copper	12·3	Copper	12 2
Iron	32·7	Iron	22 7
Sulphur	31 0	Oxide of Iron	18·5
Silica	24·0	Sulphur	16 2
		Silica	30·4
	100 0		100 0

The next operation is the fusing of the calcined ore, which is done in a reverberatory furnace, termed an ore-fusing furnace, fitted also with a hopper on the top for charging it. The charge consists of

From 25 to 30 cwt. of calcined ore.
From 7 to 9 cwt. of sharp slag from more advanced operations.
From 2 to 3 cwt. cobbing.[1]

When the charge is let down into the furnace it is spread equally over the bottom, the doors are all closed, every air-hole is stopped with clay, and the heat of the furnace increased as rapidly as possible.

After about five hours' firing, when the furnace has reached a white heat, the door-plate is removed and a long iron rake passed through the fused contents to make sure that the whole is perfectly fused. This being the case, the workman begins the operation of *skimming*, that is, drawing off the scoriæ or slag, which from its less specific gravity floats on the surface of the mat: this is effected by means of a long rake, the scoriæ being drawn out at the front door. When the surface is skimmed, the common practice is to let down a second charge of ore, and to fuse and skim in the same manner, before tapping the furnace to let out the metal or mat, which is generally tapped into a large pit of water which granulates it. These pits are from 6 to 8 feet deep, and from 4 to 5 feet square, and into them a perforated box is lowered which receives the charge of metal, and is raised by a crane or pulley. The metal is then removed to a yard for the next operation. This mat is termed granulated *coarse* metal.

The average composition of good coarse metal is

Copper	31·4
Sulphur	27·3
Iron	41·3
	100 0

and the slag or scoriæ, as

Silica	71
Protoxide of iron	27
Lime, &c.	2
	100

The next operation is the calcination of the granulated coarse metal. This is done in the same manner as the calcination of the ore. The charge of metal covers the bottom of the hearth to the depth of about 4 inches, making about 4 tons to the charge, which is put in through the hoppers fitted upon the top of the furnace, as described for the ore.

The coarse metal being easily fused, great care is required not to raise the heat of the furnace too high, otherwise the metal will cake, and by adhering to the bricks will prove prejudicial both to the calcination and the furnace. When the charge is let into the furnace, it is slowly brought to a visible red, and the fire is gradually and cautiously increased until the metal acquires a bright red heat, which should take about fourteen hours. This temperature is continued until the charge has been altogether twenty-four hours in the furnace, when it is let down through the bottom into the *cubs* or vaults beneath, and a quantity of water is thrown upon it to prevent dust, &c., from accumulating above it.

[1] Cobbing is a term given to old bricks and bottoms of furnaces that have absorbed copper, and are broken down into pieces.

Copper-Smelting.

The following analysis gives an average result of the changes effected in this operation:—

Metal put into calciner.		Metal after calcination.	
Copper	32	Copper	33
Iron	39	Iron	38
Sulphur	25	Sulphur	13
Other matters and loss	4	Oxygen, &c.	16
	100		100

The next operation is fusing the calcined coarse metal. The charge for an ordinary-sized furnace of 8 feet by 13 feet is—

25 cwt. of calcined metal,
5 to 7 cwt slags from the *roasters*,
2 to 3 cwt of *cobbing*.

In this mixture the oxide of iron is in excess in relation to the silica, and it is therefore much more easily fused than the ore; but the reactions which take place are similar: the silica and oxide of iron combine to form slag, which floats upon the surface of the mat and has to be skimmed off, after which the mat is tapped out into sand-moulds. Two charges are generally fused before the metal is tapped out. This mat is termed *blue metal*, from its being of a slate-blue colour; the scoria is termed *sharp slag*, from its containing an excess of oxide of iron, and being consequently used as a flux for fusing the ore.

The following is the composition of good blue metal and sharp slag.

Blue Metal.		Sharp Slag.	
Copper	58 8	Oxide of iron	53
Sulphur	20·5	Oxide of copper	2
Iron	12 6	Silica, &c.	45
Insoluble	4 2		100
Oxygen and loss	3 9		
	100		

Should there be no ores such as carbonates or oxides on hand to smelt, the blue metal, instead of being tapped into sand-beds as described, is run into pits of water in the same manner as *coarse metal*, and subjected to another calcination and fusion.

When oxides and carbonates, such as the Australian ores, are on hand, they are generally fused with the calcined coarse metal, by which means a double advantage is obtained; the excess of oxide of iron in the calcined metal fluxes the silica of the ore which has little iron, and the copper in the ore is converted into subsulphuret—a condition necessary for reduction by the present method of smelting. The produce of this fusion is a mat termed *pimpled* metal, from its having small rough granules on the surface of the ingots. The average composition of this metal is—

Copper	78
Sulphur	18
Iron	2
Silica	2
	100

The composition of this slag is very irregular: it always contains copper, and has to be remelted.

The next operation is roasting—a process generally identified in books on chemistry with calcining, but which is distinct. The roasting furnace differs from the fusing furnace by having a large opening in the side for putting in the charge, and is furnished with more air-holes in the bridge. The charge for an ordinary-sized furnace is three tons. When the metal is brought to fusion, the air-holes of the furnace are all opened, and a free current is allowed to pass over the surface of the fused mass: the heat of the fire is then regulated so as to keep the charge in a sort of semifluid state. This is continued for about twenty-four hours, during which a great portion of the sulphur is driven off with the whole of the iron, which, with silica and other matters, forms scoria, and is from time to time skimmed off. When all these impurities are removed, and when the composition of the mat or regulus is a subsulphuret of copper $Cu_2 S$, then begins what may be termed roasting proper; and which, unless when the regulus has been very rich, constitutes another operation termed the second roasting, requiring other 24 hours. In this last roasting, when the air-holes are opened a brisk effervescence ensues over the surface of the fluid mass.

Copper-Smelting.

The chemical reactions which take place during this effervescence may be explained thus: if we take 1 equivalent of subsulphuret of copper, which is composed of 16 sulphur and 64 copper, and 2 equivalents of oxide of copper, which is composed of 16 oxygen and 64 copper—incidentally equal weights,—mix them together in a crucible, and expose them to a heat sufficient to melt copper, the whole of the copper will be reduced, and the sulphur evolved as sulphurous acid, $Cu\ 2\ S + 2\ Cu\ O = SO_2 + 4\ Cu$.

The reactions which occur in the process of roasting are the same. The oxygen of the air combines in the first place with a portion of the sulphur, forming sulphurous acid. A portion of the copper is also oxidized, and instantly reacts upon another portion of the subsulphuret, reducing the metal, as shown above. The process is a very beautiful one, and exhibits a nice adaptation of principles to practice. The sponge regulus has a specific gravity of 5, the reduced copper of about 8; so that the copper sinks to the bottom where it is protected, and a new surface of regulus becomes exposed to the action of the air.

If the ore be pure, or if no *select* copper be required, the operation of roasting is continued until the whole of the copper is reduced; when it is tapped out into sand-moulds, forming *coarse copper*, *bed copper*, *pimpled copper*, or *blistered copper*, according to quality. The term *coarse copper* is applied occasionally to all these kinds except the blistered. If the ingot sets with contraction with a smooth hollow surface, it is termed *bed*, and generally indicates the presence of other metals, as tin. When the surface of the ingot is covered with pimples, it is termed *pimpled* copper, and indicates the presence of sulphur. When covered with large scales or blisters of oxide of copper, it is termed *blistered*; which only takes place when the copper is good and ready for refining. When making select copper, the roasting is carried on until about one-fourth of the copper in the regulus is reduced; the furnace is then tapped, and the reduced metal is obtained at the bottom of the first and second ingots or pigs, as *copper bottoms* which contain most of the metallic impurities. The regulus is collected and again roasted, which produces the purest metal the ordinary process of smelting can give: it is termed *best select*.

The reader will not have failed to remark that the reduction and purifying of the copper are effected without the aid of carbonaceous matters of any sort, contrary to what is stated in all chemical books in reference to the reduction of copper; indeed, the addition of carbonaceous matters would be detrimental.

The next operation is that of refining—bringing the metal into a state fit for the market. The refining-furnace is similar in form to a roasting-furnace, but a little smaller, and the bottom is made to incline a little to the front door, where a small well is made. The copper being ladled from the furnace, this well allows of the ladles being dipped into the metal when the quantity in the furnace is small, so that the last portions of the metal can be taken out.

About six tons of copper from the roasting-furnace are put into the refining furnace, the doors and air-holes of which are closed, and the heat raised until the metal is in fusion, when the air-holes are opened. A short roasting is generally required, which is done in the manner we have described, and the scoria which collects is carefully skimmed off. The separation of impurities is facilitated by occasionally stirring the metal with a rake. Some refiners throw pieces of green wood upon the surface, under the impression that it assists the escape of sulphur. The roasting is con-

Copperas || Coppice.

tinued until a ladleful of the metal taken out sets with contraction. If the metal be very coarse, it will set with a surface having a frothy appearance; if finer, it sets with expansion, first round the edge, then swelling towards the centre, forming a little mound or cone, and occasionally boiling over and throwing up jets of metal, forming a miniature volcano. These phenomena are caused, no doubt, by the presence of gases in the copper. Several metals when in fusion absorb oxygen; but the fact that copper, when it sets in this way, does not refine well by the operation of poling, which would soon take away oxygen, is presumptive that the gas which escapes is not oxygen, and renders probable the prevailing idea that it is caused by the presence of sulphur or sulphurous acid.

When the setting of the metal in the ladle is favourable, the charge is ready for the operation of poling. A quantity of charcoal or anthracite coal is first thrown upon the metal to prevent oxidation by the air, and then the end of a large pole of green wood, generally of birch or oak, is inserted into the melted copper, and kept pressed down to the bottom of the metal, which occasions violent ebullition, the metal spurting and boiling with loud noise. The action which takes place during this operation will be apparent to every one slightly versed in chemistry—the reduction of any oxide or suboxide. But the reason why such an operation as poling is required is, that oxide of copper dissolves in metallic copper as a salt dissolves in water and makes it brittle. To put pieces of wood or charcoal upon the surface would not remove the oxygen; hence the necessity of poling, in order to bring the carbonaceous matters into contact with the dissolved oxide. As the poling proceeds the refiner takes from time to time small samples called assays, which he hammers and breaks for examination. When the copper is in the proper *pitch* the assay bends without breaking, and if cut and broken the fracture presents a fibrous silky lustre. When this pitch is attained the pole is withdrawn, and a quantity of charcoal thrown upon the surface; and, if the copper is for rolling or hammering, a little lead is added to the charges, to insure toughness.

When the copper is brought to the proper pitch by the refining operation, it is ladled out into moulds. A ladle holds about 30 lb. of fluid metal, three of which form a cake, the ordinary size of which is 14 × 10 inches. Twenty moulds are set round the floor in front of the furnace, three ladlefuls are poured together into each mould, going over the whole, by which time the cake first poured is set, and the mould is ready to receive another charge. Each mould holds five such charges or cakes. During the lading out the refiner takes an assay at short intervals, as the metal is liable to get out of pitch, or become *dry*, as underpoled copper is termed; in which case poling has to be resumed. So much depends upon refining, that the best copper by a defect in this operation will be rendered unmarketable.

In making what is termed *best select* copper, the refining is performed in the manner described, but no lead is added. This quality of copper is used for the manufacture of fine alloys, such as Muntz's yellow metal. Copper a little overpoled is generally preferred for these purposes.

A great variety of improvements have been proposed and patented for copper-smelting. One or two have been usefully applied, but the greater portion of them exhibit a want of practical knowledge of the processes in use, and consequently of the requirements of the trade, and a few of them an entire want of principle to effect the objects sought after. (J. N—R.)

COPPERAS, green vitriol, or sulphate of iron. It is much employed in dyeing black and for making ink, and medicinally as a tonic. The copperas of commerce is usually obtained by the decomposition of iron pyrites. See CHEMISTRY.

COPPICE, or COPSE (Fr. *couper* to cut, from Gk. κόπτω), a wood or plantation which is cut down at stated periods for fuel or for making charcoal.

Coprolite || Copyhold.

COPROLITE, (κόπρος excrement, λίθος stone), the petrified fæces of carnivorous reptiles. Coprolites are of various sizes, and very much resemble pebbles of an oblong form. See MINERALOGY.

COPTOS, in *Ancient Geography*, a trading town of the Thebais, on the right bank of the Nile, about a mile from the river. Its modern name is Kouft or Keft. The inhabitants are chiefly Egyptians and Arabs.

COPY, in a law sense, a transcript of a writing or instrument, made for the use and satisfaction of some party concerned, or in order to preserve the document itself.

COPYHOLD, a term of English law, describing the nature of the tenure by which certain property is held. In the early period of English history the greater barons, who held extensive domains under the crown, frequently granted smaller manors to inferior persons, to be held of themselves. The superior lord in these cases is called the lord paramount over all the manors; but, in imitation of the greater barons, the inferior lords began to grant to their villeins (the inhabitants of the villages, so named from villa) still smaller portions of land. This was a species of tenure neither strictly feudal, Norman, nor Saxon, but a compound of them all. Under the Saxon government a great part of the rustic population were held in servitude —they, their children, and effects, belonging to the lord of the soil, like the cattle and rest of the stock upon it. It is probable that the Normans, who were regulated entirely by the feudal law, might introduce some slight relaxation of the bondage in which they were held; but though the villeins were raised above absolute slavery, they were still retained in a condition inferior to every other. The small portions of land which they held for the sustenance of themselves and their families were granted on the condition of their performing the lowest services to their superior, who might dispossess them whenever he pleased.

From so disadvantageous a condition as this, it is not a little surprising that the peasantry of England should ever have emerged; but through various causes the services of villenage were gradually rendered less onerous and uncertain, and at length were generally commuted for a small pecuniary quit-rent. In the time of Edward I. we find the tenants in some manors bound only to stated services, as recorded in the lord's book: by and by they acquired the right to be entered in the court-roll of the lord of the manor upon the same terms as their predecessors; and eventually they were allowed to get copies of the terms on which the land was held. Proofs of this remarkable transformation from tenants in villenage to copyholders are found in the reign of Henry III.; and in the year-book of the 42d Edward III. it is said to be "admitted for clear law, that if the customary tenant or copyholder does not perform his services, the lord may seize his land as forfeited;" from which it is implied, that as long as the copyholder continued to perform the stipulations of his tenure, the lord was not at liberty to divest him of his estate.

Though in general they were still said to hold their estates at the will of their lord, yet that will must be in conformity with the customs of the manor, as preserved in the rolls of the several barons' courts in which they are entered, or agreeable to the constant and immemorial usage of the manors in which the lands lie. And as such tenants had nothing to show for their estates but these customs, and admissions in pursuance of them entered on those rolls, or the copies of such entries witnessed by the steward, they came to be called *tenants by copy of court-roll*, and their tenure itself a *copyhold*. Thus, according to Blackstone, two conditions are essential to copyhold tenure,—1st, "that the lands be parcel of, and situate within, the manor in

Copyhold.

which they are held; 2d, that they have been demised or demisable by copy of court-roll immemorially."

In some manors where the custom has been to permit the heir to succeed the ancestor in his tenure, the estates are styled "copyholds of inheritance;" in others, where the lords have been more vigilant to preserve their rights, they remain copyholds for life only; for though the tenure is nominally by the will of the lord, in both cases it is regulated by the custom of the manor, as testified in the roll of the barons' court.

The burdens upon copyholds are fealty services (as well in rents as otherwise), reliefs, and escheats. The two latter belong only to copyhold of inheritance; the former to those for life also. Besides these, copyholds are also subject to wardship, fines, and heriots; which last is a custom derived from the Danes, and gave the lord the right to demand the best beast or other article of his tenant's personal property on his death. Of fines, some are due on the death of each tenant, others on the alienation of land: they are sometimes arbitrary, at the will of the lord; but the law has provided that in no case they shall exceed two years' value of the property.

So great were the inconveniences and vexations affecting copyhold property, that the legislature was at length induced to interfere, with the view of rendering the tenure more simple and fixed.

Heriots form one of those vexatious incidents affecting copyhold tenure which are apt to create a feeling of irritation. The most valuable picture may be seized as a chattel heriot, in respect of a copyhold tenement not worth L.10; and in the case of live heriots, race-horses, and other valuable animals, may be seized under like circumstances. Instances of the full exercise of such rights though rare, are not unknown.[1]—The more substantial evils of the copyhold tenure consist in uncertain fines, which drive capital from improvements, and in rights to timber, and a control over buildings. To remove these evils the act 4th and 5th Vict., cap. 35, was passed in 1841, "For the commutation of manorial rights in respect of lands of copyhold and customary tenure, and in respect of other lands subject to such rights, and for facilitating the enfranchisement of such lands, and for the improvement of such tenure."

By this act commissioners were appointed for the purpose of arbitrating between the lords of manors and copyholders, who might be desirous of commuting the uncertain rights for fixed terms of tenure.

The act provides that the lord of the manor, or any ten copyholders on the manor, or one-half of the copyholders should their number be less than ten, may call a meeting to agree upon terms of commutation. These may be payment of an annual sum as rent charge, and a small fixed fine upon death, which in no case should exceed 5s.: and after confirmation of agreement of commutation, lands to be discharged from rents, fines, and heriots, now payable, and from the lord's right of timber, and a fixed rent to be charged. Lands thus enfranchised become equal to freehold.

Two other acts were passed to amend and explain this statute; viz. 6th and 7th Vict., cap. 23, and 7th and 8th Vict., cap. 55.

After six years' experience the commissioners reported that, although there had been a slow and gradual advance in the voluntary enfranchisement of copyholds under ecclesiastical lords, leading to the expectation that the whole of the copyholds under their control would in time disappear, it was very different with the lay lords, very few of whom had effected enfranchisements; and suggested that some more effectual measures be adopted, such as either empowering each individual tenant to call on the commissioners to commute his uncertain payments, and to assign the lord a consideration, or enjoining the commission to take the manors of England *seriatim*, and completely commute all the uncertain incidents in each by turns. This last the commissioners say "would be a more rapid operation no doubt; but then it would be rougher and less practicably and immediately useful." By the Extension Act, 15th and 16th Vict., cap. 51, it was provided (with certain exceptions) that, after the next admittance to any land which shall take place after the 1st July next, either lord or tenant may compel an enfranchisement; and since that time the number of enfranchisements has greatly increased.

Copyright.

COPYRIGHT denotes the property which an author has in his literary works, or which a bookseller, or any other person, may acquire by purchase; a property consisting, in either case, in the exclusive right to print, publish, and sell a particular work.

In former times, before an author could venture to go to press, it was necessary that he should secure a patron who would assist him in bringing his work to light.

"The recompense which the wits of the age of Charles II. could obtain from the public was so small, that they were under the necessity of eking out their incomes by levying contributions on the great. Every rich and good-natured lord was pestered by authors, with a mendicancy so importunate, and a flattery so abject, as may in our time seem incredible. The fee paid for the dedication of a book was often much larger than the sum which any bookseller would give for the copyright."

"The sale of books was so small, that a man of the greatest name could expect only a pittance for the copyright of the best performance. There cannot be a stronger instance than the fate of Dryden's last production—the Fables. That volume was published when he was universally admitted to be the chief of living English poets. It contains above twelve thousand lines. The versification is admirable; the narratives and descriptions full of life. The collection includes Alexander's Feast, the noblest ode in our language. For the copyright Dryden received L.250—less than in our days has sometimes been paid for two articles in a review. Nor does the bargain seem to have been a hard one, for the book went off slowly; and a second edition was not required till the author had been ten years in his grave."—(Macaulay's *England*, vol. i., p. 405.)

The general diffusion of education in later times has prepared for the author a far more munificent patron in the public, the intermediate agent between him and his patron being the bookseller, who is either employed simply in the character of an agent to dispose of the works of the author, and receives a certain commission on the amount of the sales of the publication, or who contracts to pay the author a certain sum for the right to publish an edition or editions, or for the sole right to continue to publish the book during the statutory term.

Booksellers have some data on which they can make calculations of the probable value of the manuscript of an au-

[1] Lord Cranworth, in his speech on the Enfranchisement of Copyholds Bill (as reported in the *Times*, May 26, 1852), remarked that "instances had occurred in quite modern times when that law had been enforced so as to become a very grievous practical hardship. He remembered that the famous race-horse Smolensko, worth some L.2000 or L.3000, had been seized upon the death of the then owner, Sir C. Bunbury. A somewhat similar circumstance, he believed, had occurred on the death of Sir G. Heathcote. About thirty years ago, when the late Lord Abinger was on circuit, it was falsely rumoured that he had died; and the first intimation which Mrs Scarlett received of the melancholy event was from the agent of the lord of the manor, who went to seize three of Lord Abinger's horses. The Pitt diamond was at one time pledged to a pawnbroker who had a small copyhold tenement in Westmoreland liable to heriot; and upon his death the owner of the copyhold manor either did seize, or intimated to the parties that he had a right to seize, and he (Lord Cranworth) believed that he had seized that diamond."

Copyright.

thor of established literary reputation; but an untried author is likely to be much disappointed with the reception his first adventure receives. The subject on which he has written is one, it may be presumed, in which he takes an especial interest, and he is apt to imagine that others cannot be indifferent to it. It has cost him days and nights of laborious investigation and mental toil; and he hears of the rich prizes that have been drawn in the lottery of literature. But the bookseller is more familiar with the blanks. It is a remarkable fact, disclosed by a parliamentary discussion, that only "one publication in eight is found to come to a second edition." (See *Evidence before the Copyright Committee in* 1814.) A great proportion of these do not sell to pay the expense of printing. In the great majority of cases, the contract between an author and a bookseller is made without previous data, and is nothing more nor less than what is commonly called a blind bargain. Dr Paley, on finishing the manuscript of his *Moral and Political Philosophy*, tendered the copyright of it to a bookseller for L.300, and was offered in return L.250, exactly in the way that a cautious purchaser bids for unknown merchandise. During this negotiation, a brother of the trade, apprised of the value of Paley's work, came boldly forward and offered L.1000 for the copyright. The author having consented to give the party first in treaty the previous option, the latter now saw the matter in a new light, and ended by paying four times the amount of his original offer.

Uncertain value of copyrights.

No notion is more general among authors than that booksellers make rapid fortunes at their expense. One writer has published that Jacob Tonson and his nephew died worth L.200,000 (D'Israeli's *Calamities of Authors*, vol. i., p. 29); and not one reader in twenty will stop to question the accuracy of the allegation, though it may be doubted if such a sum was ever realized in trade by any bookseller. In the bookselling trade, as in all lines of business, there are examples of considerable capitals; but these are realized only in the case of long-established concerns, and after a progress of acquisition infinitely slower than the angry imagination of a disappointed author will allow him to believe.

It is, on various accounts, a matter of regret that the limited profits of the bookselling business should not be better understood by literary men. The discovery of it would remove the film from their eyes, and would lessen greatly their habits of complaint. A small offer from a bookseller, as in the case of Paley, is indicative, not of a design to overreach, but of an apprehension that to give more would be to injure himself. On the other hand, we are by no means disposed to launch out into a panegyric of the liberality either of particular individuals, or of the body at large. Like other men of calculation, they naturally mete out their advances, not by attachment to the writer, nor from a patriotic desire to enlighten the public, but by the extent of the expected return. A large allowance for a finished book denotes a confidence of a still larger return from its sale; while the scanty, and apparently niggardly payment of an unknown author, is a token of the fear and trembling with which a bookseller handles a production of doubtful promise.

Example of a new publication.

The agreement between a bookseller and a new author proceeds commonly as follows:—The latter having prepared a work, of which perhaps he has high hopes, but in which he has not had either guidance or advice, sets out by making an offer of his manuscript; and, after some time taken for consideration, he is answered that, his name not being yet known to the public, the publishers cannot take on themselves to make him a payment for his labour, but are willing to give it to the world on their joint account. This leads to a compact, in terms somewhat like the following:—

It is agreed between Messrs Y and Company, booksellers, and Mr Z, that Messrs Y and Company shall print and publish, on their account, jointly with Mr Z, in two volumes octavo, his historical work on ———, Mr Z supplying the manuscript, and Messrs Y and Company taking on themselves the paper, printing, and other publishing charges; the statement of the account to be made up every year at Midsummer—and when, after deducting the various publishing expenses, there shall appear a balance of profit, the same to be equally shared between Mr Z and Messrs Y and Company. The books to be accounted for at the regular trade sale price.

Copyright.

The publication now takes place; and in a twelvemonth afterwards an account is made up in the following form:—

History of ———, by Mr Z.

Dr.		Cr.	
Printing 60 sheets, at 40s	£120 0 0	750 copies printed, retail price 24s, the price to the trade 15s., 150 copies sold at 15s.	£112 10 0
Overrunning and correc-	9 0 0		
P[illegible]	90 0 0		
Advertising	30 0 0	Balance at Dr. carried to next year.	184 0 0
Boarding 750 copies.	37 10 0		
	£296 10 0		£296 10 0

Next year the account is considerably shorter, the charges consisting only of advertising and interest of money; but the attraction of novelty having gone off, the sale is also less, and does not probably exceed eighty copies, leaving still an adverse balance of L.100. The bookseller goes on with mercantile punctuality to render him a further account; but the sale is now in a state of progressive decrease, and does not, for the third year, exceed fifty copies, leaving still an unfavourable balance of L.80. The author now loses patience, and entreats the bookseller to relieve him of all responsibility, by taking over the remaining copies, and considering the account as closed. But it is not every one that escapes so easily: it too often happens that, instead of deriving any profit from his labours, the unfortunate author has to bear the whole expense of paper and printing.

Even the most shrewd and experienced bookseller is unable to calculate accurately what will be the result of his publishing speculations: but, as in other undertakings into which hazard enters, his expectations are often too sanguine; and, in order to secure the éclât of publishing the works of an author of reputation, he will venture to give fully more for his copyrights than the prospect of returns will justify.

An author may either dispose of the entire copyright of his works, or retain the copyright and bargain for so many editions, or lease the publication for a certain number of years.

It is understood that Sir Edward Lytton Bulwer lately leased the publication of his works for ten years to a bookseller for L.20,000. Perhaps no works ever yielded the author so large a sum of money as those of Sir Walter Scott, which amounted to between L.140,000 and L.150,000. Of this sum, L.110,000 was realized between 1826 and 1847, while the works were published as a joint speculation between the author and the publisher.

The number of new literary works which are published in Great Britain annually is computed at about 2500, or about 3000 volumes. This is exclusive of reprints, pamphlets, and periodical publications. Taking the average editions of each at 750 copies, we have a total of above two millions of new volumes published annually in Great Britain. In France the number of newly published volumes is greater, because the impressions are larger; but of all countries Germany is in this respect the most remarkable, the new works published there annually exceeding five thousand, or three to one compared to those of England or France.

Printing became general in England about a century after its discovery; and it was in the year 1556 that a charter was granted to the Stationers' Company, an incorporation consisting, not of venders of stationery in the present sense of the word, but of booksellers and printers, who, for their general benefit, determined to keep at their hall a register, in which should be entered the title of every new book, the name of the proprietors, and the successive transfers of the copyright. By-laws were enacted by the company; fines

Copyright. were levied on members acting in contravention of their regulations; and, in course of time, these resolutions of the association were confirmed by a well-known measure of government, we mean the licensing act of 1662, an act prohibiting the publication of any book unless first licensed by the lord chamberlain and entered in the Stationers' Register. In 1684 a new charter was issued to the company, partly for the purpose of securing the property of books, but more with the view of interposing the royal interdict on any publication at variance with the arbitrary government of Charles II. In the more auspicious reign of William (1691) this act was repealed; but whilst the liberty of the press was restored, the door was unluckily thrown open to infractions of literary property by clandestine editions of books. It was in vain for the owner of a copyright to bring an action against the trespasser; he had no other protection than common law; he could recover only to the extent of the "damage proved"—that is, he could not adduce evidence of the tenth or perhaps the twentieth part of the damage suffered, as he could not prove the sale of one copy out of twenty.[1] This led to applications to parliament in 1703 and 1706; but no act was passed until 1709, when, after much discussion, the sanction of the legislature was given to a bill of which the prominent features were two,—first, an obligation to deliver nine copies to as many public libraries; and, next, a provision for guarding, by severe penalties, the property of copyright during *fourteen years*. The public libraries entitled to the receipt of a copy each were,—the King's Library, now transferred to the British Museum; the Bodleian at Oxford, and the University Library at Cambridge; in London, Sion College, or the Library of the London Clergy; in Scotland, the libraries of the universities of Edinburgh, Glasgow, St Andrews, and Aberdeen, with that of the Faculty of Advocates; to which were added, by a subsequent act in 1791, two Irish libraries, viz. Trinity College, Dublin, and the Society of the King's Inns in that city;—thus making in all eleven copies to be delivered.

The delivery of so many copies of every new book was a heavy tax, and one which booksellers were indefatigable in their efforts to evade—giving at one time only a single volume, and at others venturing to omit the ungracious duty altogether. Hence a necessity for new acts of parliament, more particularly those of 1775 and 1791. Still these acts were not sufficiently positive; and it having been decided in 1798 (in the case of Beckford *v.* Hood) that publishers were not prevented by such irregularities from obtaining damages for pirated editions, they became more and more remiss in their deliveries. At last, in 1811, the university of Cambridge having determined to bring the question to an issue, brought an action for the non-delivery of Fox's History, and obtained a verdict. The booksellers, finding that this act was now no longer a dead letter, applied to parliament; but a committee of the House of Commons, appointed in March 1813, made a report in favour of their opponents; and in the succeeding spring an act was passed, confirming in the most explicit terms the claims of the public libraries, who were not even required to pay any proportion of the price of such books as they thought proper to require. In this respect the law of England differs from that of other countries. In several states of the continent of Europe, and in the United States of America, only one copy of a book is required from an author; in France and Austria not more than two.[2] Copyright.

Term of copyright; its successive variations.

For many years, we might more properly say for a couple of centuries, the property of a book seems to have been considered as permanent as the property of an estate; shares of literary works being bought and sold without any idea of their expiring. It is not till 1709 that we discover a trace of interference with its permanency, the act of that year defending it against intruders during fourteen years, and *no longer*. The limitation, however, had no practical effect; copyright was considered as permanent both by the booksellers and the public; nay, even by three out of the four judges of the Court of King's Bench, in the celebrated trial Millar *v.* Taylor, which took place in 1769, and led to a very memorable display of judicial erudition. The plaintiff charged the defendants with a trespass in publishing an edition of Thomson's *Seasons*, of which the plaintiff was the sole proprietor. Lord Mansfield, with Judges Willes and Aston, gave an opinion in favour of the permanency of the copyright, in which they were confirmed by Judge Blackstone; but one of their brethren, Judge Yates, took a very different course, and adhered resolutely to the literal construction of the act.

An action for a similar trespass was some time afterwards brought before the Court of Session in Scotland; the London proprietor of a copyright claiming damages for an infraction by a provincial bookseller (case of Hinton *v.* Donaldson). Here the majority of the bench were adverse to the opinion formerly delivered by Lord Mansfield, and discharged the defendant without a dissentient voice, except that of the well-known Lord Monboddo. At last, in the session of 1773-4, the question came decisively before parliament, the booksellers having brought in a bill for declaring copyright perpetual. This bill passed the Commons, but was thrown out, after much debate, in the Lords.

Objections and answers.

To avoid perplexity, we shall endeavour to comprise the arguments on both sides in these various discussions in a kind of regular succession, adopting the plan of appending a rejoinder to each argument, as the best method of doing justice to both sides.

Objection. Ideas cannot be the object of property: they are not visible, tangible, or corporeal. (Judge Yates.)

Answer. Whatever admits of exclusive enjoyment may be property. (Hargrave.)

O. Another person may arrive, by his own process of thought, at similar conclusions; would you deny to him what you granted to his predecessor?

A. There is very little apprehension of such a coincidence; the plans and the results of study admit of as infinite variety as the human countenance; the same views or the same conclusions will never come from two persons,

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[1] The following curious statement of a copyright case is extracted from the Records of the Town Council of Edinburgh:—

"*Edinburgh 26th August* 1719.

"The same day, the Councill, upon ane address from Allan Ramsay, representing that he was prejudged in his interest and reputation, and that the leidges are abused by some printers, ballad cryers, and others, by printing, and causeing to be printed, poems of his composure, without his notice or allowance, upon false and uncorrect coppies; as also, that the ballad cryers refuse to vend and publish his papers, unless he give them at rates below what really they can be printed for, they doe therefore discharge all printers or paper cryers within this citie or suburbs, to print or vend any poems or papers of his composure, without his licence; and ordains the said paper cryers to publish and vend the said Allan Ramsay's papers, he allowing them one third of the selling price as their profite, under the penaltie of twentie pounds Scots money, and confiscation of the papers so vended and printed, besides forfiture of the papers' cryers their privilege of publishing or vending papers;—anent all which, this shall be a warrand. (Ext.)"

[2] This burden was alleviated by the act of 1836, which reduced the number of presentation copies to five. When the number was eleven, publishers had good reason to complain, but relief from the heavier burden reconciles them to the lighter. The amount of tax on the last edition of the *Encyclopædia Britannica*, on this head alone, was L.415, 16s, calculated at the selling price, while the duty on the paper exceeded L.6000; and large sums were paid as advertisement duty, which is now happily repealed, and the paper duty reduced one-half: may the other half soon follow!

Copyright. or even from the same person at different times, in the same language. At all events, an arbitrator or a court of justice can be at no loss to decide whether a second publication on the same subject comes within the description of plagiarism.

O. A literary composition is undoubtedly the property of the writer so long as it remains in manuscript; but by the act of publishing he gives it to the world; he lets the bird fly; his property is gone. (Judge Yates.)

A. He gives the public the free use of the knowledge contained in his book; but this is a very different thing from the profit as publisher. The ten shillings paid for a volume entitles the reader to the use of its contents, but can certainly give him no claim to the hundred pounds which may be expected from a new edition. (Lord Mansfield, Judges Willes, Blackstone, and Aston.)

O. It is not clear that common law ever sanctioned the exclusive enjoyment of copyright. The only titles appear to have been the royal patent and the license of the Stationers' Company. (Lord Camden.)

A. It seems to have been always taken for granted by Chancery and other courts that an exclusive right existed. There is a confirmatory example in the highest quarter; the king is perpetual proprietor of the right of publishing acts of parliament and all public documents. (Lord Mansfield, Judges Willes, Blackstone, and Aston.)

O. The patentees of mechanical inventions possess but a limited term; none of them ever advanced a claim to perpetuity. (Judge Yates.)

A. Such patentees are much sooner reimbursed than authors; the fruit of their invention is of direct practical application. Besides, the stranger who makes a duplicate of a machine incurs a much greater relative expense than the stranger who reprints an edition of a book; in the one the materials form the chief part of the cost; in the other, they are comparatively insignificant, and copies may be multiplied by thousands.

O. The statute of the 8th of Queen Anne expressly limits the duration of copyright; it enacts that the protecting penalties shall be in force during fourteen years, and no longer. (Judge Yates.)

A. This is, no doubt, the apparent meaning of the statute, but the preamble of the act declares that it is passed for the protection of literature. To make the act an instrument for curtailing a literary privilege would certainly be at variance with its general language. (Lord Mansfield.)

O. If such property be admitted for a time, is not the term of fourteen years sufficient? What good could the public expect from the writings of men so selfish as to call for a perpetual monopoly?

A. Monopoly is not the proper word; the object may be obtained, as will be shown presently, under modifications which insure to the public a complete supply of books at reasonable prices.

O. "Glory," said Lord Camden, "is the reward of science, and those who deserve it scorn all meaner views."

A. Reputation is, and always will be, the grand stimulus to literary exertion, but it requires long-continued exertion; and if we do not enable a writer to live by his works, we confine the possibility of acquiring reputation to a very small class—to the rich, or to those who derive an income from other means. Such, in fact, has hitherto been the case: standard works have been attempted only by men who, like Gibbon, possessed patrimony, or who, like Robertson and Hume, arrived at the possession of income from other sources. No one imagines that our military or naval officers follow their profession for the sake of pay; yet no one would propose to abridge it on the ground of reputation being their primary object.

O. "It was not for gain," said Lord Camden, "that Bacon, Newton, Milton, and Locke, instructed the world."

A. Each of these distinguished men was obliged to trespass on the time devoted to literature, and to seek an income from public employments. How much better would it have been could they have given an undivided and uninterrupted attention to their favourite pursuits. Copyright.

The grand error on the part of the booksellers lay in demanding *perpetuity* instead of *prolongation*. The idea of perpetuity has in it something very serious, and will not be sanctioned by a legislature without the clearest proof of public advantage.

Foiled in the House of Peers, the booksellers determined to do what men always will endeavour to do when unjustly controlled, namely, to evade that which they cannot resist. They resorted to the alternative of giving an ostensible renewal to a work, by adding, at the end of the term of each copyright, notes and other appendages, which remained their property during another period of fourteen years, and afforded them a kind of guarantee in two ways: *first*, because a competitor, whatever he might do with the original text, could not touch the *addenda*; and, *next*, because the great body of publishers residing in London acted as a corporation, and combined to give circulation to works thus edited, to the complete exclusion of rival impressions.

The law continued on this footing for forty years, the term of copyright receiving no extension till 1814. On that occasion it was apparent that the universities would carry the point of the delivery copies; and the only alternative was, to seek an indemnity in an extension of copyright to twenty-eight years, which was obtained. Prolongation in 1814.

By another act passed in 1836, the number of copies to be furnished to the public libraries was limited to five, viz., the British Museum, the Bodleian Library at Oxford, the Public Library at Cambridge, that of the Faculty of Advocates at Edinburgh, and that of Trinity College, Dublin; whilst the Libraries of Sion College, the four Universities of Scotland, and the King's Inns at Dublin, received compensation for the loss of their privileges by grants from the treasury, calculated on the annual average value of the books each had received during the preceding three years.

The last statute, that which now regulates literary copyright, was passed in 1842. By this act the term of copyright was prolonged to forty-two years; and if the author should live longer than forty-two years after the date of his publication, he retains the property during his lifetime. The property of literary works is vested in the proprietor of the manuscript from which the work shall be first published, and in his assigns.

In cases of copyright subsisting at the time of the passing of the act, the author, or, if dead, his representatives, and the proprietor of the copyright, on coming to a mutual agreement, and inserting a minute to that effect in the books of Stationers' Hall, may secure the benefit of the extended term; but in default of such minute the copyright expires at the end of twenty-eight years. But such publishers or others as have acquired the copyright from "love and affection" shall be entitled to the extended term without any such agreement.

The Judicial Committee of the Privy Council are empowered to license the republication of books which the proprietor refuses to republish after the death of the author.

A copy of every book, and of every subsequent edition published with additions or alterations, upon the best paper on which the same shall be printed, is to be delivered to the British Museum within one calendar month after the same has been published, if published within the bills of mortality, or within three calendar months if published in any other part of the United Kingdom; and a copy of each book, on the paper on which the largest number has been

Copyright. printed, as well as of every subsequent edition containing additions or alterations, is to be delivered either at Stationers' Hall, or to any person authorized by the managers of the respective institutions, within a month after demand, for the following libraries :—The Bodleian at Oxford; the Public Library at Cambridge; that of the Faculty of Advocates at Edinburgh; and that of Trinity College, Dublin.

It is enacted that a book of registry be kept at the hall of the Stationers' Company, in which shall be entered the proprietorship in the copyright of books, dramatic and musical pieces, whether in manuscript or otherwise, which book shall be open for the inspection of any person, on payment of 1s. for every entry which shall be searched for. And the officer at Stationers' Hall shall give a certified copy of any entry when required, on payment of 5s., and such certified copy shall be received in evidence in the courts of law in all summary proceedings, as *prima facie* proof of proprietorship or assignment of copyright or license, as therein expressed; and in the case of dramatic or musical pieces, shall be *prima facie* proof of the right of representation or performance.

The entry in the registry book is to record the title of the book, the time of its publication, the name and place of abode of the publisher or assignee, and the share held by each, where there are more than one proprietor.

In case of piracy the proprietor may bring an action against the offender in any court of record in that part of the British dominions in which the offence shall be committed; and in the event of any such action being brought, the defendant, on pleading thereto, shall give to the plaintiff a notice, in writing, of any objection on which he means to rely on the trial of such action.

No person except the proprietor is allowed to import into the British dominions for sale, or have any book first published in the United Kingdom, and reprinted elsewhere, under the penalty of forfeiture of the book, of the sum of L.10, and double the value of every book so imported.

By this statute it is provided that the proprietor of any Encyclopædia, Review, Magazine, Periodical Work, or work published in a series of books or parts, or who shall have employed any person to compose the same, or any volumes, parts, essays, articles, or portions thereof, for publication, on the terms that the copyright thereon shall belong to such proprietor, shall enjoy the term of copyright granted by this act. But the proprietor shall not be at liberty to publish separately any article or review, without the consent of the author, and neither shall the author, unless he has reserved to himself the right of separate publication. Where neither party has reserved the right, they may publish by mutual agreement, but the author, at the end of twenty-eight years, may publish his contributions separately. Proprietors of periodical works may enter them as soon as they commence to publish, and thus secure the benefit of the entry to the whole of the work. The benefits of this act are likewise extended to dramatic and musical pieces, the sole liberty of representing or performing which is granted to the authors or their assigns, during the term of copyright in books, as provided in this act. The assignment of the copyright of any book containing a dramatic piece, or musical composition, does not convey the right of representing or performing the same.

Books pirated may be recovered by action, and become the property of the proprietor of the copyright; but no proprietor of copyright shall be entitled to sue for any infringement before making entry in the book of registry; and all actions for any offence committed against this act must be commenced within twelve calendar months next after such offence is committed.

The act 5th and 6th William IV., cap. 65, gives to authors of lectures the sole right of printing and publishing the same, provided they have given notice of their intention in writing to two justices living within five miles of the Copyright. place at least two days before the delivery of the lecture; and a penalty is imposed on such as shall print or publish them without the author's leave; but the act does not extend to lectures delivered in any university or public school, or public foundation.

The law of copyright recognises the right of property in the productions of mental as well as in the productions of physical power; and it must be allowed that nothing can more justly be said to belong to a man than the creations of his own thinking faculties, and, in this view, he and his heirs are entitled to whatever profit or advantage may result from them in perpetuity.

The act of 1842 acknowledges this right of property in the author during his lifetime, and confers on his heirs a limited extension of it in the event of the author's dying before the expiry of forty-two years after the publication of his writings. This limitation may appear an unjust interference with the rights of property; but in this, as in other cases, the rights of individuals must give way to the general benefit of the community. And as it is obvious that the application of the rules of law to the conveyance of literary property through successive generations, as in the case of heritable property, would trammel and limit the circulation of the published thoughts of the instructors of their race, and, in many instances, might even extinguish the brightest lights of science and literature, therefore it was for the interest of all that exclusive property in literary publications should not be held in perpetuity.

In France and Belgium the copyright is protected to the author during his life, and to his heirs for twenty years after his death.

The German confederation, by a decree of 19th June 1845, has extended the protection of literary property to the lifetime and thirty years after the death of the author. By an earlier decree of the confederation, 22d August 1841, it conferred ten years' protection against the illegal performance of musical compositions and the representation of dramatic pieces.

The laws of many German countries—for instance, the Bavarian law (15th April 1840), the Saxon (22d February 1844), the Wirtembergian (24th August 1845), had before the law of the confederation granted a protection of thirty years reckoned from the death of the author.

Austria, in a treaty with Sardinia, Tuscany, and the States of the Church, protects copyright in the Italian states of the empire during the author's lifetime and for thirty years after his death, and allows forty years for posthumous publications.

In Russia copyright is secured to the author for life, and to his heirs for twenty-five years.

The copyright law of the United States of America gives the author the exclusive right of publication for twenty-eight years, with the privilege of a renewal for fourteen years to himself and his representatives: these are defined to be his wife and children. A publisher who *purchases* a copyright cannot obtain a renewal. The privilege of renewal can only be obtained by the author or his representatives (whom it is intended to benefit), if they reside in the United States at the time the renewal is applied for.

No foreigner can establish a copyright in the United States unless *resident* there, but if resident he may acquire a copyright, whether citizen or not. By the American law an author may acquire copyright by merely entering the title of the book without actually publishing it; it being sufficient if a copy be deposited within three months after publication.

If it be acknowledged that the creations of his brain are the lawful property of the author, which his countrymen are to be punished for invading, is robbery by a foreigner a less heinous offence? And yet, while it has been considered disgraceful and criminal for the citizens of the same state to

Copyright. plunder each other, it has been held justifiable for the citizens of one state to commit literary piracy on the citizens of another. In Germany, popular writers have been defrauded of the fruit of their labours by the piracies of publishers in neighbouring states. The Belgians and others have pirated the works of the most distinguished French writers; and the Americans have subjected British authors to the same treatment; they have sometimes even inflicted more serious injuries on the foreign author by garbling his works, or by perpetuating imperfect editions.

We have heard a popular writer of the present day say, that, when in the shop of an American bookseller who reprinted one of his books, on looking at the American reprint, of which large numbers had been sold and were continuing to sell, he found it was copied from the first edition of his work, while later editions had been greatly improved. He asked the American bookseller why he did not rather print from the correct edition, and was answered that the book was stereotyped, and it would involve the loss of the plates to reprint from the last edition; that the present sold very well, and he did not know if a reprint from the last edition would sell any better. The author, desirous that his views should be fairly presented, proposed to another bookseller that he should publish the same work, copied from the last and correct English edition. But, as there is honour among thieves, the bookseller refused, alleging that it was considered a point of honour not to interfere with another bookseller who had the priority in reprinting a British publication; and in consequence of this rule, it is presumed, the Americans continue to enjoy the benefit of the imperfect work, and the author the discredit of its defects.

With the view of remedying this evil, the British Legislature passed an act in 1838 for securing to authors, in certain cases, the benefit of international copyright. In conformity with this statute, conventions have been entered into with France, Prussia, Saxony, Hanover, Brunswick, and some others, by which it is agreed that the authors in the two contracting states shall, "with regard to any such work or articles first published in either of the two states, enjoy in the other the same privilege of copyright as would by law be enjoyed by the author, inventor, designer, or engraver of a similar work if first published in such other state, together with the same legal remedies and protection against piracy and unauthorized republication." Certain regulations are provided for the purpose of giving effect to this general principle, and moderate duties on importation are agreed to, viz.:—

Works originally produced in the United Kingdom, and republished in ———, the cwt. . .	L 2	10	0
Works not originally produced in the United Kingdom	0	15	0
Prints or drawings, plain or coloured, each . .	0	0	0½
Bound or sewed, the dozen	0	0	1½

It is to be regretted that the offer of Great Britain to enter into treaties for the establishment of international copyright has been accepted by so few; especially that the United States of America should have refused to reciprocate in the protection of literary property. If the unfortunate authors are to be considered fair subjects of plunder by the booksellers of either country, it cannot be denied that the United States will intercept greater numbers, and secure a richer booty; still the adage that "honesty is the best policy" will hold good even in this instance. American literature has been dwarfed by the treatment it has received from those who should be its most munificent patrons—the booksellers—who, instead of encouraging the literary manufacture of native genius and industry, by affording it a fair remuneration, have preferred to lay wait for the rich cargoes of foreigners which they may appropriate.

Were both countries to agree to protect literary property, and to permit importation on the payment of moderate duties, such as those stated above, not only would authors receive the just reward of their labours, but the booksellers would be enabled to carry on a larger and less hazardous trade, and the public would be more extensively benefited. Many valuable books are published in Britain which have a limited sale; and these no American bookseller would reprint, since if he were to import copies, he must pay a high duty, which, when added to the original price, effectually checks the sale. Could the publisher calculate on both the British and American market, open and unfettered, he could remunerate the author more highly, the edition might be larger, and the cost of paper and print smaller; and the public would receive the benefit of this free intercommunion. The advantage would not be confined to either country. As the British authors and booksellers suffer by the present piratical system, so do the authors and booksellers of America. As the larger trade is carried on by the British publishers, they will suffer more in degree, but the punishment of the American publishers will be in proportion. In two states carrying on a war of piracy against each other, individuals now and then might capture rich prizes; but the unhallowed warfare would not promote the prosperity of either country, and the sooner both discontinued it the better for all. Copyright

In February 1854 articles of an international copyright treaty were drawn up with great ability by John James Crampton, minister plenipotentiary on the part of Great Britain, and Edward Everett, secretary of state on the part of the United States, and reported to the Senate in executive session.

The treaty, however, is likely to be strongly opposed; and even if it were to force its way through the senate, there are but slender hopes of its passing the House of Representatives.

The temptation to continue to appropriate the best works of British authors without compensation or control is too great for our transatlantic brethren to withstand. There is no doubt that if the American booksellers appropriate without compensation literary copyrights which have cost the British bookseller from perhaps a hundred to a thousand pounds a volume, they will be able to sell them at a greatly reduced rate and in much larger numbers. This will so far benefit the transatlantic readers by furnishing them with the best copyright books at a small price, and give employment to papermakers, printers, and bookbinders. (See Bookselling). In these circumstances it can hardly be expected that a body of representatives depending on the universal suffrages of the people will venture to act in opposition to what their constituents will doubtless consider valuable rights. They may probably acknowledge that the property they are purchasing at a cheap rate is not honestly come by; but the questionable practice has existed so long as to have grown into a prescriptive right, and it has been acted on by so many as to give a kind of sanction to piracy.

The United States of America have enjoyed not only a great advantage over Britain by the balance of literary trade being so greatly in their favour, they being able to reprint ten British authors for one that the mother country could reprint in return; but, besides this, while appropriating to themselves the numerous copyrights of Britain, they have contrived to prevent the English booksellers from reprinting the smaller number of copyright books published by Americans.

The plan that has been adopted by American and other foreign authors, is to publish in the foreign country and in Britain on the same day, and by this means to acquire a copyright in both countries. Both this question, whether a foreign author can acquire a British copyright by simultaneous publication, and the wider question whether a foreign author resident abroad can acquire a British copyright at all, except under the international copyright act,

Copyright. have given occasion to several important lawsuits and keen discussions, followed by conflicting decisions of the courts. It has been contended that the copyright statutes were passed for the benefit of authors who by birth or residence were subjects of this country, and not to encourage the importation of foreign books by securing a monopoly in their favour. On the other hand it has been argued that an alien, though resident abroad, may enjoy personal property, and enforce personal rights in this country, and that therefore he may hold copyright here. But if copyright were personal property like other goods which the foreigner possessed, then he would be entitled to retain it without any limitation of times, not for 42 years, but for ever. Copyright differs from personal property in this, that the one is an inherent and permanent right, whereas the other is a terminable privilege conferred by the statutes of the country on its subjects.

It has also been said that on the principles of free trade foreign copyright ought to be recognised. The result of free trade is to break down monopolies, and to lower the price of commodities; but the recognition of the foreign copyright would have a diametrically opposite effect,—it would enable the foreigner to extend the evils of monopoly, and greatly enhance the price of his publications in this country.

If this state of the law be continued, it will be vain to expect further adoption of the international copyright act by foreign countries, for in this view they already possess the advantages it would confer. They retain the copyright in their own country, and are likewise able to secure it in this, and at the same time to appropriate the copyright of British authors without compensation; the "reciprocity" is all on one side.

In 1835, Lord Abinger, in the cause D'Almaine *v.* Boosey, held that a foreigner might have copyright under the statute. The same opinion was held by Vice-Chancellor Shadwell, in Bentley *v.* Foster, but he sent the point to be decided by another court. In Chappell *v.* Purday, the Court of Exchequer, in 1845, delivered a solemn judgment, in which they expressed an opinion, that neither a foreign author residing abroad, who composed a work abroad, nor his assignee in this country, had any copyright in Britain. But, on the other hand, the Court of Common Pleas in 1848 affirmed, in the case of Cocks *v.* Purday, the exactly opposite doctrine, which was shortly afterwards supported by the Court of Queen's Bench, in Boosey *v.* Davidson, professedly in consequence of the decision in the case of Cocks *v.* Purday. Then followed Boosey *v.* Purday, in which the Court of Exchequer unanimously and distinctly decided, that a foreign author residing abroad was *not* an author within the meaning of the statutes, which were intended for the encouragement of British talent and industry; and that a foreigner by sending to, and first publishing his work in, Great Britain, acquired no copyright. In a subsequent case of Boosey *v.* Jeffreys, tried in the Court of Exchequer in 1850, that Court affirmed its judgment in Boosey *v.* Purday. But in May 1851, the Court of Error, consisting of the judges of the Queen's Bench and Common Pleas, overruled that judgment: the case, however, was carried to the House of Lords by appeal.

Here are three recent solemn decisions of English courts of law on one side, and five on the other—a state of judicial administration neither creditable to the British courts, nor conducive to the protection of the property of the British people. It is of the greatest importance that the uncertainty introduced into the publication trade by these decisions should be removed; and if the preponderance of judicial authority should affirm that, by the strict legal interpretation of the statutes, foreign authors and publishers are entitled to privileges which are denied to British authors and publishers, then the legislature should deal with the case, and bring the law into conformity with the copyright laws of other states, not for the purpose of giving protection to British literature in the sense of an odious monopoly, but by placing British and foreign authors and publishers on a footing of equality, and enabling the British public to enjoy the foreign literature on the same cheap terms as the foreigner obtains the English. Copyright.

The object of the international copyright act is to induce other governments to concede to the authors in the dominions of the contracting parties equal rights in their respective countries. If the law shall be confirmed to be in conformity with the decisions of the Courts of Common Pleas and Queen's Bench, then foreign nations will have no inducement to accede to these treaties, as they already enjoy all the advantages they propose to confer. But if the principle of these treaties is reasonable and mutually advantageous, then the same principle ought to induce parliament to bring our laws as nearly as possible into conformity with the system of reciprocity which the international copyright treaties seek to establish.

This article was prepared for the printer before the decision given (August 1, 1854) on the appeal to the House of Lords, which settles this vexed question, and establishes the copyright, as regards foreigners, on a satisfactory basis.

But the following extracts from the speeches of the three law lords who were present on the occasion will exhibit the grounds on which they arrived at the conclusion, that a foreign author can neither hold copyright himself, nor assign it to another, unless resident in this country.

The Lord Chancellor, in moving the judgment of the house in the appeal case Jeffreys (plaintiff in error) *v.* Boosey (defendant in error), said he adhered to the view which he had originally taken of the matter. "The right in dispute was not the right to publish, or to refrain from publishing a work which had not yet been given to the world, but was the right to have the exclusive power of publishing such given work. Now, copyright in this way defined was, if not the creature of the statute law, at least a right regulated by that law. The legislature, *primâ facie*, must be taken to legislate for its own subjects only, and the object declared by the preamble of the act must be taken to be a merely natural object. A foreigner, of course, who was not a resident abroad but was a resident in this country, and therefore subject to its laws, was for the time in the condition of a native born subject, and, if he came to this country and published his work here, he would be within the protection of the statute. But if at the time of such publication he was residing out of the kingdom, the statute did not protect him. There was a distinction to be taken between the patents for inventions and the copyrights in books. By the common law the Crown had a right to give to a subject a monopoly in a particular manufacture; and all that the statute of James did was to confine the exercise of that patent within definite limits. With regard to his own opinion on the matter, it was founded on the general doctrine that a British senate would legislate for British subjects, properly so called, or for such persons who might obtain that character for a time by being resident in this country, and therefore under allegiance to the Crown, and under the protection of the laws of England."

Lord Brougham said, coming to the case itself, "it was to be taken that the right of an author prior to publication was unquestioned; that he had the exclusive right in his own manuscript; that he might communicate it or withhold it, or that he might exercise his discretion as to whom he would communicate it. Then came the question as to the right of publication. The statute of Anne had been passed for the purpose of encouraging learned men, and with that view that act had given them the exclusive right in their publications for twenty-one years. This, however, was clear, they had no copyright by common law, for if

Copyright.

they had there would then have been no necessity for the passing of that statute. It could scarcely be said that the legislature had decided a century and a half since that an act was to be passed to create a monopoly in literary works solely for the benefit of foreigners. In the present case, he was clearly of opinion that the copyright claimed did not exist, and therefore that foreign law should not prevail over British law where there was such diversity between the two. In his opinion the ruling of his learned friend on the woolsack was perfectly correct."

Lord St Leonards concurred in all that had fallen from his noble and learned friends, and gives his view of what constitutes residence—a point which might have led to serious disputes. "He could not at the present moment take upon himself to say what would be a sufficient residence to entitle a foreigner having come to this country to claim a copyright. But he would say that whatever would constitute a residence so as to subject him to allegiance while he was in this country, and would confer upon him the rights of a foreigner resident in England, would give him a copyright during the period of his residence here. The Americans on this point experienced no difficulty, for it was expressly defined in their enactments that the law of their country permitted the importation of foreign works. They must not in this country put on their own acts of parliament a strained construction to give to foreigners those rights which foreigners denied to them. He was perfectly clear that if it were necessary, as he held that it was, that Bellini must have resided in England in order to possess the copyright, he had no legal power to assign that copyright as regarded this country, and, the assignment not being valid, the right of action was not maintainable, and therefore the judgment of the Court of Exchequer Chamber ought to be reversed."

The judgment of the Court of Exchequer Chamber was thereupon ordered to be reversed. (A. B.)

COPYRIGHT *in the Arts and Designs.*—The statutes affecting copyright in the arts of designing and engraving prints are 8th Geo. II., cap. 13, and the 7th Geo. III., cap. 56.

COPYRIGHT *in Designs for Manufactures.* Mr Emerson Tennant's act, 5th and 6th Victoria, cap. 100, gives to the proprietors of designs for manufactured goods not previously published, the sole right of applying them to articles of the following descriptions for three years:—

Articles of manufacture composed wholly or chiefly of Metals, of Wood, of Glass, or of Earthenware—Paper-hangings, and Carpets.

Shawls, when the design is not applied by printing.

Woven fabrics of linen, cotton, wool, silk, or hair, or of a mixture of these coming within the description of what is technically called furnitures; if the design be applied by printing, or by any other process, the repeat of the design being more than twelve inches by eight.

It also gives to the proprietors the sole right of applying the design to the following articles for nine months:—

1*st*, Shawls, where the design is applied solely by printing, or by any other process by which colours may be produced upon textile fabrics.

2*d*, Yarn thread, or warp, where the design is applied by printing, or by any other process by which colours may be produced.

3*d*, Woven fabrics composed of linen, cotton, wool, silk, or hair, or of a mixture of these, if the design be applied by printing, or by any other process by which colours are produced upon textile fabrics.

The sole right of applying them is granted for twelve months to the proprietors of designs. For woven fabrics, lace, and any other article of manufacture not comprised in any of the preceding classes, whether such design be applicable for the pattern, the shape, or ornament, or be produced by printing, painting, weaving, modelling, or any other means whatsoever, manual, mechanical, or chemical.

Coques || Coracesium.

Piracy is punished by a penalty of not less than L.5, or more than L.30, payable to the proprietor of the design, to be recovered by an action for debt or damages, or by summary proceedings before two justices; but the benefits of copyright can only be acquired by having the designs registered before publication.

COQUES, GONZALEZ, a painter of portraits and *conversazioni*, was born at Antwerp in 1618, and became a disciple of David Ryckaert the elder. His admiration of the style of Vandyck induced him to fix on that great artist as his model; and he was so successful, that, after Vandyck, he was esteemed equal to any other painter of his time. In the school of Ryckaert he had been accustomed to paint conversazioni, and he frequently composed fancy pieces after the manner of Teniers, Ostade, and Vandyck; a habit by which he introduced a very agreeable style of portrait painting. In this way he produced several fine pictures for Charles I., the Archduke Leopold, and the Prince of Orange; and from the latter he received a rich gold chain, with a medal on which the prince's bust was impressed. Coques died in 1684. He had an excellent pencil: his portraits were well designed, with easy, natural attitudes; his figures were disposed in his compositions so as to avoid confusion; he gave an extraordinary clearness of colour to his heads and hands; and his touch was free, firm, and broad—a kind of excellence seldom seen in works of small size.

COQUIMBO, or LA SERENA, a seaport-town of Chile, capital of a department of the same name, situated on the Coquimbo, in S. Lat. 29. 53. 43.; W. Long. 71. 18. 40. It is a regularly laid out and clean-looking town, interspersed with numerous gardens; but the houses, which are built of sun-dried brick, seldom exceed the height of one story. The harbour, one of the best in Chile, is much frequented; being well sheltered and capacious, and of depth sufficient to admit large vessels. Pop. about 10,000. (See CHILE.)

COR CAROLI, in *Astronomy*, an extra-constellated star in the northern hemisphere, between the *Coma Berenices* and *Ursa Major*. It was so called by Halley in compliment to Charles II.

COR *Hydræ*, a fixed star of the first magnitude in the constellation Hydra.

COR *Leonis*, a fixed star of the first magnitude in the constellation Leo.

CORA, in *Ancient Geography*, a very old and interesting city of Latium, on the Via Appia, about 39 miles from Rome. Its name, and various traditions connected with it, appear to assign to the city a Pelasgic origin. As it stood on the confines of the Volscian territory it suffered much in the wars between the Volsci and the Romans. It ultimately fell under the dominion of the latter power, and gradually declined from the important place it once occupied among the thirty cities of the Latin league at the beginning of the fifth century B.C. Cora possesses extensive remains of antiquity. The most interesting of these are the Cyclopean walls, which seem to have encircled the city in three several tiers, and the bridge on the road to Norba, which spans a deep ravine with a single arch, and is justly reckoned one of the most remarkable structures of this kind in Italy.

CORACHEE. See KURRACHEE.

CORACESIUM (*Alaya*), in *Ancient Geography*, a natural fortress of great strength in Cilicia Trachæa, on the confines of Pamphylia, overhanging the sea. Its position has often been compared with that of Gibraltar, and in ancient times the town had a reputation for impregnability analogous to that enjoyed by the modern stronghold. It successfully resisted all the attempts of Alexander the Great to take it, and maintained itself to the last against all

Coracle ‖ Coram.

the efforts of the Seleucidæ. In later times it became the headquarters of the notorious pirates of Cilicia, who were here utterly routed by Cn. Pompey. (See CILICIA.)

CORACLE, a small kind of boat, constructed of wicker, and covered with leather, or with cloth made waterproof with oil or tar. From its extreme lightness it may be transported on the shoulders from place to place. Coracles are common in Wales. A similar kind of boat has been used in the East from remote antiquity.

CORAH, or KORAH, in Hindustan, a district in the British province of Futtehpore, situated in the plains between the Ganges and Jumna, and between the 26th and 27th degrees of north latitude. It is in general a level country, with the exception of the high banks of the Ganges, on which the villages are usually situated, surrounded by mango trees. It produces every kind of grain except rice; also excellent crops of sugar-cane, tobacco, and cotton. It has good roads and navigable rivers on its eastern and western boundaries, by which an extensive commerce is carried on. Upon the dismemberment of the empire of Delhi this part of India became the field of contention between the king of Oude, the Mahrattas, and the English; and in 1765 the district was ceded to the emperor Shah Alum by the British, as a royal domain for the support of his majesty. A few years later, upon that prince throwing himself into the power of the Mahrattas, the territory was regarded as having escheated, and was thereupon transferred to the king of Oude, from whom, under the treaty of 1801, it passed with other districts to the East India Company. The tract contains an area of 230 square miles, with a population of 82,316.

CORAH, the capital of the above district, is situated nearly half-way between the Ganges and the Jumna. The town is surrounded by a mud wall with mud towers, and the houses are mostly constructed of the same material, and have flat roofs. It has a considerable trade in grain and cotton. Distant from Futtehpore W.N.W. 30 miles. Lat. 26. 7., Long. 80. 35. (E. T.)

CORAL (Fr. *corail*; Gr. κοράλλιον), is a marine production bearing a resemblance to the branch of a tree, which always grows to the under surface of rocks, and projects perpendicularly downwards. It consists of the united stony cells or habitations of certain minute animals (polypariæ), whose fleshy parts surround a branching hard and stony centre, which is the coral of commerce. Coral is found abundantly in many parts of the Mediterranean, the Red and Chinese seas, and in the Persian Gulf. The coral branches require about twelve years to attain the length of ten or twelve inches, and the thickness requisite to fit them for cutting into beads for necklaces or other ornaments. On this account, in prosecuting the coral fishing, the fishermen endeavour not to disturb the same ground for that period of time. The mode of obtaining the coral is by drawing among the rocks where the coral grows a heavy cross of wood, which is weighted with stones, and has its projecting extremities furnished with loosely twisted hemp or coarse nettings. The wood in rubbing along the under surface of the rocks breaks off the coral branches, which get entangled in the netting, and are drawn to the surface. Coral is of various colours, from black or bright red to a dull white, and according to its colour, size, and hardness, greatly varies in price.

CORAM, CAPTAIN THOMAS (1668–1751), an eminent philanthropist, who projected the Foundling Hospital, Guildford Street, London, and set on foot a scheme for the education of Indian females in America. He spent all his property in promoting charitable undertakings, and was at length reduced to subsist on a subscription raised on his behalf, and headed by the Prince of Wales. He was buried in a vault under the chapel of the Foundling Hospital. A fine portrait of him, by Hogarth, has been engraved among the other works of that artist.

CORAN, AL. See ALCORAN.

Coran, Al ‖ Corcyra.

CORBAN, a Hebrew word translated "gift" in the New Testament. It has reference to a formula occurring in the Talmud, which was used to release a man from the performance of a distasteful duty under the fiction of a religious vow. Thus a son might relieve himself from his duty to his parents by affirming that his property, so far as it might benefit them, was Corban, that is, already dedicated to God, and therefore beyond his control.

CORBAN, or *Koorban* (in Arabic, *a sacrifice*), is also a ceremony which the Mohammedans perform at the foot of Mount Arafat in Arabia, near Mecca. It consists in killing a number of sheep and distributing them among the poor.

CORBEIL, a town of France, department of Seine-et-Oise, capital of an arrondissement of the same name, situated at the junction of the Essonne with the Seine, 18 miles S.S.E. of Paris. It has very extensive flour mills, and a large corn magazine belonging to government, for the supply of Paris. It has also considerable manufactures of linen, cotton, paper, leather, &c. Pop. (1851) 4645.

CORBEILS (Fr. *corbeilles*), in *Fortification*, little baskets of earth about a foot and a half in height, and eight inches wide at bottom by twelve at top; set one against another upon a parapet to shelter men from the fire of besiegers.

CORBEL, in *Architecture*, a knob, boss, or console, projecting from the vertical face of a wall, to support some superincumbent object. Corbels are frequently sculptured into the form of grotesque heads, &c.

CORBEL-SOUS is used to distinguish a corbel essential in the construction of a building from one that is merely used as an ornament.

CORBET, RICHARD (1582–1635), an English poet and divine, born at Ewell, Surrey, and educated at Oxford, where he was esteemed one of the most celebrated wits of the university. Having officiated for some time as chaplain to James I., in 1629 he was appointed bishop of Oxford, and in 1632 translated to the see of Norwich. His poems, which were written long previous to his elevation to the episcopal bench, and not intended for publication, were published after his death, under the title of *Poetica Stromata*. He left behind him a character for hospitality, and was a generous encourager of public designs.

CORCULUM (dim. of *cor*, the heart), in *Botany*, the part of a seed, or rudiment of the future plant, attached to and involved in the cotyledons.

CORCYRA, now CORFU, an island in the Ionian Sea, off the coast of Epirus, from which it is separated by a strait varying in breadth from two to fifteen miles. At its northern extremity, where its breadth is greatest, Corcyra is about twenty miles broad; half-way between the cities of Cassiope and Corcyra it contracts to about a third of that width; at Corcyra it again expands to about twelve miles; from Corcyra southwards the average breadth of the island is only three miles; length from north to south nearly forty miles; total area 227 square miles. The northern part of the island is intersected from east to west by a chain of mountains, the highest peak of which, San Salvatore, nearly 4000 feet in height, is covered with forests to the top. A spur from this northern range intersects the southern portion of the island, and is indented throughout its whole extent with numerous valleys, renowned for their fertility both in ancient and modern times.

The ancient Corcyreans delighted to identify their island with the Homeric Scheria, the kingdom of Alcinous and his Phæacian subjects. It is with a description of this happy isle that nearly a third of the Odyssey is occupied. But the first authentic event in the history of Corcyra is its colonization by the Corinthians. So favourable was the

Corcyra || Corday D'Armans.

position of Corcyra for trade that in a short time it rivalled the mother country, set it at defiance, and destroyed the fleet which it sent to vindicate its sovereignty. This is the first naval battle on record. (See CORINTH.) The Corcyreans were shortly after, however, compelled to acknowledge the supremacy of Corinth by the tyrant Periander, the son of Cypselus. After his death they regained their independence; but at the time of the Persian invasion their pusillanimity drew down upon them the contempt of all Greece. At a subsequent period their dissensions with the parent state brought on the Peloponnesian war. They remained faithful to the Athenian alliance during that war, and repelled several attempts of the Lacedæmonians to bring them under the dominion of Sparta. After the death of Alexander, Corcyra experienced various vicissitudes of fortune, but ultimately fell into the hands of Pyrrhus king of Epire. After his death it was seized by the Illyrian pirates, who retained it till B.C. 229, when it surrendered to the Romans. Under them it became an important naval station in their wars with Greece, and continued to be so till the downfall of the Eastern Empire. From the Romans it passed to the Normans, and from them to the Venetians. In 1797 it shared the fate of the Venetian republic. (For the subsequent history of Corfu see IONIAN ISLANDS.)

CORCYRA, the chief city of the island, was situated on a peninsula on the east coast, nearly half-way between its northern and southern extremities. It had two excellent harbours, which served for the headquarters of the Corcyrean fleet. The only other town of importance in the island was Cassiope, on the N.E. side. Some remains of it, which still exist, are known under the name of Cassopo.

CORD. See CHORD.

CORD-WOOD, wood cut and piled for sale by the cord, in distinction from long wood: properly, wood cut to the length of four feet; but in this respect the practice is not uniform. In Scotland, cord-wood is such as is conveyed to market on board a vessel, in opposition to wood that is floated.

CORDAGE. See ROPE-MAKING.

CORDATE, or CORDATED, heart-shaped; a term used by naturalists, as of leaves, &c.

CORDAY D'ARMANS, MARIE-ANNE-CHARLOTTE, born in 1768, at St Saturnin, near Séez in Normandy, was descended of a noble family; and numbered among her ancestors the celebrated Corneille. After the events of the 31st May 1793, the heads of the republican party of the convention, Gaudet, Gensonné, Pétion, and others, having been proscribed by Robespierre, sought refuge in the departments of the Eure and the Calvados, where they hoped to stir up in their favour the numerous population of Normandy. At this time the works of certain popular writers, and particularly those of the Abbé Raynal, her favourite author, had obliterated from the mind of Charlotte Corday those lessons of gentleness and resignation which she had imbibed in the peaceful convent where she had been educated; whilst the cause of the refugees, which she now accounted alike honourable and patriotic, the energy and charm of their conversation, and the interest which a generous nature always feels in behalf of men of merit unjustly persecuted, excited beyond measure her ardent imagination. Accordingly, observing that those around her manifested but little desire to inflict vengeance upon the oppressors of her country, she resolved singly to strike a blow which should spread terror and dismay among the ranks of the triumphant faction. She therefore repaired to Paris, where she at first occupied herself in endeavouring to ascertain the temper of the public mind; and she then managed to get introduced to the gallery of the convention by the Abbé Fauchet, to whom she applied for the purpose, and who soon afterwards expiated on the scaffold this simple act of complaisance towards an unknown female stranger. At that time the convention resounded with the most violent declamations against the proscribed patriots, and the only question was who should propose to adopt the most furious measures against them. Such vehement invectives against men whose cause she had embraced, redoubled the indignation of Charlotte Corday, and she hesitated no longer about executing the project she had formed. Marat, who of all the conventional deputies had contributed the most publicly to the revolution of the 31st May, had not for several days made his appearance in the assembly. But this extraordinary woman, whose purpose nothing could shake, having discovered his lodging, wrote to him in these terms:—"Citizen, I have just arrived from Caen. Your love for your native place doubtless makes you desirous to learn the events which have occurred in that part of the republic. I shall call at your residence in about an hour;—have the goodness to receive me;—I will put you in a condition to render a great service to France." This letter, and a second of a similar description, having remained unanswered, she wrote a third, on the 15th July 1793, in which she spoke of great secrets which she had to reveal, and of personal misfortunes to which she hoped the generous soul of Marat would not be insensible. She followed the bearer of this last billet, and arrived almost as soon as he at the door of the deputy. Two women, who were in the antechamber, refused at first to allow her to enter; but Marat, having gathered from their conversation that it was the person who had repeatedly written to him, ordered her to be admitted. He was then in a bathing-tub, being afflicted with a disgusting malady, which had reduced him almost to a state of putrefaction. The conversation commenced as to what was passing in the Calvados, when Marat inquired of his unknown visitor the names of the deputies and administrators who were then at Caen and at Evreux, wrote them down from her dictation, and ended by saying, that in a few days he would cause them all to be guillotined at Paris. This was enough. Without waiting to hear more, she drew a knife which she had concealed under her gown, and buried it to the hilt in the breast of Marat, who, having exclaimed "A moi, ma chère amie!" almost instantly expired. The two women, alarmed by the noise, rushed into the apartment just as the wretch was breathing his last, whilst Corday, still holding the bloody knife in her hand, endeavoured to make her escape. Not daring to lay hold of her, the women overturned some articles of furniture in her way, and shouted out murder. The guard arrived, and the heroic assassin being seized, was immediately handed over to the revolutionary tribunal. But her firmness did not for an instant forsake her. Fouquier-Tinville attempting to pronounce an eulogy on the murdered terrorist, she interrupted him sharply, declaring that Marat was a monster, who well merited his fate. The offence and all its circumstances being not only confessed, but defended by the accused as a meritorious and patriotic act, her doom could not for a moment be doubtful. Still this bloody tribunal, which had so often condemned without evidence or against it, affected to exhaust all the ordinary judicial formalities before pronouncing sentence, and appointed Chauveau-Lagarde to defend the accused. The defence consisted merely of a repetition of the confession which the prisoner herself had previously made, with a striking allusion to the imperturbable tranquillity and sublime abnegation of every personal or selfish consideration exhibited by her almost in the presence of death itself, and a hint, which, however, was wholly thrown away, that she might have acted under the influence of some strong mental hallucination. The prisoner gracefully thanked her counsel for the few words he had uttered in her defence, declaring at the same time that the only plea worthy of her was an avowal of the act in which she gloried; and she heard sentence of death pronounced with the same unequalled serenity, and without the least perceptible change either in the colour or

Corday D'Armans.

Cordelier || Cordova.

the expression of her countenance. The same extraordinary force of character or strength of enthusiasm sustained her in her last moments, and rendered her at once an object of interest, astonishment, and terror. On her way to the guillotine she was assailed, without being in the slightest degree affected, by the hootings of the rabble; and, in presence of the apparatus of death, she stood unmoved, whilst her fine and noble figure seemed to assume a more dignified and imposing attitude. When the executioner proceeded to remove part of her dress, the sentiment of offended modesty was strongly expressed by her features; but as to the life of which she was about to be deprived, it seemed not to cost her a thought, nor to give her an instant's concern. She was decapitated on the 17th July 1793, at the age of twenty-five. (Couet de Gironville, *Charlotte Corday decapitée à Paris le* 17 *Juillet* 1793, *ou Mémoires pour servir à l'Histoire de la Vie de cette Femme célèbre*, Paris, 1796, 8vo.) (J.B—E.)

CORDELIER, a Franciscan friar; one of the religious order founded by St Francis, a Gray friar. The Cordeliers wear a thick gray cloth, a little cowl, a chaperon, and a cloak, with a girdle of rope or cord tied with three knots; and hence the name. They are otherwise called Minor Friars, which was their original denomination. The name of *Cordelier* is said to have been first given them in the war of St Louis against the infidels, in which the Minor Friars repulsed the barbarians; and when the king inquired their name, it was answered, they were people *cordeliez*, or tied with ropes. The Cordeliers are professed Scotists.

CORDELIERS was also the name assumed by one of the political clubs which abounded in Paris during the French revolution of 1789. The leading members of this club were Danton, Marat, and Camille-Desmoulins.

CORDEMOI, GERALD DE, a Cartesian philosopher and historian, born at Paris about the beginning of the seventeenth century. He gained the friendship of Bossuet, who appointed him reader to the dauphin. He was admitted a member of the French Academy in 1675, and died in 1684. Cordemoi wrote several historical and metaphysical works, which were afterwards selected and published in 1704.

CORDILLERAS. See ANDES.

CORDON (French), in *Fortification*, a row of stones jutting out between the wall of the fortress which lies aslope and the parapet which is perpendicular; serving as an ornament, and used only in fortifications of stone-work. Cordon also denotes a line of troops drawn around a town or a district, in order to prevent ingress or egress.

CORDOVA, or CORDOBA, one of the eight provinces into which the ancient kingdom of Andalucia is divided: bounded N. by the province of Ciudad Real, N.W. by Badajoz in Estremadura, S.W. by Seville, and E. by Jaen. Area 4150 square miles. Pop. 306,760. It is watered by the Guadalquiver and its tributaries; and is intersected in the N. from E. to W. by the Sierra Morena, and in the S. by the Montes de Granada. The mountainous region of the Sierra affords abundant pasturage for sheep and goats; and its forests give shelter to numerous animals of the chase. The southern part is distinguished for its fertility; but the cultivation of the cereal crops is neglected for the easier production of wine and oil. In the summer months the soil is parched by the heats; and the system of letting the land for short terms, and receiving the rent in produce, is unfavourable to the investment of capital in irrigation and other agricultural improvements. Both divisions of the province possess rich metalliferous veins. Its manufacturing industry has declined since the expulsion of the Moors, and is confined to the production of coarse linen and woollen stuffs, soap, pottery, leather, and silversmith's goods. For the statistics of the province see ANDALUCIA.

CORDOVA (Lat. *Corduba*), the capital of the above province, situated on the southern declivity of the Sierra Morena, on the right bank of the Guadalquiver, 75 miles N.E. of Seville. Its walls, the foundations of which are of Roman architecture, and the superstructure principally Moorish, inclose a very large area; but much of the space is occupied with garden-ground, which has been cleared from the ruins of ancient buildings. The streets are narrow and crooked, and with the exception of a single great square the houses are exceedingly dilapidated. The southern suburb communicates with the town by means of a bridge of 16 arches, exhibiting the usual combination of Roman and Moorish masonry. The principal public buildings are the various ecclesiastical edifices, many of which have been secularized; the *Alcazar*, now converted into stables for the royal stud; the lyceum, the city hall, and the colleges. By far the most important is the cathedral originally built by Abderrahman I., as a Mohammedan mosque, and probably erected on the site of a Roman temple. The exterior is castellated, with square buttress towers, and wears a very peculiar aspect. The interior is a labyrinth of columns, principally brought from the spoils of Nismes, Narbonne, Seville, Tarragona, and Carthage. They are of red porphyry, verd-antique, and other marbles, and have been adjusted to their present position either by being sunk into the soil, or, when too short, by receiving the addition of a variable Corinthian capital. These columns (12 feet high) support a double tier of open Moorish arches, the upper tier of which springs from the apex of the arches of the lower. They support the cypress frame of the original roof. Out of the 1200 columns of the original building, the writer of the present article counted in 1814 no more than 657, exclusive of some fragments of shafts sticking in the pavement around the building as posts. The area is about 395 feet from E. to W., and 356 feet from N. to S; and it is pillared off longitudinally into 19, and transversely into 29 aisles. The roof is about 35 feet high, and was flat previously to the introduction of the modern cupolas. A small space parted off for the use of the Imans now serves for a chapter-house, sacristy, and treasury.

Cordova.

It is greatly diminished in size, by having a part which served the Mohammedans for their ablutions converted into a garden, planted with orange trees and cypresses, and adorned with three beautiful fountains. This garden and the portico, supported by pillars, is 510 feet in length. The originality of the style of the building is destroyed by the addition of a modern lofty tower, and by the erection within the mosque of a magnificent *Crucero* or high altar and choir, of good Roman style, the work of the architect Hernan Ruiz, and by the addition of numerous chapels along the sides of the vast quadrangle. Of its original splendour some conception may be formed from the fact that its gates are said to have been covered with bronze curiously embossed; and 4700 lamps to have been lighted in the mosque every night, the oil used in them being mixed with the wood of aloes, with ambergris, and other expensive perfumes.

Under the Romans, Corduba was a flourishing city of Hispania Bætica, having been founded by Marcus Marcellus during the war with the Celtiberi, B.C. 152. The original inhabitants of the city were Roman colonists, and picked men from the well-affected Spanish tribes. It was the residence of the prætor and the seat of the provincial assize. From the great number of provincial nobility who dwelt there, Corduba received the title of Patricia; and to this day the Cordovese pique themselves on the antiquity of their descent and the purity of their blood. In the wars between Cæsar and the sons of Pompey, Corduba espoused the cause of the latter. After the battle of Munda, it fell into the hands of Cæsar, who avenged the obstinacy of its resistance by putting 20,000 of the inhabitants to the sword. In literary history, Corduba was famous as the birth-place of Lucan and the two Senecas. Under the Goths Corduba maintained its importance; and in the person of Osius its

Cordus ‖ Corea.

bishop it furnished a president for the council of Nice. Under the Moors it was at first an appanage of the kalifate of Damascus, but it soon became the capital of the Moorish dominion in Spain, and maintained its literary reputation as the birth-place of Avicenna and Averroes. At the death of Abderrahman, this city is said to have contained within its walls 200,000 houses, 600 mosques, 900 baths, and numerous public libraries; whilst on the bank of the Guadalquiver, under the power of that monarch, there were eight cities, 300 towns, and 12,000 populous villages. In the beginning of the thirteenth century, the Moorish empire became dismembered, and fell an easy prey to St Ferdinand of Castile in 1235. Since that period it has gradually declined; and in modern times it has never recovered the visitation of Dupont in 1808, who stormed the town and made a great massacre of the inhabitants.

Cordova was formerly celebrated for its silversmiths who came originally from Damascus, and for the manufacture of a peculiar kind of leather. Its industry in these departments, however, has disappeared with the race who introduced it. There still are a few artists who chase silver in the ancient filagree style; but the manufacture of Cordovan has been almost entirely superseded by the introduction of Morocco leather. Pop. about 55,000.

CORDUS, Valerius (1515-1554), a learned botanist, was the son of Euricius Cordus, professor of botany at Erfurt. He wrote Remarks on Dioscorides, a Descriptive Account of the Flora of Italy, and other botanical works.

CORDWAINERS, or Cordiners, the term by which *shoemakers* are designated in the statutes. The word is formed from the French *cordonnier*, which Ménage derives from *cordouan*, a kind of leather brought from Cordova, and used for the upper leathers of shoes. Others derive it from *corde*, rope, because shoes were anciently made of cords; as, indeed, they still are in some parts of Spain, under the name of *alpargates*. But the former etymology is evidently more proper.

COREA, a large peninsula of Asia, formed on one side by the Yellow Sea, and on the other by the Sea of Japan. It is situated immediately to the east of China; and its length may be estimated at 400 miles, by 150 in average breadth. A great part of what was formerly supposed to be its western coast was found by Captains Hall and Maxwell to consist of an immense archipelago of small islands, which have since been subdivided into several groups, and are known as Amherst's Islands, the Corean, and Hall's Archipelago. The largest of these is the island of Quelpaert, called by the natives Musa, in the centre of which there is a mountain peak about 6000 feet above the level of the sea. Though rocky and bare, these groups are for the most part inhabited. The peninsula itself is divided from the Japanese island of Kiusin by the straits of Corea, and by a high mountain range called the Shanalin or Champeshan, from the country of the Mantchoos. It embraces an area of about 95,000 miles, with a population of about eight millions. The interior of the country is rugged and mountainous, being intersected by a lofty branch of the northern range; which in turn sends off numerous offshoots to the sea. The principal valleys lie towards the western and southern coasts, and these districts alone enjoy a temperate climate. The eastern coast is bleak and precipitous, while the northern frontier is cold and desolate, and thus subserves the purposes of despotism by cutting off all friendly communication with the mainland. The principal products of the country comprise wheat, millet, rice, ginseng, tobacco, silk, cotton, and hemp. The three last are exported both in the raw and manufactured state. Timber and cattle are plentifully supplied from the forests and pasture-grounds, as well as furs from the northern jungles. Its mineral wealth is said to include gold, silver, iron, rock-salt, and coal; and from the tribute sent to the emperor of China—consisting both of bullion and manufactured articles—the precious metals seem to be wrought to a considerable extent. The Coreans resemble the Japanese and Chinese in dress, habits, and religion, but are said to be as inferior to either of these in mental vigour as they are superior in strength and stature. Their mode of writing is alphabetic, and they are said to possess an extensive literature; but as all ingress into the country is denied to Europeans, and all egress to natives, little is known of these particulars. They keep up considerable commercial intercourse with China and Japan, whence they import pepper, aromatic woods, alum, and goods of Dutch manufacture; but most of the trade is managed by a circuitous overland route, and, being discouraged by the government, is carried on with secrecy and at considerable risk. The kingdom of Corea, although tributary to China, is governed at will by its own king—the Chinese emperor doing little more than formally ratifying his decrees. It is divided into eight provinces; and contains, according to Chinese accounts, 161 towns. The capital, King-ti-tao, stands on the river Kiang, a small stream which flows into the Yellow Sea. It is the residence of the king, and contains, amongst other things, an extensive library. In modern times a few French missionaries have penetrated into the country, but with little success.

Corelli ‖ Corfinium.

CORELLI, Arcangelo, a distinguished violinist and composer, was born at Fusignano, near Imola, in the territory of Bologna, in February 1653, and died at Rome on the 18th of January 1713. After finishing his musical studies in Italy he visited Germany, where he obtained employment at the court of Bavaria. In 1681 he returned to Italy and settled at Rome, residing in the palace of Cardinal Ottoboni, his steady friend and patron. He published twelve violin concertos, forty-eight violin trios in four books, and twelve violin sonatas. These sonatas, published at Rome in 1700, were his fifth work; and they have to the present day retained their high reputation in every violin school of Europe. All well-trained violinists have studied Corelli's twelve sonatas, in order to attain firmness of tone and breadth and dignity of style. In the first six of these sonatas, the movements with double stops and arpeggios, and others which give scope to all possible varieties of bowing in rapid passages, form admirable exercises for the student. In Corelli's time, and in his music, the shifting of the hand upon the finger-board of the violin was of very limited extent. We find a surprising change in the music of Corelli's pupil, Pietro Locatelli (that Paganini of the eighteenth century), who freely used the whole range of the finger-board. (See Locatelli.) Dr Burney, in the third volume of his *History of Music*, pp. 550-559, gives an account of Corelli's career and compositions. (G. F. G.)

CORENZIO, Belisario, by birth a Greek, was the pupil of Tintoretto at Venice. Having adopted his master's style in painting, he obtained thereby great reputation at Naples, where he settled about 1590; but his name is execrated on account of the assassinations to which he was believed to have been a party. He was associated with the Spaniard Ribera and the Neapolitan Carraccioli in most of the great works of art in Naples about that period; and by them the murder of Domenichino by poison was perpetrated. Annibale Caracci, Guido, and several other eminent painters were driven from Naples by their threats and machinations; while a promising young artist, Luigi Rodrigo, was destroyed by poison administered by the hand of his envious master Corenzio. This detestable man was an able colourist in oil, and has left several grand works in fresco in the churches and palaces of Naples. His picture of Christ feeding the multitude was finished in forty days. Corenzio was killed in 1643, when an old man, by a fall from a scaffold while repairing one of his own pictures.

CORFINIUM, a once large and important city of Samnium, capital of the Peligni, situated on the right bank of

Corfu || Corinth.

the Aternus, a few miles from Sulmo the birth-place of Ovid. It is chiefly celebrated in history as the place selected by the allies in the social war, B.C. 90, to be the rival of Rome and the capital of the confederation. At this time its name was changed into Italica. Though the place was strongly fortified both by nature and art, it fell into the hands of the Romans without resistance. In the civil war it was stormed by Cæsar after a week's siege. After this event Corfinium continued to flourish as a municipal town for many ages. It was destroyed about the beginning of the tenth century. Traces of its site, and some ruins of its public buildings have recently been discovered.

CORFU. See CORCYRA, and IONIAN ISLANDS.

CORIANDER, the popular name of a genus of plants of one species, *Coriandrum sativum*, belonging to the natural order Umbelliferæ. The fruit or seeds of this species when ripe and dry have a strong aromatic odour and taste; but when fresh gathered the smell of the fruit resembles that of bugs; whence its original name, from κόρις a bug. Coriander is occasionally employed in medicine as a stomachic and carminative; also to flavour sweetmeats and certain liqueurs; and it forms one of the ingredients of curry-powder. The source of its aroma is a volatile oil. The plant is an annual, and is cultivated in the south of Europe. It also grows in some parts of Britain. See BOTANY, vol. v., p. 195.

CORIGLIANO, a town of Naples, province of Calabria Citra, 6 miles W. of Rossano. Pop. 13,000.

CORINGA, a seaport of Hindustan, in the Northern Circars, and district of Rajamundry, situated on the western side of the bay of Bengal. It is the best port on the coast of Coromandel, and affords the only smooth water on that coast in the south-west monsoon,—Point Godavery projecting out to the southward and breaking the swell from the sea. A wet dock has been constructed which is capable of admitting a frigate. Coringa carries on a considerable trade with Bengal and Pegu; the principal exports being teak wood and salt to the former, and piece goods to the latter. In 1787 a dreadful storm and inundation of the sea swept away the greater part of the town, and almost the whole inhabitants. A similar disaster occurred in 1832, when several vessels were carried into the fields by the inundation and left aground; and one new ship on the stocks was swept into the river and lost. The French had an establishment here before any other Europeans, and they still retain the neighbouring town and territory of Yanaon. The English took possession of the place in 1759, and established their factory five miles to the south of Coringa. Long. 82. 29. E.; Lat. 16. 49. N. (E.T.)

CORINNA, a Greek poetess, born at Tanagra in Bœotia. She is said to have been a contemporary of Pindar, and to have carried away the prize from him five times in the public games at Thebes. Plutarch says that she was the instructress of her antagonist; and Pausanias ascribes her victory to her beauty and the copious use of the familiar Æolic dialect, rather than to her talents. By the Greeks she was esteemed as the first of the nine lyrical muses, and her statues were to be found in almost every part of Greece. She received the popular surname of Myia or *the Fly*. The fragments of her poetry have been collected by Ursinus, Wolf, and Schneider.

CORINTH (now corrupted into Gortho), originally EPHYRE, one of the most celebrated and important cities of ancient Greece, was the capital of the small district of Corinthia, which, along with Megaris, formed the isthmus that connected the Peloponnesus with Greece Proper. A considerable portion of Corinthia was covered with the ridges and spurs of the Geranian and Oneian mountains, and was thus rendered useless for purposes of agriculture. The only arable land in the province was the region lying between the city of Corinth and the little river Nemea, which separated Corinthia from Achaia; but the fertility of this district, and its proximity to a great city and to the sea, made it a place of proverbial wealth. The Geranian mountains, which occupy the northern part of the province, belong rather to Megaris than Corinthia; but the Oneian mountains in the south are interesting, inasmuch as one of their spurs, an isolated hill overhanging Corinth—and from this circumstance called Acrocorinthus—formed the citadel of the town. From this hill also issued the well-known spring PIRENE, so often mentioned in the ancient classics as the spot where Bellerophon caught the winged horse Pegasus. On its western side Corinth was connected with its harbour Lechæum by two long walls (about a mile and a half in length), like those which connected Athens with the Piræus. On the side of the east it was protected by its fortified harbour Cenchreæ, about 8 miles distant. The position of Corinth was such as completely to command all the great roads leading from Greece Proper through the defiles of the Geranian and Oneian mountains into the Peloponnesus, and to fit it peculiarly for becoming a great maritime power. On the one side through the Saronic gulf it attracted all the commerce of the Ægean Sea and the East, and on the other through the Sinus Corinthiacus it commanded the trade of the Ionian and Sicilian Seas. The Greeks have never at any period of their history been remarkable as seamen: at a very early period they discovered the advantages of the overland route across the Corinthian isthmus, which saved them a dangerous voyage round the Peloponnesus. The favourable position of Corinth for commercial enterprise was a frequent subject of remark among the ancient writers both of Greece and Rome. Corinth.

From traces of orientalism in the early worship of the Corinthians, as well as from some Phœnician words in use among them, it is argued that Corinth was founded by a Phœnician colony. Before the age of authentic history it appears to have been inhabited by a mixed population of Æolians and Ionians, though the former are always represented as the dominant race. The founder of this dynasty, according to the traditions, was Sisyphus, the father of Glaucus, and grandfather of Bellerophon; and by him were laid the foundations of that great commercial prosperity which Corinth afterwards attained. Upon this legend of Sisyphus the Corinthian Æolids grafted another, in order to trace their descent from Medea. Æetes the father of the renowned sorceress was said to have reigned originally over Corinth, and to have exchanged that kingdom for Colchis. On the death of Corinthus (his last male representative), the Corinthians are said to have sent for Medea to be their queen. After a short reign she returned home, and resigned the throne in favour of Sisyphus, of whom according to the myth she had been enamoured.

The first historical king of Corinth was Aletes, the leader of the Dorian adventurers who subdued the Æolic inhabitants of the city, and incorporated them in their own number with all the privileges of citizenship. The dynasty of Aletes lasted for twelve generations, interrupted only by the changes introduced by Bacchis, who converted the regal into an oligarchical government. The oligarchy was in turn overthrown by the Commons with the aid of Cypselus, who established a tyrannis which endured for thirty years. The reign of Aletes began B. C. 1074, and his descendants (including the Bacchiad oligarchy) held the chief power till the year 657 B. C. It was under Bacchis and his successors that Corinth first emerged into importance as a maritime power. Its fleets were soon powerful enough to rival those of the Æginetans, whose supremacy was undisputed in the Ægean sea. For the protection of its commerce Corinth now (B. C. 754) fitted out a fleet of war-galleys and began to colonize. Its first and greatest colonies were Corcyra (which afterwards became its rival) and Syracuse; but speedily all the western seas of Greece acknowledged the

Corinth. supremacy of the Corinthian flag, and the flourishing colonies of Leucas, Anactorium, Ambracia, &c., betokened the naval power of the mother-country. See CORCYRA.

The accession of Cypselus to the supreme power (B.C. 657), gave a great impulse to the prosperity of Corinth; which was still further promoted under the able administration of his son Periander, who reigned forty-four years (B.C. 627–583). Soon after the death of Periander, Corinth allied itself with Sparta, restored the oligarchical form of government, and threw its weight into the scale of the Peloponnesian confederation. It had at first befriended the Athenians and assisted them with a fleet against Ægina; but becoming jealous of the growing naval power of that state, had declared war against it and been defeated in a great battle in Megaris. A peace was now concluded between the rival powers. This lasted till the revolt of the Corcyreans, whom the Athenians aided in their rebellion against the parent state, and thus brought about the Peloponnesian war. The events of that war are so well known that they need not be recapitulated here. The power of Athens was annihilated at the sea-fight of Ægospotami; and when the city surrendered after this disaster, the Corinthians recommended that it should be razed to the ground. But the jealousy with which the Corinthians had watched the rise and prosperity of Athens now animated them against their own allies and kinsmen the Lacedæmonians. Gained over by Persian diplomacy and Persian gold, the Corinthians leagued themselves with the Argives, Bœotians, and Athenians, against Sparta; and at the beginning of the fourth century B.C. began what was called the Corinthian war. Twice the allies were defeated in bloody battles, once near Corinth, B.C. 394, and again at Coroneia in the same year. After this the war was conducted with various success, till it was brought to a close by the peace of Antalcidas B.C. 387. In the wars which again disturbed the peace of Greece when the star of Thebes rose under Epaminondas, Corinth took part at first with her ancient allies the Spartans; but exhausted by her late struggles, she soon concluded a separate peace with Thebes, and remained neutral till the end of the war. From this date till the battle of Chæronæa, Corinth took little part in the affairs of Greece; and her history is only saved from being uninteresting by the romantic exploits of her last hero, Timoleon, in Sicily. Her government was oligarchical as in her best days; and no attempt was made to change or remodel it except by Timophanes, the brother of Timoleon. This attempt, as is well known, proved a failure, and Timophanes fell by the hand of his patriot brother. After Chæronæa, Corinth shared the fate of the other states of Greece, and passed into the hands of the Macedonian conquerors. Its citadel was by them regarded as the key of the Peloponnesus, and they always took care to maintain a strong garrison in it. In 243 B.C. Corinth was stormed by Aratus, the general of the Achæan league, and incorporated by him with the other states which formed that confederation. It was shortly afterwards made over once more to the Macedonians; in whose hands it continued till the defeat of the last Macedonian king by the Romans at the battle of Cynoscephalæ in 197 B.C. By the Romans it was re-annexed to the Achæan league and declared a free city; but its citadel was occupied by a Roman garrison. The same year which witnessed the destruction of Carthage witnessed also that of Corinth. The Achæans rebelled against their Roman conquerors. Their troops were routed with great slaughter; and Mummius the Roman general entered Corinth in triumph. The city was sacked; its magnificent temples and buildings were levelled with the ground; its paintings, marbles, bronzes, and priceless works of art, were carried off to Rome; and the male inhabitants slaughtered to a man, while the women and children were sold into captivity. No attempt was made to raise the city from its ruins till the days of Julius Cæsar, who established there a colony of his veterans two years before his death. The city soon rose from its ashes, and began again to prosper. In the days of the apostle Paul, who visited it about the middle of the first century of the Christian era, it was a considerable place. Two of the most important letters of that apostle were addressed by him to the members of the church which he had founded there. The subsequent history of Corinth is an unbroken record of disasters. In the later days of Rome it shared the fate of the mistress of the world, and was sacked by the Visigoths under Alaric, about the beginning of the fifth century. On the downfall of the Roman empire in the east, it passed into the hands of the Venetians, who retained it till the overthrow of the western empire. In 1458 it was taken by the Turks, who held it till the year 1687, when it once more fell under the Venetian yoke. In 1715 it was again occupied by the Turks, who retained it till the re-establishment of Greece as an independent kingdom. Corinth.

The modern Gortho, which occupies the site of the ancient Corinth, is a wretched place, on the shores of the gulf of Lepanto, with a population of about 2000. It carries on a small export trade in dried fruit, corn, and honey. The only traces of its ancient greatness are the ruins of a Doric temple, believed to be one of the oldest extant specimens of that order of architecture.

At an early period of her history, Corinth became distinguished as a seat of the fine arts. The art of painting is said to have originated here, and to have found its most munificent patrons among the wealthy merchants who resided in the city. At the time of its destruction by Mummius, Corinth is said to have been adorned with some of the most splendid masterpieces of ancient art. Polybius, who witnessed the sacking of the town, records that he saw some Roman soldiers playing at dice on a picture of Bacchus by the Theban Aristides (the contemporary and rival of Apelles), for which Attalus, king of Pergamus, offered L.5000 of our money. So inadequate were the ideas of art prevalent among the Romans at this time, that Mummius threatened the shipmasters who conveyed the art-treasures of Corinth to Rome, that if they lost or injured any of them they should be obliged to replace them at their own cost. It is not known that any of the great architects of antiquity were natives of Corinth; yet in Corinth originated the most ornate and beautiful of all the orders of Grecian architecture. The wealth of the inhabitants enabled them to adorn their city with a greater number of splendid buildings than any other town in Greece could boast. Statuary too was extensively encouraged, and the bronzes of Corinth were the most famous of antiquity. Some have thought that the celebrated Corinthian brass was an amalgam of the various precious metals which were fused together at the conflagration of the city. But this opinion has now been proved to be incorrect, as records are still extant of artists who worked in that metal long before the period in question. The Corinthian brass is said by Pliny to have been of three kinds—the *white*, into whose composition silver entered largely; the *yellow*, in which gold predominated; and a third tint produced by an amalgam of both these metals. Others have denied that the *æs Corinthiacum* was any other than a highly refined species of bronze. In the humbler walks of art the Corinthians were equally eminent. The vases of *terra cotta* made at Corinth were the finest produced in Greece; and in the days of the Roman empire the old Greek cemeteries were ransacked in quest of them. When discovered they were sent to Rome, where they brought fabulous prices. Literature was also cultivated by the Corinthians, but not with such pre-eminent success as art. Their wealth nurtured habits of luxurious indolence, and they were better able to appreciate foreign poets and philosophers than to train them in their own state. Some of the

Corinth ‖ Corinthians.

older cyclic poets were natives of Corinth, which, however, could claim none of the great writers who moulded Greek thought in later times. The wealth of Corinth, as has been observed, was proverbial among the ancients. Like the Capuans of Italy the Corinthians were noted for the luxurious magnificence of their houses and entertainments, and the profligacy of their manners. The goddess most scrupulously worshipped in this city was Venus, for the service of whose temple a thousand sacred female slaves (hierodouloi) were kept. This fact has often been adduced as conclusive evidence of the oriental origin of the founders of the city, as it is well known that in many cities of Asia Minor a large staff of servants was maintained for the worship of the tutelary deity. The gross immorality of the Corinthians is proved by the flagrant publicity with which the Phallus-worship was carried on among them. Corinth was proverbial among the Greeks themselves for the number and extravagance of its courtezans.

The population of Corinth when at the acme of its power and prosperity has been conjecturally estimated at about 100,000 souls. (J. C—L.)

CORINTH, *the Isthmus of*, in the Morea, is a neck of land which joins the Morea to Greece, and reaches from the gulf of Lepanto or Corinth to that of Ægina. Attempts were made to cut a canal through this isthmus by Periander, Alexander, Demetrius, Julius Cæsar, Caligula, Nero, and Herodes Atticus; but from some cause or other these all proved abortive. A wall was afterwards built across it, and was called *Hexamilium*, because it was six miles in length. This was demolished by Amurath II. and afterwards rebuilt by the Venetians, but was levelled a second time by Mahommed II.

CORINTHIAN, pertaining to Corinth, as Corinthian brass, Corinthian order, &c.

Corinthian Order. See ARCHITECTURE.

CORINTHIANS, EPISTLES TO THE, two canonical epistles of the New Testament, addressed by St Paul to the church which he had planted with his own hand at Corinth, during an eighteen months' residence there in the years A.D. 50 and 51. From an incidental allusion in the former of these, it seems that this was not the first epistle that St Paul had addressed to the Corinthian converts, and two letters still exist in an Armenian version, which, by Whiston and others, have been regarded as furnishing authentically the apostle's previous correspondence. These letters are now, however, universally regarded as spurious. In the note appended to the common version, the first epistle is said to have been written from Philippi, but from internal evidence we know it to have been written from Ephesus, and this is confirmed by the note appended to the Vatican MS. and the Coptic version. The date of its composition is generally assigned to a period very shortly before Easter A.D. 58. In writing it the apostle aimed chiefly at repressing the unseemly manifestations of party-spirit which had been betrayed by some of the leading members of the church, and also at giving them decisive answers on certain points of duty, in regard to which the practice of the Corinthian converts had been somewhat influenced by the characteristic immorality of the place. Of the parties then prevailing in the church there are generally distinguished four; but it is not to be supposed that these existed in open schism, and from the allusions to them in Clement's epistle, it seems that they were all of short duration. The party claiming Apollos as their leader differed from those who still held by Paul, in their peculiar fondness for the Alexandrian forms of thought; the Petrine section differed from both in still clinging to the shadows of Judaism; while the Christine party seems to have sprung from a reaction in favour of unity, which, however, in the troubled state of the church only caused farther division. The second epistle was written shortly after the first, and despatched from Philippi in that same year. It is in the main apologetic, and as a piece of oratory has been admired by the rhetoricians of every age. The authenticity of both epistles has scarcely ever been questioned.

Corio ‖ Cork.

CORIO, BERNARDINO (1459–1519), an Italian historian, born of an illustrious family at Milan. He was secretary of state to that duchy; and was employed by Ludovico, duke of Sforza. to write the history of his native town. The best edition of his history (Milan, 1503, folio) is very scarce. Corio wrote also *Vitæ Cæsarum*, and a poem entitled *Utile Dialogo Amoroso*.

CORIOLANO, the name of three excellent engravers on wood in the sixteenth and seventeenth centuries, Cristoforo, Giambattista, and Bartolomeo. The latter was the most celebrated, and has executed, in chiaroscuro, several excellent prints, after the two Caracci and Guido.

CORIOLANUS, C. MARCIUS, one of the haughtiest leaders of the patrician party at Rome in the early ages of the republic. His name is associated with one of the most beautiful of the legends which adorn that period of Roman history. This legend will be found detailed in full under the article ROMAN HISTORY. See also CORIOLI.

CORIOLI, an ancient Latin city, celebrated as giving a surname to the Roman C. Marcius. Corioli is first mentioned in Roman history as falling into the hands of the Volsci, and being retaken from them by the Romans, B.C. 493. When Coriolanus made common cause with the Volsci against his countrymen, this city was one of the first that yielded to his victorious arms. It was never a very large or important place, and seems to have dropped out of existence before the close of the fifth century B.C. The site of Corioli is now unknown. Some geographers have assigned it to the hill called Monte Giove about nineteen miles from Rome on the way to Antium. Others have suggested a hill four miles nearer Antium as a more plausible locality.

CORK, the bark of a species of oak (*Quercus Suber*), common in the southern parts of Spain, France, and Italy. When the tree is fifteen years old, it may be barked for eight years successively; and the quality of the bark improves with the age of the tree. When stripped from the tree, it is piled up in water and loaded with heavy stones to flatten it. It is then dried and put up in bales for carriage. If care be not taken to strip the bark, another bark formed underneath will cause the outer one to split and peel off.

The cork tree, and the uses to which the bark may be applied, were known to the Greeks and Romans. Pliny mentions that the Romans employed it to stop all kinds of vessels; but the use of it for this purpose does not appear to have been common till glass bottles came into general use, which, according to Beckmann, was not till the fifteenth century.

Other vegetable productions have been sometimes employed instead of cork; as, for instance, the *spondias lutea*, a tree which grows in South America, particularly in moist places, and which is there called *monbin* or *monbain*. The roots of liquorice are applied to the same use, and on this account the plant is cultivated in Sclavonia, and exported. A tree called *nyssa*, which grows in North America, has been found also to afford a substitute for cork.

CORK JACKET, an apparatus to buoy up the body in swimming. It consists of pieces of cork inclosed between two pieces of strong canvas, and is shaped so as to be worn like a jacket, but without arms. It is now almost quite superseded by the air-belt made of waterproof cloth. The cork-jacket appears to be a very old invention; for Plutarch, in his life of Camillus, mentions that the messenger sent by that general to his fellow-citizens when besieged in the capitol, made use of a cork-jacket in swimming across the Tiber, the Gauls being in possession of the bridge. See LIFE-PRESERVERS.

CORK, a maritime county in the province of Munster;

Cork. the largest and most southern in Ireland; bounded N. by Limerick, E. by Waterford, W. by Kerry, S., S.E., and S.W. by the Atlantic Ocean. Area 2885 square miles, or 1,846,333 acres,—*i.e.* 1,308,882 arable; 465,889 uncultivated (of which it is estimated that 100,000 acres might be reclaimed, 150,000 drained for coarse meadow and pasture, and 216,000 may be considered as not worthy of improvement); 52,180 in plantations; 6515 in towns; 12,867 under water. The county is divided into east and west ridings (the county of the city of Cork being included in the east riding); and it is subdivided into 23 baronies, containing 251 parishes, which form the dioceses of Cork, Cloyne and Ross, and a part of that of Ardfert. The county is in the Cork military district, having barracks at Cork (which is the headquarters of the district), at Kinsale, Fermoy, Ballincollig about five miles from Cork; at Spike Island, which is strongly fortified; at Youghal, Buttevant, &c. The constabulary force consists of 647 men and officers, with headquarters at Cork and Bandon, and 20 subinspectors' districts. The assizes are held in Cork city, where the county prison and the county lunatic asylum are situated. There are savings-banks at Cork, Fermoy, and Youghal, with an aggregate amount of upwards of L.315,000 deposited by 9000 individuals. The poor-law unions are Bandon, Bantry, Castletown, Clonakilty, Cork, Dunmanway, Fermoy, Kanturk, Kinsale, Macroom, Mallow, Midleton, Millstreet, Mitchelstown, Skibbereen, Skull, and Youghal. The amount of property in the county, valued under the act 6th and 7th Will. IV., cap. 84 (Griffith's valuation), is L.1,150,643; and the net annual value of property rated to the poor, L.971,622.

The county returns eight members to the imperial parliament, two for the county at large (constituency in 1853 13,474); two for Cork city, (constituency 3152); and one for each of the boroughs of Youghal, Bandon, Mallow, and Kinsale (constituencies 317, 205, 243, and 156 respectively). Previous to the union this county returned 26 members to the Irish parliament. At the union the number was reduced to eight, and the Reform Act made no change in the number of representatives.

According to Ptolemy, the district was inhabited by the Uterini, the Vellebori, the Coriundi, and the Vodii. Before the arrival of the English it was considered as a distinct sovereignty or principality under the MacCarthys; but in 1172 Dermod MacCarthy, who had sworn fealty to Henry II., threw off his allegiance, and attacked the English under Raymond le Gros, thereby forfeiting the crown. What formed his kingdom was granted by Henry II. to Robert Fitzstephen and Milo de Cogan, with the exceptions of the city of Cork and the adjoining cantred belonging to the Ostmen of the same city, which were retained by the king. It was made shire ground by King John in 1210, who appointed sheriffs and other local officers for its government. For many years, however, the royal writs were of little efficacy in many parts of it, as the great families still virtually commanded the allegiance of the inhabitants.

Fitzstephen's share of the grant descended through the female line to the Barrys and Roches, whilst that of De Cogan became vested in Maurice Fitzgerald, growing into an extent of territory and consequent power far exceeding any ever possessed by the MacCarthys. Whilst making a show of attachment to the English, the Fitzgeralds intrigued with the foreign Roman Catholic powers (who projected the conquest of Ireland during the reign of Queen Elizabeth), and ultimately broke out into open rebellion. After being utterly defeated, Gerald, the fifteenth and last Earl of Desmond, when a fugitive in the wilds of Kerry, was slain by an obscure individual named Kelly. Against this Earl of Desmond an act of attainder was passed in 1583, and the Fitzgeralds of Desmond, after having maintained their power and possessions for upwards of 300 years, were reduced to utter ruin; their strong castles were seized, and their vast estates, to the extent of no less than 574,628 acres, confiscated by the crown. These were again transferred to English settlers, called undertakers or planters, who were bound not to convey any part of the lands to the native Irish, or to intermarry with, or maintain any of them. Sir Walter Raleigh obtained 40,000 acres, which afterwards passed to the family of Boyle, Earl of Cork; Arthur Robins 18,000; Hugh Worth 12,000; Fane Beecher 12,000; Arthur Hyde 12,000; Sir Warham St Leger 6000; Sir Thomas Norris 6000; Hugh Caffe 6000; Thomas Say 5800; Sir Richard Beacon 1600; and Edmund Spenser the poet 3028. This attempt to set aside or extirpate the native population failed. The Irish outbade the English settlers, and were, therefore, at least for a time, found to be more profitable tenants, so that ultimately they re-occupied nearly all the lands as tenants under the English undertakers. In 1602 a large portion of the estates of Sir Walter Raleigh and Fane Beecher were purchased by the Earl of Cork, who had them colonized with English settlers: and by founding or rebuilding the towns of Bandon, Clonakilty, Baltimore, Youghal, and afterwards those of Midleton, Castlemartyr, Charleville, and Doneraile, which were incorporated and made parliamentary boroughs, the family of Boyle became possessed of nearly the entire political power of the county. In 1641 and the following years the sons of the Earl of Cork, more especially Lord Broghill, rendered good service to the parliamentary cause, and obtained considerable military renown. The course of events led to the forfeiture of the estates of Lords Muskerry and Roche; afterwards of those of the Earl of Clancarty, Viscount Kenmare, Sir Richard Nagle, and others, to the extent of 250,000 acres. Since that period no events of equal importance have occurred in this county.

The earlier antiquities of the county are rude monuments of the Pagan era, such as stone circles, druids' altars, *raths* or circular mounds of earth, and stone pillars.

The ecclesiastical antiquities consist of numerous ruins of religious houses, built chiefly since the invasion of Ireland by Henry II., and owing their existence to the descendants of English adventurers. The most ancient ecclesiastical edifice in the county is the abbey of Rosscarbery, picturesquely situated upon a rocky eminence, partly insulated by the tide. The abbey of Timoleague is also beautifully situated, with the tide flowing up to its walls; and that of Kilcrea, about eleven miles from Cork, is placed in the centre of a rich vale on a green bank above the river Bride. The interior of the ruins of Kilcrea has long been the favourite burial-place of the peasantry of the country: the architecture is plain, but the ruins are in tolerable preservation. There are also numerous ruins of the old parochial churches, built of stone without mortar, generally of very small dimensions, and destitute of ornament. The cathedral of Cork was rebuilt in the eighteenth century, the old cathedral having been taken down in 1725, in consequence of injury received during the siege of Cork by King William's forces under the Earl of Marlborough. Cloyne cathedral is a plain Gothic building, and is now one of the few remaining ancient cathedrals. That of Ross exhibits no particular feature of antiquity. Near the cathedral of Cloyne is the only round tower now remaining in the county, excepting that of Kinneagh.

Of castles, or rather square towers, there are numerous remains. The chief of these are Blarney, Macroom, and Lohort.

The county of Cork contains but a small quantity of dead level land, and presents a great variety of surface. Although hilly, it cannot be called mountainous, and there is but little lowland bog. The unimproved land is therefore trifling as compared with that of some other counties, or with its own superficial extent. The barony of Duhallow

Cork. in the north-west, contains the chief portion of unreclaimed land, but even that is now much improved. The prevailing character of the western part of the county, which is bold, rocky, and mountainous, is wildness; the northern and eastern parts are distinguished for their richness and fertility. The natural formation of the eastern and southern parts of the county is highly favourable to picturesque effect. That this county was once profusely adorned with timber is evident from the numerous vestiges still to be found above and beneath the surface. The ranges of high and low lands are observed to run nearly in the direction of east and west; the chief deviation from this general character being the high barren tract of the Boghra mountains, situate between the Lee and the Blackwater: these extend in every direction, not rising into sharp or narrow summits, but spreading out into an ample area of deep boggy surface. The limestone rocks, which are not so general in this as in some other Irish counties, form the most extensive tracts of lowland running east and west, and are remarkable for their purity. The marble of this county is of considerable value. It is generally of a dark gray colour with various shades, and presents a rich display of fossil shells. The rivers generally mark the limestone districts. The greater part of the surface of the county of Cork, however, rests on the old red sandstone, of which rock it is the chief locality in Ireland. It commences in the west, on the limits of the upper slate formation, and extends throughout the entire breadth of the county to Waterford county, comprising the various districts of limestone already mentioned. Next in extent to the old red sandstone is the upper clay slate which forms the adjoining county of Kerry, and enters this county on the west, stretching from Dunmanway to Macroom, and thence to the neighbourhood of Mallow, forming the group of the Boghra mountains. The south-west coast, which is formed of immense masses of this rock standing as barriers against the waves of the Atlantic Ocean, is remarkable for its extreme boldness of character. Carboniferous slate occupies a considerable area of the south-eastern coast. It rests on yellow and red sandstone, and contains rich ores of copper, lead, and manganese. In the extreme north-west of the county is a portion of the Munster coal-field. Coal was formerly raised, but the disadvantages of situation in a mountainous district remote from water carriage prevented its general use. Marl, fuller's earth, potter's clay, and brick-clay, are also found. The chief mines and quarries are Allihie's copper mine, near Berehaven, which has realized large sums, and employs upwards of 1000 persons; Audley copper mine, near Skibbereen; the Dromagh collieries, near Kanturk; the limestone quarries on Little Island, in Cork harbour; and the Irish Dove marble quarries near Cloyne. The copper ores found in this county have been ascertained to be extremely rich.

The most extensive tracts of rich lowland in the county are those in which limestone is found. The largest lies on the north side of the river Blackwater, occupying parts of the baronies of Orrery and Fermoy including the towns of Fermoy and Mallow. This district furnishes, on the banks of the Blackwater from Mallow to Fermoy, a succession of picturesque scenery seldom equalled. In another limestone vale, extending in an easterly direction until it reaches the sea near Youghal, the city of Cork is situated.

The climate of this county is mild; winter along the coast being disarmed of its severity by the south wind, while the summer heat is tempered by breezes from the sea. Its climate, like that of Devonshire, is sufficiently moist to be injurious to grain crops, which are generally inferior to those of drier climates.

The chief rivers are the Blackwater, the Lee, and the Bandon. The picturesque Blackwater rises on the confines of Kerry, and flowing eastward past the towns of Mallow and Fermoy, through the northern baronies, enters the county of Waterford, where, changing its direction, it flows southward, returns to the boundary of the county, and empties its waters into Youghal bay. During its course, among other tributary streams, it receives the Awbeg (Spenser's "Mulla fair and bright," and "Gentle Mulla"), not far from whose banks, on a rivulet joining the Awbeg at Doneraile, stand the ruins of the poet's castle of Kilcolman. Since 1580 Spenser had been in Ireland as secretary to the Lord Deputy, Arthur Grey, and here was written his great poem *The Faery Queen*, which abounds in beautiful descriptions of Munster scenery. The river Lee also rises on the borders of Kerry out of the small but romantic lake of Gougane Barra, and passing through the larger lake of Inchigiela runs through varied and beautiful scenery to the city of Cork, where it becomes navigable for large vessels; and after a further course of eleven miles, the beauty of which from Cork to Queenstown it would be difficult to overpraise, it terminates in the magnificent harbour or inland bay of Cove—or Queenstown as it is now called. The "pleasant Bandon crowned with many a wood," rises a few miles east of the head of Bantry Bay, and passing the towns of Dunmanway and Bandon, ultimately expands into Kinsale harbour. Cork.

There are no extensive lakes in the county, but many of diminutive size in the western portion of the county. Among others, the small lake of Gougane Barra, generally considered the source of the river Lee, is highly interesting on account of its sanctified character and wildly picturesque scenery. Nearly surrounded by gigantic mountains rising in almost perpendicular masses from the waters of the lake, it incloses within its limits a small wooded island occupied chiefly by the ruins of a chapel and ancient religious house. It is a favourite resort of pilgrims and pleasure seekers combined on the *pattern* days, either to bathe in its waters and offer up vows to the tutelar saint Fin Bar, the founder of Cork cathedral, or from curiosity and other motives.

There are no canals or extended means of inland navigation in this county; but rapid communication is maintained with the metropolis by means of the Great Southern and Western railway, which enters the county at Charleville, and passing the towns of Buttevant and Mallow terminates at Cork. A branch line from Mallow extends to Killarney, and Cork is also the terminus of the Cork and Bandon and Cork and Passage railways.

The want of the means of inland navigation is in a great degree compensated by the numerous bays and inlets capable of admitting large vessels, with which the coast is indented. Proceeding westwards from Youghal Bay, which has good anchorage without the bar, and passing that of Ballycotton, which is wholly unsheltered, the fine and capacious inlet of Cork harbour appears, many miles in diameter, completely landlocked, studded with numerous islands rising abruptly and high above the water, and capable of accommodating the entire fleet of the kingdom. It is much resorted to by wind-bound merchantmen, and used as a rendezvous for ships from abroad waiting for orders. Its narrow entrance is defended by batteries on each side, and on the Great Island opposite to its mouth. Spike Island and Hawlbowline Island, within the harbour, are strongly fortified, and used as naval arsenals. Kinsale harbour, though incommoded by a bar at the entrance, has depth enough within for the largest vessels. Clonakilty and Castlehaven harbours are fit for smaller vessels only; but Baltimore Bay has deep water, and enjoys the shelter of Cape Clear Island, and several others at its entrance. Crookhaven is narrow, but well sheltered. Dunmanus Bay, though having deep water and good anchorage, is little frequented except by small craft, or during summer, in consequence of its exposure to the western gales and proximity to Bantry Bay, which is large, safe, and commodious for vessels of any size. It is surrounded by the most magnifi-

Cork.

cent scenery; and within its entrance is Bere Haven, and farther inwards Whiddy Island, off which lay the French fleet when contemplating an invasion in 1796. The water is deep almost close to the shores, and free from rocks and shoals. Ballydonaghan Bay and Quolagh Bay lie near the mouth of Kenmare river. This last-named inlet, though called a river, is an estuary of large dimensions, separating the counties of Cork and Kerry, and capable of accommodating the largest vessels.

The most remarkable among the numerous islands along the coast, besides those already mentioned, are Inchidony, in Clonakilty Bay; Cape Clear, Inisherkin, and Ringarona or Donegal Island, in Baltimore Bay; Bere Island, in Bantry Bay, affording a secure shelter from the storms of the Atlantic; and Dursey's Island, off the southern point of Bere Barony. Of these, Cape Clear is the largest and most remarkable. It is the most southern point of Ireland except the Fastnet rock, which lies in the sea four miles to the S.S.W. The inhabitants of Cape Clear—a hardy, primitive people, occupied in fishing and agriculture—live almost wholly secluded from the world; and, like other islanders, are superstitious, and tenaciously attached to their rocky and sterile home. The lighthouse, on the south side of the island, is a circular tower, erected in 1817.

Numerous chalybeate and other springs exist, but most of them are now totally neglected. The thermal spring of Mallow resembles the waters of Clifton, and is impregnated with magnesia in its passage through the limestone rocks of the district. It has long been celebrated for the cure of chlorotic, stomachic, and urinary complaints; but is not now quite so much frequented as formerly. The town is favourably situated on the banks of the Blackwater, sheltered on all sides by high grounds thickly planted, and in the midst of scenery of great natural beauty. There are also many summer bathing places along the sea-shore, but Kinsale and those in the neighbourhood of the city of Cork are more especially frequented. The chief of these are Monkstown, Blackrock, Summercove, Passage, and Cove (or Queenstown), which is now more frequented as a summer residence for invalids than any other spot in Ireland, and is remarkable for its equable temperature, being protected from the colder winds and open to those from the warmer quarters.

The soils of the county exhibit no great variety: they may be reduced in number to four. The calcareous in the limestone districts; the deep mellow loams found in districts remote from limestone, and generally occurring in the less elevated parts of the gray and red sandstone districts; the light shallow soils and the moorland or peat soils, the usual substratum of which is coarse retentive clay.

In a district of such extent and variety of surface, the state of agriculture must be liable to much variation. The more populous parts near the sea, and in the vicinity of the great lines of communication, exhibit very favourable specimens of agricultural improvement. In the more retired and mountainous districts, the cultivation of the soil is carried on according to the habits of the past century. Spade cultivation is used to a considerable extent. In the improved parts, where there are facilities of carriage, limestone and sea-sand are largely used. Dairies are extensive, and the character of the Cork butter stands high, both in the British and foreign markets.

The number of acres under crop in 1852 was 492,883, viz.:—wheat, 52,049; oats, 150,581; barley, bere, and rye, 43,293; peas and beans, 133; potatoes, 92,055; turnips, 41,683; mangel-wurzel, 2418; other green crop, 10,076; flax, 1710; meadow and clover, 99,885. The live stock of the county consisted of 51,624 horses; 7751 mules and asses; 264,272 cattle; 215,469 sheep; 121,300 pigs; 30,717 goats; and 612,637 poultry, of the total value of L.2,568,230.

Even proportionately to the great extent of this county, in few others has more property passed through the court for the sale of encumbered estates, and much facility for improvement may be expected to result from the change or disembarrassment of owners of land, for nowhere more than in Ireland has it been matter of practical experience that "a landlord of straw may break a tenant of steel."

Cork.

Manufactures are not carried on to any great extent, the frequent attempts made to establish them having generally failed. The only extensive manufactures are those of whisky and porter, which cause a considerable demand for the agricultural produce; and the chief trade of the county is in the export of provisions—a branch of business which was a source of great profit during war time.

The population of the county, including that of the city and liberties, has been ascertained at various periods to be as follows:—

1791. By returns of the hearth-money collectors	460,434
1812. By the first parliamentary census	603,328
1821. By the second parliamentary census	730,444
1831. By the third parliamentary census	807,446
1841. By the fourth parliamentary census	854,118
1851. By the fifth parliamentary census	649,071

In 1824–26 there were, according to the reports of the board of education, 1354 schools, in which somewhat more than 69,000 pupils were instructed (45,000 boys and 24,000 girls). Of the whole number, 9494 were of the Established Church, 58,174 were Roman Catholics, 340 Dissenters; leaving a remainder of 1110 whose religious persuasion had not been ascertained.

In 1852, of 54,424 children on the rolls of the national schools, 471 belonged to the Established Church, 12 were Presbyterian or other Protestant Dissenters, and 53,941 were Roman Catholics.

The following was the state of instruction of the inhabitants above the age of five years in 1851:—

	Rural Districts.	Civic Districts.	Total.
Could read and write	116,346	67,089	183,435
Could read only	50,465	23,485	73,950
Could neither read nor write	267,716	64,439	342,155

There has been much intermixture of English blood among the inhabitants. Besides the followers of Strongbow, whose descendants have long ranked among the most influential families, English settlers were the founders of most of the towns, and the services of numerous bands of adventurers were rewarded at different periods with grants of conquered or forfeited lands. With these came many followers, whose intermarriages with the natives gradually instilled their manners and prejudices into their posterity, who have sometimes been charged with having become more Irish than the Irish themselves. The Danes also, who possessed several of the sea-ports and the adjoining districts, increased these international varieties of character. The easy communication between this county and the Spanish peninsula also led to a commercial intercourse, which, together with the military invasions of the Spaniards during the reigns of the Tudors, has had its due effect in impressing a distinctive character on the inhabitants.

Cork, a city and river-port, a county in itself, and the shire town of the county of the same name, 159 miles S.W. of Dublin, in N. Lat. 51. 53. 39·3., and W. Long. 8. 20. Upwards of 150 years since it ranked below Limerick and Waterford, and was considered the fourth city in Ireland; but having risen rapidly in importance, it long maintained its place as second only to the metropolis. Of late, however, it has taken rank after Belfast in population, wealth, and commerce. According to the census of 1851 the population of the city was 85,745, inhabiting 9419 houses; being an increase of 5025 inhabitants and 646 inhabited houses since the census of 1841.

The city is finely situated in the centre of the valley of the Lee, inclosed on each side by high ground through which the river pursues its course to the harbour through a perpetual variety of beautiful scenery. The site of the city, which owes its origin either to the Danes, or more probably to a religious establishment founded at a remote period, was originally part of a series of small islands and marsh land formed by various channels of the river, many of which have at different times been covered over; and carriage drives and walks are formed upon ground over which even lately the tide flowed. The ancient group now forms one extensive island, formed by the two main branches of the Lee, and which is the chief portion of the present site of the city. It is connected with the mainland by six bridges, beyond which are extensive suburbs. The unevenness of much of the ground on which the city is built, the irregularity of the streets, the variety of the style of building, the intersecting river, and the overhanging heights, give a very pleasing and a somewhat picturesque aspect to the city of Cork. There are only a few good streets in it, and its public buildings will stand no comparison with those of Dublin.

Cork. It contains seven parishes, in which are the cathedral, six churches, two chapels of ease, three Roman Catholic parochial chapels, four monasteries and two nunneries with a chapel attached to each. These buildings have in general very small pretensions to architectural merit, and few towns of similar extent are so destitute of spires or other indications of ecclesiastical distinction. There are also two Presbyterian, a Baptist, an Independent, and two Methodist chapels. A Friends meeting-house also exists; and in this city the celebrated William Penn, together with several soldiers of the republican garrison, became converted to Quakerism. The palace of the bishop of Cork, Cloyne, and Ross, is a comfortable residence, without architectural pretensions. The county and city court-house, an elegant Grecian structure with a bold Corinthian portico thirty feet in height, is one of the few fine buildings in Cork. Also may be noticed the military barracks, a large building commanding the city, and capable of accommodating four regiments of infantry and 1000 cavalry; the new lunatic asylum, beautifully situated on the brow of a hill; the county and city gaols, with more of a palatial than a prison aspect. Besides these, there are other buildings less deserving of particular notice; as the savings-bank, the custom-house, the chamber of commerce, and the commercial buildings. The Royal Cork Institution is the chief literary association in the city. It obtained a charter in 1807, and a parliamentary grant of L.2000 per annum, afterwards increased to L.2500, but withdrawn in 1830. A society of arts was formed in 1815, but has long ceased to exist,—their fine collection of casts from the antique being deposited in the government school of design, which, together with the Royal Cork Institution, is transferred to the old custom-house. The new queen's college, built on the site of an ancient religious establishment, west of the bishop's palace on the south branch of the river Lee, is a handsome quadrangular building in the Tudor-Gothic style. It was opened in 1849. Cork abounds in religious, educational, literary, scientific, and charitable institutions, which have accommodation in appropriate buildings. Like the Liffey at Dublin, the river Lee is walled in by handsome quays erected at an expense of more than L.100,000. Near the city is the "Père la Chaise" of Cork, founded by the Rev. Father Matthew, on the site of the old botanic garden of the Cork Institution, and containing many curious and valuable trees; and the citizens of Cork are justly proud of their delightful public walk, the Mardyke, shaded by noble elms extending in a straight line about a mile in length; and of the principal entrances to the city, commanding fine panoramic views in all directions. Within the boundaries of the borough, however, are numerous narrow and wretched streets and lanes, with a numerous population huddled together in a manner utterly repugnant to cleanliness or comfort.

Since the time of Henry II. no less than seventeen charters have been granted to the city; but extensive changes in the corporation were ultimately made by the Municipal Act, 3d and 4th Vict. cap. 108. It is now styled the "Mayor, Aldermen, and Burgesses of Cork," and consists of a mayor, 16 aldermen, and 48 town-councillors, whose jurisdiction is limited within the municipal boundaries, whilst that of the water bailiffs extends to the harbour. Since 1559 the city has returned two representatives, before the union to the Irish, and since that period to the imperial parliament. Although the area of the municipal borough contains only 2680 acres, the right of voting for the city members is still possessed by the inhabitants of the barony of Cork, essentially a rural population.

The trade of Cork is very extensive, consisting chiefly in the export of grain, provisions, and butter, &c., to the value of several millions annually. The principal branches of manufacture are distilling, brewing, tanning, iron-founding, and glove-making. The aggregate tonnage of vessels registered at the port is about 50,000: the number and tonnage of vessels entering the port employed in the cross channel and coasting trade reaches 1900 vessels and 240,000 tons; in the British colonial trade 50 vessels of 15,000 tons; in the foreign trade 370 vessels, tonnage 77,613. The foreign and colonial trade is chiefly with Portugal, the Mediterranean, the Baltic, and Canada; and the produce of the customs duties of the port average about L.240,000 per annum. Corleone ‖ Corn.

The harbour, to the existence of which Cork is mainly indebted for its rise and progress, is situate about 11 miles below the city. It is completely land-locked, surrounded by charming scenery on every side, and capable of sheltering the entire navy of the United Kingdom. See QUEENSTOWN.

Cork has not much prominence in historical records. When surrendered to Henry II. in 1172 by Dermod MacCarthy, king of Cork or Desmond, it was a walled town. In 1493, as a punishment for having received and given encouragement to the pretender Perkin Warbeck, the city was deprived of its charter; and in the 16th century Camden describes it as a populous trading town, much resorted to, but beset with rebel enemies on all sides. In 1688 James II. landed in Cork; and two years after the city, which is incapable of being made a place of strength, was besieged by the forces of King William, under the command of the Earl afterwards the Duke of Marlborough. The town was defended for five days, when it surrendered. Henry Fitzroy, the second illegitimate son of Charles II., who had been created Duke of Grafton, and was one of the first who deserted the cause of James, was wounded at the storming of the city, and died there about a fortnight afterwards. (H. S—R.)

CORLEONE, a town of Sicily, intendancy of Palermo, and 22 miles S. of the city of that name, on the declivity of a hill near the source of the Belici. It is pretty well built, and has several churches and convents, a royal college, a prison, and some other public buildings. Pop. 15,000.

CORMONTAIGNE (1695–1752), an eminent French engineer, who fortified many border strongholds of France. His system is explained under FORTIFICATION.

CORN (Saxon *corn*), the grain or seeds of plants separated from the spica or ear, and used for making bread.

There are several species of corn, such as wheat, rye, and barley, millet and rice, oats, maize, and lentils, peas, and a number of other kinds, each of which has its peculiar qualities and usefulness. Egypt was anciently the most fertile of all countries in corn. This appears both from sacred and profane history. It supplied a considerable part of the people subject to the Roman empire, and was called the *dry nurse of Rome and Italy*. Ceres has the credit of being the first who taught them the use of corn, on which account she was ranked by them as a deity. Some, however, attributed the honour to Triptolemus; whilst others award the honour to both alike, making Ceres the first discoverer, and Triptolemus the first planter and cultivator of corn. Diodorus Siculus ascribes the whole to Isis; in which, as Polydore Virgil observes, he does not differ from other authors—Isis and Ceres being in reality the same person. The Athenians pretended that it was among them the art of sowing corn took its rise; and the Cretans or Candiots, Sicilians, and Egyptians, also lay claim to the distinction. Some think the title of the Sicilians best supported, Sicily being the country of Ceres; and it is alleged that she did not teach the secret to the Athenians till she had first instructed her own compatriots. Others says that Ceres passed first into Attica, thence into Crete, and last of all into Sicily. Many scholars, however, maintain that it was in Egypt that the art of cultivating corn first began; and it is certain that there was corn in Egypt and the East long before the time of Ceres.

CORN LAWS AND CORN TRADE.

History of the Corn Laws.

I. HISTORICAL SKETCH OF THE CORN LAWS.

ALL governments, in every age of the world, have interfered too much with the affairs of their subjects. A notion has very generally prevailed, that certain branches of commerce were sometimes advantageous to society, though ruinous to those who should attempt to carry them on; and that other branches, though profitable to individuals, were frequently inconsistent with the general advantage. On a first view, this opinion, though essentially erroneous, seems sufficiently plausible. Many of the pursuits of individuals apparently conduce very little, and may sometimes even seem hostile, to the interests of the whole; and hence we are naturally enough led to infer, that the public advantage would be best consulted by their prohibition. Nothing evinces more strikingly the prevalence of this notion of the propriety of restricting and directing the operations of industry and the investment of capital, than the regulations respecting the trade in corn. This, no doubt, is only what might have been expected. To secure an adequate supply of food, and to obviate famine and scarcity, must always be an object of the first importance with legislators; and while the efficacy of the regulating system is unquestioned, it is here it will be chiefly called into action.

When legislators abandon the principle of free competition, and imagine they can give a more advantageous direction to national industry, their habits and station in society have a powerful influence in determining the regulations they adopt. Agriculturists raise corn for *sale*, as well as for their own consumption; and as they naturally endeavour to obtain the highest price for their produce, where their voice predominates in the legislature of a country, it is reasonable to presume, that the regulations respecting the trade in corn will be framed with a design rather to enhance than to lower its price. Whether they have that effect is an entirely different, and often a very delicate inquiry; but unless there be pretty explicit evidence to the contrary, it is not easy to imagine, that agriculturists, or those supported by agriculture, should give their consent to any law intended to lower the value of the products they have to dispose of. On the other hand, where the legislature of a country is principally composed of merchants, manufacturers, capitalists, and others depending on the profits of stock, as was formerly the case in Holland, or where it is chiefly influenced by them, it is nearly certain it will not intentionally adopt any measure which may have for its object to raise the price of corn. When it is low, such persons obtain a comparatively large quantity in exchange for their peculiar products or services. How then is it to be expected that they should voluntarily consent to any measure which they supposed would contribute to raise the price of so important an article?

Throughout the principal continental states, the regulations affecting the corn trade have been mostly framed with a view to keep down the price of corn. This fact, however, is perfectly consistent with what has now been stated. After the feudal system lost its energy, and the power of the great barons had been weakened by the rise of cities and the consolidation of the royal authority, monarchs were able to take such measures as appeared most likely to benefit the lower classes of their subjects, which it was then their object to exalt. Of these, none seems more natural, or better calculated to effect its object, than the imposing of restrictions on the exportation of raw produce. If a nation raise more corn than is required for its consumption, the first consequence of a prohibition of export is undoubtedly to lower its value. It is certain, indeed, that this effect will very soon cease; but, in early ages, men seldom attend to prospective considerations, and it is not a very easy matter, even now, to convince the bulk of mankind that the granting liberty to send abroad the necessaries of life lowers their price at home. To demonstrate, or even apprehend this principle, requires a considerable acquaintance with political economy, a science altogether unknown when the first laws respecting the corn trade were framed in the European commonwealth. With a view still further to reduce the price of corn, its free importation was very generally allowed; and, in periods of scarcity, bounties or premiums, over and above the market price, were sometimes given by the state to the importer.

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In this country, an opposite course has been pursued. The Lords and Commons, the first depending entirely, and the latter principally, on agriculture, having attained great power and influence, we cannot be surprised at their having more frequently exerted it to increase than to lower the price of corn.

Restrictions on the exportation of corn, without being in any degree advantageous to the consumers, are eminently hurtful to agriculturists. While they exist, no market can be found for that excess of produce which an agricultural country generally has to dispose of in favourable seasons. Farmers are not, therefore, stimulated to exertion, because, in a country thus situated, a luxuriant crop, by its causing a great fall of price, is nearly as prejudicial to them as a scarcity; which, indeed, by its lessening the quantity sown next year, it seldom fails to occasion. In most countries, however, these very simple considerations have been overlooked, and the exportation of corn, unless in years of extreme plenty, has been forbidden under severe penalties. In the reigns immediately succeeding the conquest, this was done in England; but, in 1436, in the reign of Henry VI. an act was passed permitting exportation without license, whenever the price of wheat did not exceed 6s. 8d. (equal in amount of pure silver to 12s. $10\frac{2}{3}$d. present money) per quarter, and barley 3s. 4d. In this act it is stated, that the previous regulations had obliged farmers to sell their corn at low prices, to the great prejudice of the whole kingdom. But, in addition to the reason assigned for this important measure, we may observe, that, for a considerable time posterior to the conquest, rents were paid in kind, and the high or low price of corn was not, therefore, a matter of so much importance to landlords, as it became after money rents were generally introduced. In Henry I.'s time, the rents of the crown lands were paid in corn and other farm produce, and were only converted into pecuniary payments, in consequence of the great complaints made by the tenants of the inconveniences they suffered in bringing necessaries for the king's household from distant parts of the kingdom. (Eden's *Inquiry into the State of the Poor*, vol. i. p. 55.) The same causes would doubtless affect, though in a less degree, the tenants of the great barons; and, when once money rents were introduced, it was for the advantage of the proprietors that all obstacles to a rise in the price of corn should be removed. A more favourable opportunity could not have been found for effecting their abolition. Henry, weak and irresolute, with a disputed title to the throne, and a powerful competitor, could not, had he been so disposed, have made any effectual opposition to a change

Statute of 1436, permitting exportation.

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of the system on which the corn trade had been conducted.

At the time when this act was passed, the prices of corn were exposed to fluctuations of which we can now form a very inadequate conception; and hence it is not easy to determine whether the exportation price of 6s. 8d. was above or below the medium price. While the trade of corn merchants and corn factors was unknown, or laboured under degrading restrictions, very little providence was exercised in the distribution of the crops, and the superfluous produce of one year scarcely ever compensated for a deficiency in the crop of the next. "Purchasers," says Sir F. M. Eden, "who only looked to their immediate wants, having corn cheap, were naturally wasteful and improvident in the consumption; the price, therefore, almost invariably rose as the year advanced, and was frequently at an enormous height just before harvest; and, before a fresh supply could be obtained, the stock of the preceding year was often entirely exhausted." (*Inquiry into the State of the Poor*, vol. i. p. 18.) Of this Sir Frederick has collected many instances; and he conjectures, seemingly with great probability, that the enthusiastic joy with which the rustic feast of harvest-home was anciently celebrated, arose chiefly from the almost constant fall that then took place in the price of corn.

That the act of 1437 was advantageous to the agriculturists cannot be doubted; and having experienced the benefit of legislative interference in one instance, they were not slow in again having recourse to it. Not satisfied with the liberty of exporting, they procured in the following reign (1463) the enactment of a law prohibiting *importation* from abroad until the home price exceeded the price at which exportation ceased. Had the uncertain and fluctuating policy of the times permitted the proper execution of these laws, the restrictive system would have been thus early perfected; and, with the exception of the bounty, all the refinements of modern policy would have been in full operation. In practice, however, they were nearly inoperative, and a lengthened period elapsed before the agriculturists succeeded in obtaining a real monopoly of the home market. (Dirom's *Inquiry*, p. 34.)

Statute of 1463, prohibiting importation.

Until the reign of Elizabeth, these acts nominally regulated the prices at which the exportation and importation of corn might take place. In that period, however, the coin had been greatly degraded; and the value of silver, owing to the discovery of the American mines, was rapidly falling throughout Europe in the latter part of the fifteenth and in the sixteenth century. The consequent rise of prices, as it could not, in a nearly stationary state of society, when capital was but slowly accumulating, be speedily followed by a corresponding rise of wages, was necessarily productive of much distress. But neither the government nor the people seems to have been at all aware of the real cause of the rise of prices, and of the extraordinary increase of pauperism in this interval.[1] It was not yet known that silver may fall in value, and that this fall must always be attended by a proportional rise in the money price of the commodities for which it is exchanged. Instead, therefore, of ascribing the enhancement of prices to the degradation of the coin, and the greater plenty of gold and silver, it was universally affirmed to be owing to the *decay of tillage*, and to the improper practices of corn merchants; and many (now obsolete) statutes for the improvement of tillage, with the laws against engrossing, forestalling, &c. owe their origin to the absurd attempts that were then made to lower the price of corn.

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That the complaints respecting the decay of tillage were very ill founded, appears evident. The great foreign demand for English wool, the exportation of which was not then prohibited, caused the consolidation of some small farms, and the more general introduction of inclosures. But this fact, so far from being any proof of the alleged decay of tillage, affords satisfactory evidence of the accumulation of capital, and shows that some improvement had been made in agriculture.[2] An increase in the size of farms is, no doubt, always disagreeable to the lower classes; and being then attended by a great rise of prices, raised the popular indignation to such a pitch that, in the reign of Edward VI. the greater part of the inclosures were violently demolished. As might have been foreseen, the statutes directing the extension of tillage effected nothing; unfortunately, however, those against engrossing were not quite so inefficient.

Statutes against forestalling and engrossing.

By the statute fifth and sixth of Edward VI. cap. 14, it was enacted, that whoever should buy any corn or grain, with intent to sell it again, should be reputed an unlawful engrosser, and should, for the first fault, suffer two months imprisonment, and forfeit the value of the corn; for the second, suffer six months imprisonment, and forfeit double its value; and for the third, be set in the pillory, suffer imprisonment during the king's pleasure, and forfeit all his goods and chattels. And by the same law no person could transport corn from one part to another, without a license, ascertaining his qualifications as a man of probity and fair

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[1] In 1436 the pound sterling contained as much pure silver as is now contained in L.1. 18s. 9d. In 1464 the value of the pound sterling was reduced to L.1. 11s. present money, at which sum it remained stationary until 1527, when it was reduced to L.1. 7s. 6¾d. present money. In 1543 the previous value of the coin was again reduced about one seventh part, or to L.1. 3s. 3¼d. present money. In the ten years subsequent to this era, the process of degradation advanced with unparalleled rapidity; the weight of the coin being not only diminished, but the standard purity of the metal itself debased; so that in 1551 the pound sterling only contained as much silver as is now contained in 4s. 7¾d. In 1552, the last year of the reign of Edward VI. the standard was restored to its former purity; but the weight of the coin, and consequently the quantity of pure silver which it contained, was at the same time reduced about *one seventh* part below its weight in 1543, and hence the value of a pound sterling in 1552 corresponded to L.1. 6¾d. present money. Since that period the standard has undergone almost no variation, either as to weight or purity.

It therefore appears, that between 1527 and 1552, the value of the pound sterling was reduced from L.1. 7s. 6¾d. to L.1. 6¾d., or about *one fourth* part; and this degradation of the value of the coin, accompanied as it was by an extraordinary fall in the value of the precious metals themselves, leaves us at no loss to account for the distress by which the people of England were then assailed, and for the universal complaints of a rise of prices. The dissolution of the monasteries by Henry VIII. in 1536 and 1538 has commonly been considered as the immediate cause of the institution of a legal provision for the support of the poor in England; but it seems abundantly certain that this was really a consequence of the misery of the lower classes, caused by the degradation of the standard, and the fall in the value of gold and silver. "The principal real grievance at this time," says Mr John Smith (*Memoirs of Wool*, 8vo edit. vol. i. p. 88), when adverting to some riots and complaints caused by the high prices in 1550, "of the poorer manufacturers, they do not appear to have been sensible of, and historians have since overlooked it, was the *state of the coin*. The debasement of the coin, which was now of several years standing, had undoubtedly given a nominal advance to all things vendible; and, though perhaps to wages too, yet probably nothing near in proportion to the difference of the coin. And, as the money in which they were paid, not containing as much silver as it did before, would not purchase the same quantity of the necessaries of life it was wont to do; that, in course, must have bore hard upon the lower sort of people especially, who had every thing to buy, and nothing to sell except their labour." This idea has been borrowed, and illustrated, in an article of considerable merit, published in the 22d volume of the *Edinburgh Review*.

[2] In 1553 an act was passed, restraining the number of sheep to be kept in one flock to 2000. It is mentioned in that act, that some proprietors had then flocks of 24,000 sheep. Anderson states, that in 1551 no fewer than sixty ships sailed from Southampton for the Netherlands loaded with wool. (*History of Commerce*, vol. ii. p. 89.)

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dealing. Neither could corn be purchased to be laid up in granaries for home sale, unless the quarter of wheat was at or under 6s. 8d. and oats at 2s. money of the time. By the same statute the authority of three justices of the peace was necessary in order to grant a license; and even this restraint not being thought sufficient, a statute of Elizabeth confined the privilege of granting it to the quarter sessions.

That the landed interest should have made little opposition to the laws restricting the freedom of the internal corn trade, does not appear very surprising. Before the principles of trade began to be understood, it was natural for landlords and farmers to conclude that they would deal on fully more advantageous terms by selling their produce directly to the consumers, than by transacting with them through the medium of a third party. Forgetting that the profits of the corn merchants were but a fair remuneration for the capital they had engaged in the most important of all employments—that of distributing the supply of food equally throughout the year, and according to the effective demand—the farmers believed that they were acquired from the community at their expense, and, of course, felt no repugnance to the virtual annihilation of the trade of the dealer.

But as society improved, and as the principles of commerce were better understood, the bad effects of these laws became apparent. The statute of 1548 was considerably modified in 1624, and at last, by the 15th of Charles II. cap. 7, the engrossing or buying of corn, in order to sell it again, so long as the price of wheat did not exceed 48s. the quarter, was declared lawful to all persons not being forestallers, that is, not selling again in the same market within three months; an act, as Dr Smith has justly observed, which, with all its imperfections, has contributed more, both to the plentiful supply of the home market, and to the increase of tillage, than perhaps any other law in the statute book.

The act of Henry VI. regulating the export prices of corn was again renewed, but without any variation of the rates, in the reign of Philip and Mary. As the coin, however, had in the interim been greatly degraded, no exportation could now take place, until prices had really fallen much below the level of 1436. This act, like that against engrossing, was no doubt framed in the view of reducing the rising money price of corn, and of quieting the discontent then prevalent among the labouring classes; although, by shackling and discouraging cultivation, its real effects must have been extremely different.

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Statutes of 1562 and 1570.

In 1562 the prices at which exportation might take place were extended to 10s. per quarter for wheat, and 6s. 8d. for barley and malt. This scale, however, was soon after abandoned; and in 1570 it was enacted that corn might be exported from particular districts; wheat paying a duty of 1s. and other grain of 8d. per quarter, whenever no prohibition to the contrary was issued by government; and that the lord presidents and councils for shires, and the justices of assize, at their different sessions, should consult with the respectable inhabitants of the counties, and determine whether any exportation could with propriety be allowed.

The provisions of this act allowing corn to be exported from one part of the country, at the same time that its exportation was prohibited in another, arose from the extreme inequality of prices. At this era roads were scarcely formed; and as there hardly existed any communication between distant parts of the kingdom, the prices in the different counties differed exceedingly from each other, and from the price in London. England was then in the same situation as Spain in the present day. A particular province might be afflicted with scarcity, without deriving any assistance from the superfluous produce of its neighbours. But the complex nature of the regulations prevented their being properly executed; and they were superseded by a fresh law (35th Eliz. cap. 7), which permitted exportation on paying a duty of 2s. on wheat, and of 1s. 4d. on all other species of corn, whenever the price of wheat did not exceed 20s. per quarter, and barley and malt 12s. This act did considerable service to agriculture, by repealing several absurd statutes for the promotion of tillage, and against the enlargement of farms.

Origin of the poor-laws.

It deserves to be remarked, that the check given to cultivation by the injudicious imposition of heavy duties on the exportation of corn, and still more, the rapid depreciation of money in the reign of Elizabeth, caused an astonishing rise in the price of commodities. A contemporary author, quoted by Mr Hume, estimates this rise in the twenty or thirty years previous to 1581, at no less than fifty per cent. Wages not having increased in proportion, pauperism became very general; and this circumstance, combined with the excessively high prices of 1596, 1597, and 1598, resulting from the bad harvests of those years, occasioned the enactment of the famous statute of 1601, which has served as a basis to the whole of the present English system for supporting and managing the poor.[1]

No alteration was made in the duties payable on the

[1] The contemporary author quoted by Mr Hume (*Hist. of England*, vol. v. p. 485), and by Sir F. M. Eden (*State of the Poor*, vol. i. p. 119), says, that in 1581 it required L.200 to keep as good a house as might have been kept sixteen years before for 200 merks, or L.133. 6s. 8d.—"Cannot you remember," says he, "that within these thirty years I could, in this town, buy the best pig or goose I could lay my hands on for 4d., which now costeth 12d., a good capon for 3d. or 4d., a chicken for 1d., a hen for 2d., &c. Now a payre of shooes costs 12d.; yet in my time I have bought a better for 6d." Latimer, in his sermons, ascribes this increase of price to landlords raising their rents. "Notwithstanding," says he, "God doth send us plentifully the fruits of the earth mercifully, according to our desertes, these rich men causeth such dearth, that poore men, which live of their labour, cannot with the sweat of their face have a living, all kinde of victuals is so dear." A variety of passages to the same import may be found in other contemporary authors, quoted by Sir F. M. Eden, and by Mr Smith in his *Memoirs of Wool*.

This extraordinary advance of prices, caused partly by the degradation of the coin, but more by the fall in the real value of the precious metals, as it very far exceeded the rate at which capital, and consequently the demand for labour, was then increasing, must, even supposing wages had been left to find their own level, and to be adjusted on the principles of fair competition, have been attended by a very great deterioration in the circumstances of the labouring classes. But positive enactments were framed to prevent the increase of wages; so that, while the prices of all sorts of commodities were advancing with unprecedented rapidity, the sums paid the labourers were violently kept down to near their former level.

By the statute 11th Henry VII. c. 22, regulating the wages of labour, a common labourer was allowed 4d. per diem, from Easter to Michaelmas; and, taking the average prices of wheat, rye, and barley at that period at 6s. 8d., 4s., and 3s. per quarter respectively, it will follow that a labourer who had 4d. a day, could earn a quarter of wheat by twenty days' labour, a quarter of rye by twelve days' labour, and a quarter of barley by nine days' labour.

But in the latter part of the reign of Queen Elizabeth, the labourer's situation was very different. The prices of corn may be supposed to have nearly corresponded with the rates at which exportation was allowed by statute 35th Eliz. c. 7, that is, wheat probably averaged 20s. a quarter, rye 13s. 4d., and barley 12s. It appears, however, from the determination of the justices of the East Riding of Yorkshire, in the same year, that the wages of a common labourer, without meat or drink, were limited to *five* pence a day, from the 1st March to the Feast of All Saints. Consequently, a common labourer could not, in the latter part of the reign of Queen Elizabeth, earn a quarter of wheat by less than 48 days' labour, a quarter of rye in less than 32 days, nor a quarter of barley in less than 28⅔ days. If barley was his common sustenance, he could have earned *three* times as much in 1495 as in 1593, of rye 2⅔ as

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exportation of corn, during the pacific reign of James I.; but the prices at which exportation might take place were, after some trifling alteration in 1604, fixed in 1623 at the high rate of 32s. the quarter for wheat, and of 16s. the quarter for malt and barley. In this and the preceding reigns, and for a considerable time afterwards, importation continued unrestricted; and notwithstanding the improvement of agriculture, the nation was partially dependent for supplies of corn on the trade with the countries round the Baltic, and others.

During the agitation of the civil wars, the people of England, intensely occupied in endeavouring to throw off, or at least to restrict and modify, the royal authority, paid no regard to the corn trade. But this inattention does not seem to have been attended with any bad effects. The high prices of that turbulent period, if they were not altogether caused by a fall in the value of the coin, which, previously to the recoinage under Cromwell, was very much clipped and debased, were most probably owing to the interruptions thrown in the way of agricultural labour.

Statute of 1660, regulating exportation.

On the restoration of Charles II. in 1660, an act was passed, permitting the exportation of corn on the same terms as other commodities on which duties were payable, whenever the price of wheat did not exceed 40s. per quarter, barley and malt 20s., and oats 16s. But as this law laid a duty of 20s. on every quarter of wheat exported, and on other grain in proportion, it really amounted to a prohibition; and neither the agriculturists nor the revenue derived any advantage from the extent to which exportation was permitted, although both must have been somewhat benefited by the high duties it imposed on importation.

Mr Dirom's opinion, that the prohibitory duties on exportation were the chief causes of the high prices of this and the two following seasons, seems entirely destitute of foundation. The law against exportation could not certainly raise the prices of the year in which it was framed, and this high price, as far as it was not caused by a deficiency in the crop, or by any fluctuation in the value of the coin, was unquestionably owing, not to the duties on exportation, but to the exorbitancy of those on *importation*, which had really secured a monopoly of the home market to the agriculturists.

This view of the matter appears to have been soon after taken by parliament; for in 1663 the high duties on importation were taken off, and an *ad valorem* duty of nine per cent. imposed in their stead. The exportation price of wheat was at the same time extended to 48s. per quarter, chargeable with a duty of 5s. 4d. and other grain in proportion.

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Statute of 1670.

This act, however, by permitting the importation of foreign grain on paying a moderate duty, not being reckoned sufficiently advantageous to the landholders, a more decided step was subsequently taken, and in 1670 exportation prices were extended to 53s. 4d. per quarter for wheat, and other grain in proportion, while import duties, amounting to a complete prohibition, were imposed on foreign wheat till the home price reached 53s. 4d., and between that price and 80s. a duty of 8s. was exigible. But this law, though extremely favourable to the agriculturists, by whom indeed it had been framed, did not perfectly correspond with their wishes. The necessities of the crown caused the continuance of impolitic duties on exportation, and the prohibition of importation was rendered to a certain extent nugatory, by the want of any proper and settled method for ascertaining prices. Groundless complaints of the decay of agriculture, and of the evils of foreign competition, were therefore continued, and gave occasion to the act of 1685, designed more effectually to check importation from abroad, by securing correct returns of the home prices.

Bounty act.

We have now reached a period no less memorable in the economical than in the political history of Great Britain. A BOUNTY on the exportation of corn was granted at the revolution. The Prince of Orange could not oppose the wishes of the landed interest, who then constituted the immense majority of parliament, on this particular subject. Whether he really approved of the measure cannot now be ascertained; but whatever may have been William's private sentiments, it was necessary for him to give way to the inclinations of those who had so lately raised him to a throne, and on whose assistance he was chiefly to depend in prosecuting his war against France. The bounty payable under the act 1st William and Mary, cap. 12, amounted to 5s. for every quarter of wheat exported, while the price continued at or below 48s.; 2s. 6d. for every quarter of barley or malt, while their price did not exceed 24s.; and 3s. 6d. for every quarter of rye, when its price did not exceed 32s.

A still more essential advantage was shortly after con-

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much, and of wheat 2½. As far, therefore, as the necessaries of life were concerned, the situation of the labourer was not *one half* so advantageous in 1593 as it had been in 1495. (*Edinburgh Review*, vol. xxii. p 195.)

This extraordinary rise in the price of provisions being unattended by any proportional rise in the price of labour, was the real cause of the institution of poor-rates. In the long interval between 1379 and 1530, it does not appear that any statute was passed directly referring to the maintenance of vagrants or beggars. At the latter era, however, when the prices of all sorts of commodities began suddenly to rise, pauperism became very prevalent, and engaged a considerable portion of the attention of the legislature.

The following extract from Dr Burn's *Justice of Peace* (vol. iii. p 608), shows in a very distinct manner the various steps by which the compulsory maintenance was established in England:—"By 22d Henry VIII. c 12, the justices were to distribute themselves into several *divisions*; within which divisions respectively they might *license* persons to beg. By 27th Henry VIII. c. 25, the several hundreds, towns corporate, parishes, or hamlets, were required to *sustain* the poor with such *charitable voluntary alms*, as that none of them might, of necessity, be compelled to go openly in begging, on pain that every person making default should forfeit twenty shillings a month. And the churchwardens, or other substantial inhabitants, were to make collections for them with boxes on Sundays, and otherwise by their discretions. And the minister was to take all opportunities to stir up and exhort the people to be liberal and bountiful. By the 1st Edward VI. c. 3, houses were to be provided for them by the devotion of good people, and *materials* to set them at work; and the minister, after the gospel every Sunday, was specially to exhort the parishioners to a liberal contribution. By the 5th and 6th Edward VI. c. 2, the collectors of the poor, on a certain Sunday in every year, immediately after divine service, were *to take down in writing* what every person was willing to give weekly, for the ensuing year; and if any should be obstinate, and refuse to give, the minister was gently to exhort him; if he still refused, the minister was to certify such refusal to the bishop of the diocese, and the bishop was to send for him, to induce and persuade him by charitable ways and means, and so according to his discretion *to take order for the reformation thereof.* By the 5th Elizabeth, c. 3, if he stood out against the bishop's exhortation, the bishop was to certify the same to the justices in sessions, and bind him over to appear there; and the justices at the said sessions were again gently to move and persuade him; and, finally, if he would not be persuaded, then they were to *assess* him in what they thought reasonable towards the relief of the poor; and, in case of refusal, were to commit him till paid. By 14th Elizabeth, c. 5, power was given to the Justices to lay a *general assessment*; and this hath continued ever since; for the statute of the 43d Elizabeth, c. 2, is only a re-enacting of former provisions, with some additional alterations."

In a tract published in 1611, the author dwells with great earnestness on the extreme dearth of victuals. They were grown more dear in price, he affirms, in the six years foregoing, than in the twenty years before.—See *Memoirs of Wool*, vol. i. p. 128. The fall in the value of gold and silver, caused by the discovery of the American mines, seems to have ceased about 1630 or 1640.

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ferred on agriculture, by the act 11th and 12th William III. cap. 20, which repealed all previous duties on the exportation of corn, and prevented the operation of the bounty from being in the slightest degree counteracted.

No alteration having been made in the prices and duties regulating importation, as fixed in 1670, and these duties being rigorously exacted, the act repealing the duties on exportation completed the restrictive system. Every part of this complex machine was now in operation; and while no foreigner was allowed to contend with the home growers, the liberality of the state enabled them to contend with foreigners, even when the price of corn in Great Britain was considerably higher than its price abroad!

Scotch corn laws.

The policy adopted in Scotland respecting the trade in corn was nearly the same as that of England. Previously to 1663 the importation of corn into this kingdom was permitted without limitation or duties (Dirom, p. 61); but in that year it was loaded with an *ad valorem* duty of about forty per cent.; while its free exportation was allowed, on payment of a trifling duty, until the prices exceeded those mentioned below.[1] This duty was afterwards relinquished, and a bounty granted by the statute William, Par. 1, cap. 32. At length, by the treaty of union, the corn laws of both kingdoms were incorporated, and it was settled that "the allowances, encouragements, and drawbacks, prohibitions, restrictions, and regulations of trade, and the customs and duties on import and export, settled in England when the union commences, shall, from and after the union, take place throughout the whole united kingdom." Oats not having been mentioned in the English statute granting the bounty, it was declared, that whenever oats did not exceed the price of 15s. sterling per quarter, there should be paid a bounty of 2s. 6d. for every quarter of oatmeal exported.

Effects of the bounty act.

Whatever may have been the ultimate consequences of the bounty act, there can be no doubt that it was framed in the view of enhancing the value of corn. In the preamble to this celebrated statute, it is stated "that the exportation of corn and grain into foreign parts, *when the price thereof is at a* LOW *rate in this kingdom*, hath been a great advantage, not only to the owners of land, but to the trade of this kingdom in general." It would indeed be absurd to suppose that the landed interest should have unanimously urged the adoption of a law, had it been imagined to have any tendency to lower the value of agricultural produce.

We shall afterwards endeavour to show that the bounty had in fact no such tendency; but at present we shall only offer a few observations explanatory of the fall in the price of corn posterior to 1690, which has, as it appears to us, without any sufficient reason, been ascribed to the bounty.

It is obvious that no certain conclusions can ever be drawn as to whether the real value, that is, the expense of producing a commodity, is diminished, from the fact of its *money* price having declined. Before forming any accurate conclusions as to a rise or fall in the real price of commodities, from variations in their money price, it is essential to know, not only the state of the coin as to purity and weight, but also whether the value of bullion be itself stationary. A fall of money price may be as effectually produced by a rise in the value of gold and silver, as by a diminution of the cost of production; and the real price of a commodity may be increasing at the very time its money price is falling. To produce this effect it is only necessary that the real price of bullion should increase faster than the real price of the commodity with which it is compared.

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Value of gold and silver in the early part of last century.

That the real value of gold and silver rose in the early part of last century, has been maintained by Dr Smith, apparently on pretty good grounds. As no remarkable improvements in agriculture were then made, either on the continent or in England, the expense of producing corn may be reckoned to have remained nearly the same, or rather to have increased, as the increase of population, however slow, would cause recourse to be had to inferior soils. But during this period the money price of corn fell, not only in this country, where a bounty was given on exportation, but in those continental kingdoms where exportation was prohibited. Conclusive evidence of this fact, as far as regards France, will be found in the table of the prices of wheat, at the Paris or Rosoy market, annexed to the work of Duprè de St Maur, entitled *Essai sur les Monnoies, ou Reflexions sur le Rapport entre l'Argent et les Denrées.* Paris, 1746. And the table of the price of wheat at Seville, from 1675 to 1764 inclusive, published in the appendix to the *Bullion Report*, strongly confirms the reasoning of Dr Smith, and shows that prices declined considerably in Spain in the first fifty years of last century.

The impulse imparted to this country by the revolution, the abolition of all oppressive and arbitrary exactions, and the number of intelligent and wealthy foreigners who sought refuge in England from the persecution of intolerant and bigoted governments, coupled with the revival of trade and the establishment of the bank in 1694, caused the extension of commerce, and a considerable accumulation of capital, subsequently to the treaty of Ryswick. The wars of Queen Anne counteracted this progress; but during the long and pacific administration of Sir Robert Walpole, the increase of capital, and the improvement of every species of industry, though not so great as they afterwards became, continued uninterrupted. A rise in the money price of labour in Great Britain during that interval is not therefore inconsistent with the fact of an advance in the value of the precious metals, but, as Dr Smith has stated, is a natural consequence of the improving state of the country, and of the increasing demand for labour. In France, which had been completely exhausted by the ruinous enterprises of Louis XIV. and where, of course, the demand for labour remained nearly stationary, wages *fell* as the price of corn declined. (*Wealth of Nations*, i. 313.)

State of the coin in the reign of William III.

But whatever weight may be attached to these conclusions, respecting a general rise in the real value of gold and silver in the early part of last century, there can be no question as to the fact of a rise having taken place in the value of the coin of Great Britain, in consequence of the recoinage in the latter part of King William's reign. At that period silver constituted the English standard of value, and to such an extent had the silver currency been debased by clipping, filing, &c. that, in 1695, the common price of silver bullion was 6s. 5d. per ounce, or 1s. 3d. above the mint price. A guinea then passed current for about 30s., and the *nominal* exchange between London, Holland, and Hamburg was rather more than twenty-five per cent. against the first. (*Wealth of Nations*, i. 304.) That this degraded state of the coin raised the price of every other commodity as well as bullion, might be concluded for certain, although no direct evidence of the fact had been transmitted to us. Mr Lowndes, however, in his Report on the state of the silver coin in 1695, mentions its degradation as "*one great cause of the raising the price, not only of all merchandises, but of every article necessary for the sustenance of the common people, to their great grievance.*" (Liverpool *on Coin*, p. 70.) And Mr Locke, in his answer

[1] Wheat, L.12 Scots per boll; bear and barley, L.8 do.; oats and peas, 8 merks.

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to Lowndes' proposal for lowering the standard, confirms this statement, and asserts, that the "*price of* ALL *sorts of provisions and commodities had risen excessively.*" (*Idem.*)

The *medium* rise in the price of undepreciated gold coin, and of silver bullion, compared with the clipped and degraded coin, appears, from the statements of Locke and Lowndes, to have rather exceeded thirty per cent. And it is of importance to remark, that, in 1700, the year in which the new coin came into general circulation, the market price of corn, which had previously been rising, *declined to very near the same extent.* That this fall may in some degree have been owing to luxuriant crops, is probable; but it is quite certain that the increased value of the circulating medium would of itself have speedily lowered the money price of corn, and of every other commodity.

Mr Charles Smith, Mr Malthus, and others who contend that a bounty on the exportation of corn tends to lower its price, admit that the bounty granted in 1688 had no such effect anterior to 1700! This fact should have stimulated them to inquire whether any thing peculiar belonged to that year. They should have recollected, that a fall of money prices may be as effectually brought about by a rise in the value of the currency, as by a fall in the value of commodities. Had they kept this principle in view, and adverted to the circumstances under which the recoinage of 1696, 1697, and 1698 took place, perhaps they would not have been so very confident in their assertions as to the effects of the bounty; and, at all events, they would not have adduced the fall of prices in 1700, and subsequently, as any proof of their correctness.

We do not certainly mean to affirm that the whole rise of price, from 1692 to 1698 inclusive, is to be ascribed to the depreciation of the currency. The bounty, and, in a still greater degree, bad seasons, contributed to produce this rise; and the fair inference is, that had there been no bounty, prices would have fallen still lower after the recoinage.

In considering the effects of the bounty, it ought always to be recollected that prices were gradually falling previously to its being granted.

From 1649 to 1658, the average price of the Winchester quarter of middling wheat was.....	L.2	7	0
—— 1659 to 1668.....	2	6	8
—— 1669 to 1678.....	2	3	4
—— 1679 to 1688.....	1	18	4[1]

The bounty was given with the avowed intention of checking this fall, and it was, in our opinion, well calculated to accomplish its object. But, whatever may have been its effects, it cannot surely be assigned as the cause of the fall of prices between 1700 and 1746, seeing that that very fall began thirty years before it was granted, and that prices rose in the first ten years of its existence.

Perhaps part of the fall of corn in England subsequently to 1640 may be justly ascribed to the prohibition of the exportation of wool, which, after several previous attempts, was carried into full effect by the act of 1660. The wool formerly raised in Great Britain having much exceeded what was required for our manufactures, its price declined as soon as its exportation was put an end to; and, of course, some portion of the soil employed in rearing sheep would be brought under tillage, and a greater quantity of good land, besides an additional capital, would be turned to the raising of corn.

Although the mint price of gold had been reduced by King William, it was still rated too high as compared with silver; and consequently the currency again became deranged. The deficiency of new silver coin, caused by the inducement to melt it down, was not immediately experienced; but towards the latter part of Queen Anne's reign, a want of silver, and a difficulty in making payments, were universally felt and complained of. As might have been expected, *prices rose*, and, from 1709 to 1717 both inclusive, were much above the average of the eight preceding or of the following years. That this could not be an effect of deficient crops, is evident from the fact of a considerable exportation, forced, no doubt, to a certain extent, by the bounty having then taken place. The government did not indeed entertain any such opinion, but having wisely adopted the suggestion of Sir Isaac Newton, and reduced the mint value of the guinea, the melting and hoarding of silver ceased, and prices, as in 1700, fell to their former level.

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In accounting for the low price of corn in the reigns of George I. and George II., after allowing for the increased value of the coin, the relaxation of the laws against forestallers and engrossers must not be forgotten. Large capitals being engaged in the corn trade, extraordinary fluctuations of price were avoided. The home demand was rendered more steady and equal; while the perfect security of property, and the greater political influence attached to landed possessions, naturally attracted a more than ordinary portion of the accumulating capital of the country towards agriculture.

The bounty, by extending the foreign market, no doubt contributed materially to the extension of cultivation, although, by forcing recourse to worse soils in order to obtain additional supplies of corn, it raised prices. In the period from 1740 to 1751, the cheapest in last century the bounties paid on exportation amounted in all to L.1,515,000; and in 1749 alone they somewhat exceeded L.324,000. The bounty, however, had by this time been too long in operation to permit the growers or exporters to realise more than the common and ordinary profits of stock; and, therefore, had it never been granted, the quantity of corn exported, and the home price (which must have been regulated by the expense necessary to produce the increased supply required by the bounty on the poorest soils in cultivation), would both have been reduced. We shall afterwards elucidate this principle at greater length; but it is of importance to remark how much this forced exportation must have raised the real price of corn, at the very time when it is supposed to have reduced it.

Diminution of exports subsequent to 1750.

But notwithstanding the factitious stimulus thus given to exportation, the exports which, in 1750, amounted to 1,667,778 quarters of all sorts, rapidly diminished; and the gradual increase of the home demand, in the last ten years of the reign of George II. accompanied as it was by a rise of prices, reduced the annual average exportation, at the accession of George III. in 1760, to about 600,000 quarters. After the peace of Paris in 1763, the progress of improvement was prodigiously accelerated. The extension of industry caused by the acquisition of new branches of commerce, by the increase of our colonial possessions, and, perhaps more than all the rest, by the introduction of improved machinery into the cotton manufacture,[2] was followed by a sudden increase of the population, and, as importation was prohibited, by a corresponding rise of prices.

The admirers of the restrictive system have generally reasoned as if this rise of price and the cessation of ex-

[1] See table of prices of wheat at Eton College, annexed to this article.

[2] Jennies were invented in 1766, by Richard Hargraves, weaver in Lancashire, who, to the disgrace of his age and nation, was suffered to pass his days in obscurity and poverty.

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portation had been a consequence of the alteration of the corn laws in 1773. But it should be carefully observed that this alteration was an avowed, and indeed a necessary consequence of the previous rise. In 1765, before any suspension of the restrictive system had taken place, the balance on the side of wheat exported amounted to only 77,000 quarters, and the home price in that and the two preceding years rose to an unusual height. The general and growing dissatisfaction at continuing the prohibition of importation under such circumstances, produced a suspension of the high duties in 1766; and by temporary enactments, this suspension (accompanied occasionally with restrictions on exportation) was continued to 1773, when a permanent act was framed under the auspices of Mr Burke. By this act foreign wheat was allowed to be imported on paying a nominal duty of 6d. whenever the home price reached 48s. a quarter; and the bounty and exportation were together to cease when the price reached 44s. This statute also permitted the importation of corn at any price, in order to be again exported, duty free, provided it was, in the mean time, lodged under the joint locks of the king and the importer.

Statute of 1773.

The prices, when exportation was to cease, seem to have been fixed too low in this act; and, as Dr Smith has observed, there appears a good deal of impropriety in prohibiting exportation altogether at the precise prices at which the bounty given to force it is withdrawn; yet with all these defects, the act of 1773 was a material improvement on the former system, and should not have been altered unless to render the trade perfectly free.

The idea that this law must, when enacted, have been injurious to the farmers, seems altogether illusory. The permission to import foreign grain, when the home prices rose to a certain rate, certainly prevented their realizing exorbitant profits at the expense of the other classes, and prevented an unnatural proportion of the capital of the country being turned towards agriculture. But as this rate was fixed very considerably higher than the average price in the reign of George II., it cannot be maintained that it had any tendency to lower prices, which alone could discourage agriculture; and in fact no such reduction took place.

It is indeed true, that but for this act we should not have imported so much foreign grain in the interval between 1773 and 1791. This importation, however, was not occasioned by the declining state of our agriculture, for it is universally admitted that every department of rural economy was more improved in that period than in the whole course of the preceding century; but arose entirely from a still more rapid increase of the manufacturing population, and hence of the effective demand for corn.

By referring to the tables of exports and imports annexed to this article, it will be seen that, in 1772, the balance on the side of wheat imported amounted to 18,515 quarters; and in 1773, 1774, and 1775, all years of great prosperity, this balance was very much increased. The loss, however, of a great part of our colonial possessions, and the stagnation of commerce occasioned by the American contest, diminished the consumption; and this diminution concurring with luxuriant harvests, the balance was high on the side of exportation in 1778, 1779, and 1780. In 1783 and 1784 the crop was unusually deficient, and considerable importations took place; but in 1785, 1786, and 1787, the exports again exceeded the imports; and it was not till 1788, when the country had fully recovered from the effects of the war, and when manufacturing improvements were carried on with extraordinary spirit, that the imports permanently overbalanced the exports.

Increase of produce between 1773 and 1791.

The growing wealth and commercial prosperity of the country had thus, by increasing the population, and enabling individuals to consume additional quantities of food, caused the home supplies to fall somewhat short of the demand; but it must not therefore be concluded that agriculture had not at the same time been very greatly ameliorated. "The average annual produce of wheat," says Mr Comber, "at the beginning of the reign of George III. was about 3,800,000 quarters, of which about 300,000 had been sent out of the kingdom, leaving about three and a half millions for home consumption. In 1773, the produce of wheat was stated to the House of Commons to be 4,000,000 of quarters, of which the whole, and above 100,000 imported, were consumed in the kingdom. In 1796 the consumption was stated in the House of Commons, by Lord Hawkesbury, to be 500,000 quarters per month, or six millions annually, of which about 180,000 were imported, showing an increased produce, in about twenty years, of 1,820,000 quarters. It is evident, therefore, not only that no defalcation of produce had taken place in consequence of the cessation of exportation, as has been too lightly assumed, from the occasional necessity of importation; but that it had increased with the augmentation of our commerce and manufactures." (Comber *on National Subsistence*, p. 180.)

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These estimates are, no doubt, very loose and unsatisfactory, but the fact of a large increase of produce is unquestionable. In the Report of the House of Commons on *Waste Lands*, drawn up in 1797, the number of acts passed for inclosing, and the number of acres inclosed, in the following reigns, are thus stated:

	Number of Acts.	Number of Acres.
In Queen Anne's reign	2	1,429
In George I.	16	17,660
In George II.	226	318,728
In George III. to 1797	1,532	2,804,197

It deserves particular notice, that from 1771 to 1791, both inclusive, the period when these great agricultural improvements were principally carried on, there was no rise of prices.

The landholders, however, could not but consider the liberty of importation granted by the act of 1773 as injurious to their interests, inasmuch as it prevented prices from rising with the increased demand. A clamour, therefore, was raised against that law, and, in addition to this interested feeling, a dread of becoming habitually dependent on foreigners for supplies of corn operated with many, and produced a pretty general acquiescence in the act of 1791, by which the price, when importation could take place at the low duty of 6d., was raised to 54s., under 54s. and above 50s. a middle duty of 2s. 6d., and under 50s. a prohibitory duty of 24s. 3d., were exigible. The bounty continued as before, and exportation without bounty was allowed to 46s. It was also enacted that foreign wheat might be imported, stored under the king's locks, and again exported free of duty; but if sold for home consumption in the kingdom, it became liable to a warehouse-duty of 2s. 6d. in addition to the ordinary duties payable at the time of sale.

Statute of

Mr Comber has justly blamed this imposition of duties on the warehousing of foreign corn; but the deficient crops of 1795 and 1797, followed as they were by a great rise of prices, superseded these provisions, and even caused the granting of high bounties on importation.

In 1797 the Bank of England was restricted from paying in specie, and the consequent facility of obtaining discounts gave a fresh stimulus to agriculture; the efficacy of which was most powerfully assisted by the great scarcity and high prices of 1800 and 1801. These may indeed be said to have inspired all classes with a sort of agri-

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cultural mania; and as the prices of 1802 and 1803 would not permit the profitable cultivation of the poor soils which had been taken into tillage during the scarcity, a new corn law was loudly called for by the farmers, and passed in 1804. This act imposed a prohibitory duty of 24s. 3d. per quarter on all wheat imported when the home price was at or below 63s.; between 63s. and 66s. a middle duty of 2s. 6d. was paid; and above 66s. a nominal duty of 6d. The price at which the bounty was paid on exportation was extended to 40s. and exportation without bounty to 54s. By the act of 1791, the maritime counties of England had been divided into twelve districts, and importation and exportation had been regulated by the particular prices of each; but by the act of 1804, they were regulated in England by the *aggregate average* of the twelve maritime districts, and in Scotland by the *aggregate average* of the four maritime districts. The averages, as at present, were taken at four periods in the year, and the ports were either open or shut for not less than three months. This method of ascertaining prices was, however, modified in the following season, and it was then fixed that importation both in England and Scotland should be regulated by the average price of the whole twelve maritime districts.

Statute of 1804. increasing the duties on importation.

To prohibit the importation of the necessaries of life into a country where the supply is short of the demand, till prices rise to a certain height, has an obvious tendency to raise them still higher. In 1805 the crop was very considerably deficient, and the average price of that year was about 22s. above the price at which importation was allowed by the act of 1804. The depreciation of paper compared with bullion, being at that time about four per cent., the high price must have been owing to the new corn law preventing importation till the home price was high, and then cramping mercantile operations; and to the war rendering the cost of importation unusually great. In 1806, 1807, and 1808, the depreciation of paper, compared with bullion, continued at nearly four per cent.; and the price of wheat in these years being generally from 66s. to 75s., a small importation only took place. From autumn 1808 to spring 1814, the depreciation of our currency was rapid beyond all former example; and several crops in that interval being likewise deficient, the money price of corn, influenced by both causes, rose to a surprising height. The following is a statement of the money or *paper* price, and of the *bullion* price of corn, from 1809 to 1814, both inclusive:—

Paper Price per Quarter.	Bullion Price per Quarter.
1809..... 97s. 4d.	1809 ..... 94s. 9d.
1810.....106s. 5d.	1810..... 91s. 11d.
1811..... 95s. 3d.	1811..... 87s. 9d.
1812.....126s. 6d.	1812.....100s. 3d.
1813.....109s. 9d.	1813 ..... 86s 6d.
1814..... 74s. 4d.	1814 ..... 55s. 8d.

The crops of 1809 and 1810 were much below an average, and the *bullion* price of these years is a good deal higher than the importation price fixed by the act of 1804. This excess is to be ascribed partly to that law, and partly to the extraordinary difficulties then thrown in the way of importing grain. At that time no vessel could be loaded in any continental port for England, without purchasing a license; and the freight and insurance were at least *five* times as high as during peace. The same causes operated in 1812; but in the autumn of 1813 the destruction of Napoleon's anti-commercial system having increased the facilities of importation, a large quantity of corn was poured into the kingdom; and in 1814 its bullion price was reduced below the point at which importation was allowed.

Before this fall of price, a committee of the House of Commons had been appointed to inquire into the state of the laws affecting the corn trade; and their report (dated 11th May 1813) recommended a very great extension of the rates at which exportation was formerly allowable, and when importation free of duty could take place. The recommendation of this committee was not adopted by the House; but the fact of its having been made when the home price was at least 112s. per quarter, displays a surprising solicitude to exclude foreigners from all competition with the home growers.

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The lessening of the dependence of the country on foreign supplies formed the sole ostensible ground on which this committee proposed to alter the act of 1804. But after the fall of price in autumn 1813, and in the early part of 1814, it became obvious, on comparing our former prices with those of the Continent, that, without an alteration of the existing law, this dependence would be considerably increased; that a good deal of the poor lands, which the recent high prices had forced into cultivation, would have to be thrown into pasturage; and that rents would be materially reduced. These consequences alarmed the landlords and occupiers, and in the early part of the session of 1814 a series of resolutions were voted by the House of Commons, declaring that it was expedient to repeal the bounty; to permit the free exportation of corn, whatever might be the home price, and to impose a graduated scale of duties on foreign corn when imported. Thus, wheat imported when the home price was at or under 64s. was to pay a duty of 24s.; when at or under 65s. a duty of 23s.; and so on till the home price reached 86s. when the duty was reduced to 1s., at which it became stationary. Corn imported from the British colonies in North America was to pay only half the above duties. As soon as these resolutions were agreed to, two bills founded on them, one regulating the importation of foreign corn, and another repealing the bounty, and permitting unrestricted exportation, were introduced. Very little attention was paid to the last of these bills; but that which imposed fresh duties on importation encountered a very keen opposition. The manufacturers, and every class not directly supported by agriculture, stigmatized it as an unjustifiable attempt to keep up the price of food, and to secure excessive rents and large profits to landlords and farmers, at the expense of the consumers. Meetings were generally held, and resolutions entered into strongly expressive of this sentiment, and dwelling on the fatal consequences that a continuance of high prices would have on our manufactures, in a season of peace, when we could no longer monopolize the commerce of the world. This opposition, coupled with the indecision of ministers, and perhaps, too, with an expectation, on the part of some of the landlords, that prices would speedily rise, without any legislative interference, caused the miscarriage of this bill. The other was passed into a law.

Proceedings respecting the alteration of the corn laws in 1814.

Committees of both houses of parliament were appointed in 1814 to examine evidence and to report on the state of the corn trade; and a great number of the most eminent agriculturists were in consequence examined. The witnesses were unanimous in this only, that the protecting prices fixed by the act of 1804 were insufficient to enable the farmers to make good the engagements into which they had subsequently entered, and to continue the cultivation of the inferior lands lately brought under tillage. Some of them thought 120s. ought to be fixed as the limit when wheat might be imported free of duty; others varied from 90s. to 100s.; others from 80s. to 90s.; and a few from 70s. to 80s. The general opinion, however, seemed to be that 80s. would answer; and, as prices continued to decline, a set of resolutions, founded on this assumption, were sub-

Report on the corn trade and laws, presented in 1814.

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mitted to the House of Commons by Mr Robinson (now Lord Goderich), and having been agreed to, a bill founded on them was, after a very violent opposition, carried in both houses by immense majorities, and finally passed into a law (55th George III. c. 26).

History of corn laws from 1815 to 1828.

The agriculturists confidently expected that this act would immediately raise prices, and render them steady at about 80s. But, for reasons which will be afterwards stated, these expectations were entirely disappointed; and there has been a more ruinous fluctuation of prices since 1815, when it was passed, than in any previous period of our recent history. In 1821, when prices had sunk very low, a committee of the House of Commons was appointed to inquire into the causes of the depressed state of agriculture, and to report their observations thereupon. This committee, after examining a number of witnesses, drew up a report, which, though not free from error, is a very valuable document. It contains a forcible exposition of the pernicious influence of the law of 1815, of which it suggested several important modifications. These, however, were not adopted; and as the low prices and consequent distress of the agriculturists continued, the subject was brought under the consideration of parliament in the following year. After a good deal of discussion, a new act was then passed (3d Geo. IV. cap. 60), which enacted, that, after prices had risen to the limit of free importation fixed by the act of 1815, that act was to cease, and the new statute to come into operation. This statute lowered the prices fixed by the act of 1815, at which importation could take place for home consumption, to the following sums, viz.

	For Corn not of the British Possessions in North America.	For Corn of the British Possessions in North America.
Wheat	70s. per quarter.	59s. per quarter.
Rye, peas, and beans	46s.	39s.
Barley, bear, or big	35s.	30s.
Oats	25s.	20s.

But in order to prevent any violent oscillation of prices from a large supply of grain being suddenly thrown upon the market, it was enacted, that a duty of 17s. a quarter should be laid on all wheat imported from foreign countries during the first three months after the opening of the ports if the price was between 70s. and 80s. a quarter, and of 12s. afterwards; and if the price was between 80s. and 85s. the duty was to be 10s. during the first three months, and 5s. afterwards; and if the price should exceed 85s. the duty was to be constant at 1s.; and proportionally for other sorts of grain.

This act, by preventing importation until the home price rose to 70s. and then loading the quantities imported between that limit and the limit of 85s. with heavy duties, was certainly more favourable to the views of the agriculturists than the act of 1815. But, unluckily for them, no species of corn except barley was sufficiently high while this act existed to bring it into operation.

In 1825, the first approach was made to a better system, by permitting the importation of wheat from British North America, without reference to the price at home, on payment of a duty of 5s. a quarter. But the act for this purpose was passed with difficulty, and was limited to one year's duration.

Owing to the drought which prevailed during the summer of 1826, there was every prospect that there would be a great deficiency in the crops of that year; and in order to prevent the disastrous consequences that might have taken place had importation been prevented until the season was too far advanced for bringing supplies from the great corn markets in the north of Europe, his majesty was authorized to admit 500,000 quarters of foreign wheat, on payment of such duties as the order in council for its importation should declare. And when it was ascertained that the crops of oats, peas, &c. were greatly below an average, ministers issued an order in council, on their own responsibility, on the 1st of September, authorizing the immediate importation of oats on payment of a duty of 2s. 6d. a boll, and of rye, peas, and beans, on payment of a duty of 3s. 6d. a quarter. A considerable quantity of oats was imported under this order, the timely appearance of which had no doubt a considerable effect in mitigating the pernicious consequences arising from the deficiency of that species of grain. Ministers obtained an indemnity for this order in the subsequent meeting of parliament.

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Nothing could more strikingly evince the impolicy of the acts of 1815 and 1822 than the necessity under which the legislature and government had been placed of passing the temporary acts and issuing the orders alluded to. The more intelligent portion of the agriculturists began at length to perceive that the corn laws were not really calculated to produce the advantages they had anticipated; and a conviction that increased facilities should be given to importation became general throughout the country. The same conviction made considerable progress in the House of Commons; so much so, that several members who supported the measures adopted in 1815 and 1822 expressed themselves satisfied that the principle of exclusion had been carried too far, and that a more liberal system should be adopted. Ministers having participated in these sentiments, Mr Canning moved a series of resolutions, as the foundation of a new corn law, on the 1st of March 1827. These resolutions bore that foreign corn might be imported, at all times, free of duty, for warehousing; and that it should always be admissible for home consumption on payment of certain duties. Thus, in the instance of wheat, it was resolved that, when the home price was at or above 70s. a quarter, the duty should be a fixed one of 1s. a quarter; and that for every shilling that the price fell below 70s. a duty of 2s. should be imposed; so that, when the price was at 69s., the duty on importation was to be 2s.; when at 68s. the duty was to be 4s. and so on. The limit at which the constant duty of 1s. a quarter was to take place in the case of barley was originally fixed at 37s.; but it was subsequently raised to 40s.; the duty increasing by 1s. 6d. for every shilling which the price fell below that limit. The limit at which the constant duty of 1s. a quarter was to take place in the case of oats was originally fixed at 28s.; but it was subsequently raised to 33s., the duty increasing at the rate of 1s. a quarter for every shilling that the price fell below that limit. The duty on colonial wheat was fixed at 6d. the quarter when the home price was above 65s.; and when the price was under that sum, the duty was constant at 5s.; the duties on other descriptions of colonial grain were similar. These resolutions were agreed to by a large majority; and a bill founded on them was subsequently carried through the House of Commons. Owing, however, to the change of ministers which took place in the interim, several peers originally favourable to the bill, and some even who assisted in its preparation, saw reason to become amongst its most violent opponents: a clause interdicting all importation until the home price exceeded 66s. having been carried in the Lords, ministers gave up the bill, justly considering that such a clause was entirely subversive of its principle.

A new set of resolutions with respect to the corn trade were brought forward in 1828 by Mr Charles Grant. They were founded upon the same principles as those which had been rejected during the previous session. But the duty was not made to vary equally, as in Mr Canning's resolu-

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tions, with every equal variation of price; it being 23s. 8d. when the home price was 64s. the imperial quarter, 16s. 8d. when it was 69s., and 1s. only when it was at or above 73s. a quarter; a difference of 4s. in the price making a difference of no less than 15s. 8d. in the duty. After a good deal of debate Mr Grant's resolutions were carried, and embodied in the act 9th Geo. IV. cap. 60.

The prices which governed the duties in this act were ascertained from the sales of corn in most of the principal towns of England. The dealers were bound, under a penalty for each omission, to make weekly returns of these sales to the corn inspectors resident in the different towns, who reported them to the comptroller of corn returns in London. The latter deduced from them a general average price, published weekly in the Gazette. Attempts have sometimes been made to falsify the average, by making reports of fictitious sales; but it is generally believed that the prices as reported have corresponded very closely with the real prices at the time.

Varying duties increase the risk of the corn trade.

Besides the objections which, it will be immediately shown, may be made to all protecting duties, from their tendency to force up average prices, and to render exportation in abundant years impossible, the duty imposed by the 9th Geo. IV. cap. 60 is liable to some weighty objections, which may be looked upon as peculiar to itself. From the way in which it was graduated, it introduced a new element of uncertainty into every transaction connected with the corn trade, producing a disinclination on the part of the merchant to import, and of the foreigner to raise corn for our markets. Suppose a merchant had commissioned a cargo of wheat when the price was at 71s. a quarter, in the event of the price declining only 3s. or to 68s., the duty rose from 6s. 8d. to 16s. 8d.; and if the merchant brought the grain to market he realised 13s. a quarter less than he expected, and 10s. less than he would have done had there been no duty, or the duty been constant!

It may perhaps be said, that if, on the one hand, the late scale of duties was injurious to the merchant when prices were falling, and when importation was consequently either unnecessary, or of less advantage, it was, on the other hand, equally advantageous to him, when prices were rising, and when the public interests required that importation should be encouraged. But the prices in the view of the merchant when he gives an order are usually such as he supposes will yield a fair profit; and if they rise, this rise would, supposing the duty to be constant, yield such an extra profit as would of itself encourage him to increase his importations to the utmost. If it were possible to devise a system that should diminish the losses of the merchants engaged in unfavourable speculations, by making a proportional deduction from the extraordinary gains of those whose speculations turn out to be unusually successful, something perhaps might be found to say in its favour. But the system we have been considering proceeded upon quite opposite principles; its effect was not to diminish risks, but to increase them; it added to the loss resulting from an unsuccessful, and to the profit resulting from a successful speculation!

It is plain, therefore, that if a duty be imposed, one that is constant is preferable to one that fluctuates. When the duty is constant, all classes, farmers as well as merchants, are aware of its amount, and can previously calculate the extent of its influence. But the effect of a duty that fluctuates with the fluctuations of prices can never be appreciated beforehand. Its magnitude depends on contingent and accidental circumstances, and it must, therefore, of necessity prejudice the interests of the farmer as well as of the corn-dealer.

The crops having been deficient in 1829 and 1830, there was a large importation of corn in these years, its average price being at the same time about 65s. a quarter. But the crops from 1831 to 1836 having been more than usually abundant, importation almost wholly ceased, and the price of wheat sunk in 1835 to 39s. 4d. a quarter, being less than it had been in any previous year since 1776. In consequence of this succession of good harvests and low prices, the corn laws ceased for a while to attract any considerable portion of the public attention, and an impression began to gain ground that the improvement of agriculture was so rapid, that, despite the increase of population and the existence of the corn laws, our prices would fall to about the level of those of the Continent. But the cycle of favourable seasons having terminated in 1837, the crops of that and the succeeding five years were considerably deficient; so much so, that prices rose in 1839 to 70s. 8d. a quarter, the importations in that and the three following years being also very large. This increase in the price of corn, combined with the depressed state of commerce, originating in the pecuniary revulsion in the United States, and other causes, again attracted a great deal of attention to the corn laws; and the oppressive magnitude and injurious operation of the duties were very strongly animadverted upon at public meetings in the manufacturing towns and elsewhere. An association, denominated the Anti-Corn-Law League, originally founded in Lancashire, but which subsequently extended its ramifications to most parts of the country, was set on foot for the express purpose of keeping up an incessant agitation against the corn laws, which, in consequence of these concurring circumstances, were assailed with greater bitterness than ever. The importance of the subject at length forced it on the attention of government; and in 1841, ministers, actuated partly by a sense of the mischievous influence of the sliding scale, and partly also by a wish to strengthen their declining popularity, brought forward a plan for remodelling the corn laws, by repealing the sliding scale, and imposing in its stead a constant duty of 8s. a quarter on wheat, and in proportion on other grain. But, having no majority in parliament, ministers were obliged to resort to a dissolution; and their proposal having, notwithstanding its moderation, excited the greatest apprehensions among the agriculturists, without being very warmly supported by the other classes, a new parliament was returned, which gave a decided majority to the opposition. It was, however, felt on all hands to be necessary to make some considerable change in the existing law, and in 1842 a measure was introduced in that view by Sir Robert Peel, which was subsequently passed into a law, 5th Vict. 2d Sess. cap. 14.

History of the Corn Laws. History of the corn laws from 1828 to 1846.

Unfortunately, however, this measure, like that by which it was preceded, was bottomed on the principle of making the duties vary with the variations in the price of corn; and though the duties were decidedly less oppressive than those imposed by the 9th Geo. IV. cap. 60, still they were in no ordinary degree objectionable, as well from their too great magnitude as from their adding to the natural insecurity of the corn trade, and increasing the chances and severity of fluctuations. It is not, therefore, to be wondered at that the new measure gave but little satisfaction. Instead of being abated, the agitation and clamour against the corn laws continued progressively to gain strength; and the conviction began at the same time gradually to extend itself among many of those by whom these laws had hitherto been supported, that farther modifications would have to be made in them, and that they might be made without inflicting any very serious injury upon agriculture.

This conviction was greatly strengthened by the result of the important changes made by Sir Robert Peel in the

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tariff in 1842, and more especially by those which had reference to the importation of live cattle and fresh provisions. These had previously been prohibited; but the minister proposed that this prohibition should be repealed, and that their importation should be permitted under reasonable duties. This proposal, when first brought forward, excited the greatest apprehensions among the farmers and graziers, and was followed by an immediate fall in the price of cattle. Happily, however, the measure was carried, and it was speedily discovered that there was no such difference between the prices of cattle of the same quality here and in the adjacent parts of the Continent as had been supposed, and that the fears entertained by the agriculturists of the approaching ruin of the businesses of breeding and grazing were altogether visionary and unfounded. The experience afforded by the reduction and subsequent abolition of the duty on wool was exactly similar. Instead of being injured, the interests of the British sheep farmers were promoted by these measures, the demand for home-grown wool having been rendered comparatively steady, and its price considerably increased by the stimulus which the change in the duty on foreign wool gave to the woollen manufacture.[1]

In the following year, that is, in 1843, a measure was adopted, which made a wide breach in the corn laws. In 1842 the Legislature of Canada passed a law, imposing a duty of 3s. a quarter on all wheat imported into the province, unless from the United Kingdom, stating, in the preamble to this act, that it was passed in the expectation and belief that a corresponding reduction would be made in the duties on wheat and wheat-flour imported into the United Kingdom from Canada. And conformably to this anticipation, the act 6th and 7th Vict. cap. 29, passed in 1843, reduced the duty on wheat imported from Canada to 1s. a quarter, and proportionally on wheat-flour. This act met with much opposition from a part of the agricultural interest in this country, who contended that it would lead to the introduction of unlimited supplies of corn from the United States, at a duty of only 4s. a quarter, or, allowing for smuggling, at perhaps only half that amount. But experience showed that these anticipations were not likely to be realised; for, though the imports from Canada were materially increased, the obstacles in the way of the importation of corn from the United States into Canada, and the danger and expense of the voyage from Montreal or Quebec to England, must necessarily have prevented the importation through this channel from ever becoming of much importance. Still, however, the measure was in so far an abandonment of the corn laws; and if we were justified in admitting the produce of the United States to our markets in this indirect way, it was not easy to discover satisfactory grounds on which to exclude the produce of other States.

The success of the measures adopted in 1842 encouraged Sir Robert Peel to attempt still more considerable changes in 1845, when he abolished the customs' duties on about 420 articles, some of which were of very considerable importance. The measures then adopted were equivalent, in fact, to the virtual abandonment of the protective system; and, under such circumstances, it could not be expected that the corn laws, on which so serious an inroad had been made by the Canada act, would be able to maintain their place on the statute-book for any very lengthened period.

They might, however, have been continued for some time longer, had not the unsatisfactory corn harvest, and the failure of the potatoe crop of 1845, made it necessary to adopt measures for averting the anticipated deficiency in the supplies of food. Under the critical circumstances in which the population was then believed to be placed, the temporary suspension of the corn laws could hardly have been avoided; but, if once suspended, their re-enactment would have been all but impossible, and it was better, perhaps, by at once providing for their repeal, to make an end of the system, and of the dissatisfaction and agitation to which it had given birth, than to endeavour to continue it in any modified shape. Such was the view of the matter taken by Sir Robert Peel; and he fortunately succeeded, despite difficulties that none else could have overcome, in carrying the act 9th and 10th Vict. cap. 22, for the immediate modification of the corn laws, and for their total repeal at the end of three years, or on the 1st February 1849. From that date wheat and other corn will be subjected, on importation, to a fixed duty of 1s. a quarter; and flour and meal, of all sorts, to a fixed duty of 4½d. a cwt.

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Irish corn laws

The policy on which the corn trade of Ireland was conducted during the last century, was not materially different in its principles from that followed in Great Britain. In 1707 the Irish parliament granted, by a statute framed in imitation of the English act of 1689, a bounty of 1s. 6d. per quarter on every quarter of wheat exported when the price was at or under 14s.; of 1s. on the quarter of barley, bear, or big, when at or under 10s.; and of 1s. on the quarter of oats when at or under 9s. This act, however, did not by any means place the Irish agriculturists on the same footing with those of Great Britain. The bounty scarcely exceeded a fourth part of what had been granted in this country; and Mr Newenham has shown, that the prices, when it became payable, were fixed much below the average rate at the time. (*Natural and Political Circumstances of Ireland*, p. 124.)

Though we are very far from imagining that Ireland lost any thing by this different treatment, it shows the spirit which influenced, at that period, the English Government in its conduct towards that country. If bounties were really beneficial, as they were then supposed to be, Ireland had a right to every advantage that could be derived from them. We had just succeeded in putting a stop to her rising progress in the woollen manufacture; and if the government of England, and its dependents in the Irish parliament, had not been actuated by an illiberal jealousy of Irish agriculture, as well as of Irish manufactures, the same encouragements to cultivation would doubtless have been held forth in both countries.

The bounty continued to be regulated by the act of 1707 till 1755, when its mode of payment was changed, but the amount remained nearly the same. In the reign of George III., however, a different policy was adopted, and several consecutive laws (5th Geo. III. cap. 19, 13th and 14th Geo. III. cap. 11, 19th and 20th Geo. III. cap. 17) were enacted, by which the bounties were greatly enlarged. At last, in 1784, the statute 23d and 24th Geo. III. cap. 19, was passed, by which a bounty of 3s. 4d. was granted on every barrel of wheat weighing twenty stone exported when the home price was at or under 27s.; of 1s. 7d. on the barrel of barley, bear, and big, weighing sixteen stone, when at or under 13s. 6d., and of 1s. 5d. on the barrel of oats, weighing fourteen stone, when at or under 10s. These high bounties, coupled with the prohibitory duties imposed at the same time on importation, amounting to 10s. the barrel on wheat when

Bounty act of 1784.

[1] The late fall in the price of wool has had nothing to do with these measures, but has been wholly a consequence of the vast and rapidly increasing importations from our Australian colonies. These have reduced the price of wool, not in this country only, but generally throughout the commercial world.

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the home price was at or under 30s., on barley 10s. when at or under 14s. 6d., and on oats 5s. when at or under 11s., gave an extraordinary stimulus to cultivation, and soon caused a very great increase of tillage, and of the exports of corn from Ireland.

Effects of the bounty act of 1784.

It is extremely doubtful, however, notwithstanding the encomiums which have been lavished on the act of 1784 by Mr Newenham and others, whether the increase of tillage it occasioned has not been really prejudicial. If the agriculture of Ireland had been improved, if more produce had been obtained with less labour than formerly, and if the cottage system, the bane of that kingdom, had been losing ground, it might have been justly contended that the immediate effects of the bounty had been beneficial; but it has not had, and could not rationally be expected to have, any such consequences. "Perhaps," says Mr Wakefield, "I shall be told that Ireland, under the present system, is improving, and that rents of late years have considerably risen. Rents will rise by an extension, as well as by an improvement of tillage; they will rise from an increase in the price of produce; and it is well known that they have risen in consequence of an enlargement of circulating medium. To these causes I ascribe the latter circumstance, the truth of which I fully admit, though I absolutely deny the former. If any one will show me farming buildings of a late erection, or point out a single plough of a proper construction, in the hands of an Irish farmer, whose only means of support is the cultivation of the soil, I will allow that some improvement has taken place. Is any competent judge prepared to say, that fewer acres in proportion to the whole tillage land, are cultivated with the spade, than there were twenty years ago? Some, perhaps, may consider this system as beneficial, by affording employment to the people; but it might be observed, on the other hand, that to count the grains of wheat in every barrel would furnish them employment also. In every case of this kind we ought to look to the result, for employment is useful only as it becomes productive." (*Account of Ireland, Statistical and Political*, vol. i. p. 582.)

Mr Wakefield is quite correct. By suddenly raising prices, the bounty certainly stimulated the cultivation of the soil; but the want of capital, and the consequent difficulty of finding farmers capable of taking large farms, coupled with the general predilection of the Irish people in favour of small ones, conspired to cause a still more minute division of property, and to give a factitious stimulus to population. The fact of an increase having taken place in the numbers of a people (and it is on this that Mr Newenham principally relies when contending for the favourable effects of the bounty), does not by itself authorise the inference that it has been really beneficial. Were it possible, and we trust it is not, to give the English and Scotch peasants the same habits as those of Ireland, to render them satisfied with potatoes, mud cottages, rags and wretchedness, their numbers would rapidly increase; but their situation would, at the same time, be altered very much for the worse. In the same way, if we could inspire the people of Ireland with that taste for comforts, cleanliness, and good living, which so honourably distinguishes the people of England, their numbers would perhaps be diminished, but their social condition would be rendered far more enviable than at present. More happiness, more enjoyment, more, in short, of every thing that is either desirable or praiseworthy, will be found in a country occupied by a comparatively small number of well fed, well clothed, and well educated inhabitants, than are to be found in a nation peopled with myriads of human beings pressing against the limits of subsistence, and sunk in sloth and poverty.

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To endeavour to impress on the minds of the lower classes the propriety of being contented with the simplest and cheapest fare, is generally pernicious to the best interests of mankind. Encomiums should not be bestowed on those who are satisfied with mere necessaries. On the contrary, such indifference ought to be considered as disgraceful. A taste for the comforts, the enjoyments, and the luxuries of life, should be as widely diffused as possible, and, if possible, interwoven with the national character and prejudices. This, as it appears to us, is the best mode of attempting to meliorate the condition of the lower classes. Luxurious and even wasteful habits are incomparably better than that sluggish apathy, which would content itself with what can barely continue mere animal existence. "In those countries," Mr Ricardo judiciously observes, "where the labouring classes have the fewest wants, and are contented with the cheapest food, the people are exposed to the greatest vicissitudes and miseries. They have no place of refuge from calamity; they cannot seek safety in a lower station; they are already so low that they can fall no lower. On any deficiency of the chief article of their subsistence, there are few substitutes of which they can avail themselves, and dearth to them is attended with almost all the evils of famine."

The corn law of 1804, the first framed subsequently to the union, extended to Ireland; and the price at which the bounty became payable on the exportation of wheat from that country was raised to 29s. 4d. per barrel, and of rye to 20s. 4d.; the price at which the bounty was given on the exportation of oats remained the same, and very little alteration was made in the amount of the bounties themselves.

Act of 1806, establishing freedom in the corn trade between Britain and Ireland.

The shackles which an absurd policy had at different times (see 33d Geo. III. cap. 65, 42d Geo. III. cap. 35, 44th Geo. III. cap. 65, &c.) imposed on the transport of corn between Great Britain and Ireland, were not removed by the act of 1804. They were, however, abolished very soon after. The act of 1806 (46th Geo. III. cap. 97) established a perfect freedom in the corn trade between the two great divisions of the empire; and contributed more perhaps to the general advantage and prosperity, than any other enactment framed in the reign of Geo. III. The law of 1828, and the 9th Geo. IV. cap. 60, regulating importation from abroad, and the subsequent acts having the same object in view, have all extended to Ireland.[1]

II. PRINCIPLES OF THE CORN LAWS.

Having completed this sketch of the history of the corn laws, we shall now briefly examine the principles on which they have been founded. And as there no longer exists any difference of opinion as to the propriety of giving an unbounded freedom of exportation, we shall confine our inquiries, 1st, to the policy of encouraging this exportation by means of a bounty; and, 2d, of laying restrictions on importation.

That this subject may be properly understood, it is necessary to premise that the average value of corn, like that of every other commodity, is regulated, in every stage of society, *by the greater or less quantity of labour necessary to its production under the most unfavourable circumstances.*[2] A bushel of wheat may be obtained from the

[1] Our readers will find a very ample and instructive discussion respecting the inland bounty on the importation of corn into Dublin, in the Appendix to Mr Young's *Tour in Ireland*.

[2] For a complete demonstration of this important and fundamental principle, see Mr Ricardo's *Principles of Political Economy and Taxation*.

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Circumstances regulating the exchangeable value of raw produce.

rich soils of Essex, Kent, or the Carse of Gowrie, at a half or a third part of the expense necessary to produce it in less favoured situations, and might therefore be sold for a half or a third part of the price of the other. But if the demand be such as requires the cultivation of inferior lands, the price of the produce of such lands is elevated so as to admit of the ordinary profits of stock being realised by their cultivators. For were it not raised thus high, the cultivation of inferior lands would be abandoned, and the necessary supplies of food would no longer be obtained.

In the earlier stages of society, and wherever the population is very limited, the best lands only are cultivated; and as they yield a large produce with comparatively little labour, its value is proportionally low. But as society advances, and the density of population increases, recourse must be had to inferior soils. A greater expenditure of capital and labour is then required to produce the same quantity of corn; and, of course, its value, compared with other commodities, in the production of which no additional quantity of labour has been required, is increased.

The raising of raw produce differs, therefore, from any other species of industry. In manufactures, the worst machinery is first set in motion, and every day its powers are improved; and it is rendered capable of yielding a greater amount of produce with the same expense. The discovery of a new machine, or of a more expeditious and less expensive mode of manufacturing, very soon supersedes the older and clumsier machinery previously in use; while the consequent competition never fails to reduce the price of commodities to the sum which the least expensive method of production requires for their manufacture.

In agriculture, on the contrary, the best machines, that is, the best soils, are first brought into use; and recourse is afterwards had to inferior soils, requiring a greater outlay of capital and labour to produce the same supplies. Improvements in the construction of farming implements, and in agricultural management, reduce the price of raw produce: and, operating like improvements in manufacturing machinery, so far assimilate the two species of industry. Any fall, however, which may take place in the price of raw produce, as it enables every class of society to procure a greater quantity of it than before, in exchange for their commodities or their services, raises the profits of stock, and leads, of course, to an increased accumulation of capital. But "this accumulation necessarily leads to a greater demand for labour, to higher wages, to an increased population, and consequently to a further demand for raw produce, and to an increased cultivation." (Ricardo, *Principles*, &c., p. 79.) Agricultural improvements check, for a time, the necessity of having recourse to inferior soils; but the check is only temporary. The stimulus which they at the same time give to population, equalizes, in the end, the demand with the supply, and, by a re-action of a different kind, raises prices, and forces the cultivation of poor lands.

The value of raw produce, therefore (though improvements in agriculture, and other circumstances, occasionally reduce it), naturally tends to rise as society advances. As it becomes more difficult to raise food, it necessarily exchanges for a greater quantity of other products. Not merely its nominal, but its real price is increased; and no person can have the same command over it as before, without making a proportionally greater sacrifice of labour, or of some other equivalent.

This circumstance, and not the accumulation of capital, by raising wages, reduces the profits of stock, and checks, or at least retards, the progress of all old settled and populous countries. The cost or real value of a commodity not being regulated by the price at which the labour required for its production is paid, but by the quantity of that labour, every increase in the wages of workmen obviously lessens the share of the commodity they manufacture which belongs to the capitalist, or, which is the same thing, it lessens the profits of stock. Principles of the Corn Laws.

Supposing the value of money to be invariable, and the quantity of labour necessary to produce L.1000 worth of gloves to remain the same, the gloves would continue to sell for that sum, whether the wages of the labour necessary to their production amounted to L.600, to L.800, or to L.900. The rise of wages, it must be remembered, is supposed to be quite general; and hence, if the L.1000 worth of gloves freely exchanged, before wages rose, for a certain quantity of boots, stockings, coats, &c., they would do the same afterwards, unless the labour expended on the other commodities had increased or diminished; for it is evident that a rise of wages which equally affects different commodities leaves their relative values unaltered.

An increase in the wages of labour always reduces the profit of stock.

If the rise of wages were not universal, and if the glove manufacturer alone had to pay 10 per cent. additional on the wages of his workmen, while the manufacturer of boots, stockings, coats, &c., paid only the former rate of wages, he would either obtain a greater quantity of these articles in exchange for gloves, or be forced to abandon his trade. Hence there would in no long time be an influx of labourers into the glove manufactory; and their increase in that department of industry, and consequent diminution in the rest would, in the end, adjust wages to the same level. And when this adjustment is effected, the exchangeable values of commodities are precisely the same as before a rise of wages. The glove manufacturer could not then say to the stocking manufacturer that he must have a greater quantity of stockings in exchange for gloves, because he paid a higher rate of wages, for the other would have it in his power to answer that the rise of wages affected him to exactly the same extent. Commodities would, therefore, continue to sell after the rise for the same price as before, but that price would be differently divided. A greater share would belong to the labourer, and a less to the capitalist, or, which is the same thing, the profits of stock would be diminished.

Fluctuations in the value of money obscure, but do not in any degree affect, the relation of profits and wages. A rise or a fall in the *real* wages of labour, the only one we are here considering, results entirely from a greater or less proportion of its produce going at one time to workmen, and at another to capitalists. When a greater share is assigned to the workmen, their wages are really augmented, and when a smaller share, they are as really diminished, whatever may be the state of *money* wages.

Effect of a high price of provisions on wages.

It has, indeed, been contended, that the price of labour has no connection with the price of food, and that the former, being regulated solely by the supply and demand, a rise in the price of corn does not necessarily cause any increase in the wages of labour, nor consequently any reduction in the profits of stock. But the cost of rearing and maintaining labourers, independent of all other considerations, determines the lowest limit to which the price of labour can permanently fall. In a manufacturing country the rate of wages is, no doubt, exposed to great fluctuations, and a stagnation may take place in trade at the same time that corn is rising, so that the labouring class may at once experience an increase in the price of provisions and a fall of wages. But if the rise in the price of corn be of a permanent nature, and if the demand do not occasion a corresponding rise in the price of labour, the principle of increase will be affected, and the number of

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workmen will be gradually reduced, until wages be raised to their proper level.

It may perhaps be objected, that in countries where labour is well rewarded, and where a third or two fifths of the wages of workmen suffice for the purchase of corn, an increase in the price of bread and meal would act rather as an inducement to retrench from what was not essentially necessary, than to diminish the rate of increase. Few, however, of the countries of Europe are in this situation; and as labourers constitute by far the greater portion of every society, no system of policy should be recommended which has any tendency to diminish their comforts. The experience of all ages has shown that a needy populace lose a just sense of their dignity and rights as men, and become depraved and riotous. It is in vain to expect industry where it does not meet with a suitable reward; men will not submit to privations and labour, unless in the hope of securing corresponding comforts.

If the number of labourers were suddenly increased when wages rise, or suddenly reduced when they fall, such fluctuations would have little influence over their condition. But the number of labourers, though not fixed, can, speaking generally, be increased or diminished only by slow degrees. When wages rise, the condition of the labourers is improved; for the stimulus given to population by such rise cannot have any sensible influence over the supply of labour for more than twenty years, and during this lengthened period the labourer has time to acquire improved tastes and habits; the standard of his enjoyments is raised; and he hesitates about marrying unless he supposes he can maintain his wife and children in the improved condition to which he has attained. The opposite circumstances take place when wages fall. The labourers are in that case obliged to economize; to descend, as it were, to a lower station, and to content themselves with inferior accommodations; so that when wages rise after having been for a considerable time depressed, a good deal of the influence of the rise, or perhaps the whole, is exhausted in elevating the labourers to the point whence they had been sunk by the fall.

Hence, in stating that money wages are determined by variations in the price of food and other necessaries, the proposition must be understood with its necessary limitations. There is in all cases a *vis inertiæ* to be overcome, that prevents any change of prices from having what may be considered its proper effect on wages. When the former rise, money wages do not immediately rise in the same proportion, nor do they immediately fall when prices fall. But they always vary in *the same direction*, and depend mainly upon, and are materially influenced by, each other.

If, therefore, speaking generally, a bounty on exportation, or a restriction on importation, raise the exchangeable value, or real price of corn, it will also raise the rate of wages. But as the exchangeable value of manufactured commodities is not enhanced by a rise in the price of labour, it is evident that the profits of stock, and the power of accumulating capital, must be diminished proportionally to the fictitious increase in the price of corn.

Effects of a bounty on the exportation of raw produce.

By extending the market for corn, when a bounty is first granted, the money price of raw produce is raised, and agricultural profits being elevated above the general level, there is an influx of capital from other departments, until they are again reduced. Thus far a bounty accomplishes its object, and gives at least a temporary stimulus to cultivation. If the newly employed capital render the same returns as the capital previously engaged in raising corn, its real price will not be increased. But, as we have already observed, this is not likely to be the case for any considerable period. Discoveries in agriculture may, for a while, prevent recourse being had to poor soils; but the constant increase of population will in the end force their cultivation. Now, the bounty has in this respect the same effect as an increase of population. Both increase the demand for corn; and as by this increase we are at length forced to employ inferior machinery, or worse land, in order to raise the additional supplies, their value must be augmented.

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Were the prices of corn in Britain and Spain, for example, nearly on a level, no exportation would take place from the one to the other. But if, when prices were in this situation, a bounty of 10s. per quarter were granted by our government, corn would be immediately poured from England into Spain. Limits would, it is true, be soon set to its exportation. The competition which takes place among exporters, as among every other class of traders, prevents their realizing more than the ordinary profits of stock, so that grain would be exported from England to Spain, not in the expectation of realizing the whole bounty as profit, but in the view merely of securing the *ordinary rate* of profit on the capital employed in its transfer. A rise of prices, though not to the whole extent of the bounty, would therefore immediately take place in this country, and a corresponding fall in Spain. And this rise and fall would not be temporary. Corn would be permanently cheaper in Spain, because the unusual cheapness of the foreign supplies would throw the poorest lands out of tillage; and it would be permanently dearer in England, because the increased demand would stimulate the bringing of them under cultivation. A bounty to the extent we have supposed would perhaps depress prices 5s. per quarter in Spain, and raise them as much in Britain. To the Spaniards it would be advantageous, inasmuch as it would enable them to obtain an indispensable necessary for less than it would otherwise cost; in Britain, however, its effects would be directly opposite. A few more of our heaths and bogs might be cultivated, but every class of persons, landlords only excepted, would find it more difficult to procure food than before. The higher price of corn (supposing it not to raise wages and diminish profits, which it would certainly do) would obviously be of no advantage, and could not enrich the public, since it would in the end be proportioned to the greater difficulty experienced in raising the additional quantity.

Every bounty is objectionable, as producing an unnatural distribution of the national capital; but a bounty on a manufactured commodity does not increase the quantity of labour necessary for its production, and does not, of course, raise its exchangeable value. In this respect, a bounty on the raising of raw produce is the most impolitic of any, inasmuch as it not only occasions a faulty distribution of capital, but also raises the cost of production, or real price of the article produced, and consequently lowers the rate of profit.

Bounties have no tendency to reduce the real price of corn by causing a glut of the market.

It has, however, been contended, that although the first effect of a bounty may be to raise prices, yet that, by attracting an unusually great capital to land, it ultimately causes a glut of the market, and a fall of price. That this statement may to a certain extent be consistent with fact, and that a glut of the market, sufficient to cause a *temporary* depression of prices, may be produced by a bounty, we do not mean to deny; but such depression cannot last for any lengthened period, unless the real price of corn, that is, unless the labour necessary for its production, be diminished.

When an unusual demand is experienced for corn, and capital is in consequence moving from manufactures to land, prices may subsequently be higher, lower, or the same as before. Their rise or fall depends entirely on the circumstance of equal quantities of this newly employed

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capital being less or more productive than the capital previously engaged in agriculture. The fresh capital cannot, however, be more productive, except from an improvement in the manner of working land, or from a saving of labour, which it is evident might take place without any bounty, and is not occasioned by it; and if it be expended unaccompanied by any such improvement, it will either raise prices or be in a great measure lost to the proprietors; for if the poorest soils in tillage do not yield the ordinary rate of profit, their cultivation will be abandoned.

In reference to a glut of the home market caused by a bounty, it may be observed that that will seldom happen, except in seasons when there is an extraordinarily luxuriant crop, and of course very low prices, in the country to which the grain exported by means of the bounty is usually sent. Were Great Britain *regularly* in the habit of exporting corn, either by a bounty or otherwise, to Spain, the *average* prices of both kingdoms would become nearly stationary, at a rate such, that the cost of a quarter of wheat in Spain would exceed that of a quarter in England, by the cost of its transport from the one to the other, including therein the profits of the capital employed, insurance, &c. But though such would be the case in ordinary years, it would be very different when there was any great diversity in the crops in either country. When prices suddenly fell in Spain, owing to a luxuriant harvest, exportation from England would as suddenly cease, and would not be renewed until the fall in this country, caused by the cessation of the foreign demand, had been as great as in Spain. A nation which exports corn is liable to fluctuations of price, not merely from the state of its own harvests, but also from those of its customers; and inasmuch as a bounty gives a factitious extension to exportation, it must also tend to render prices less steady.

Bounties increase fluctuations in the price of raw produce.

But supposing the accuracy of this statement to be admitted, it may still be contended, that a nation which exports an extra quantity of corn by means of a bounty, has at least a greater resource in years of scarcity than a nation in a different situation. This idea, however, though plausible, and to a certain extent correct, is in the main fallacious. If the deficiency of the crop did not exceed the ordinary quantity of corn exported, there would not certainly be any considerable rise of price; but if the deficiency exceeds that quantity, the situation of an exporting country must evidently be a good deal worse than that of a regularly importing one. In the latter, a slight rise of prices would occasion a greater importation than ordinary; but in an exporting country, prices must not only be raised by the whole cost of the carriage from foreign ports, but by an additional sum, sufficient to determine importation into new channels.

Thus, a deficiency of the crop of Poland, not exceeding the quantity of corn ordinarily exported from that country, would not have any material effect over prices; but no importation to make up for a larger deficiency could take place until prices had risen, not merely higher than ordinary, but decidedly higher than the prices of the countries to which Poland is in the habit of exporting.

Again, in seasons when there is a luxuriant crop in a country exporting by means of a bounty, it operates with double effect, and very little of the surplus is stored up to answer the home consumption in case of future exigencies. By forcing exportation, it hinders, as Dr Smith has observed, the plenty of one year from relieving the distresses of another, and therefore occasions, in years of scarcity, a greater importation than would otherwise be necessary.

Those who compare the prices in the subjoined tables from 1688 to 1766, during what may be called the period of the bounty, with the prices from 1766 to 1792, when the corn trade was comparatively free, will see that the foregoing conclusions do not depend on theory only, but are consistent with experience.

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We have now said enough to show the tendency of a bounty. The following remarks shall therefore be directed solely to the consideration of *restrictions on importation*; and as we have already shown that restrictions, wherever they prevent access to the cheapest markets, and thereby factitiously keep up the price of corn, tend, as well as the bounty, to diminish the profits of capital and to force it abroad, we shall now advert, *first*, to the security which the restrictive system is supposed to afford, of furnishing an independent and ample supply of provisions; and, *second*, to its influence in maintaining prices uniformly at a high level.

Restrictions occasion fluctuations, and afford no security for obtaining an independent supply of corn.

I. Where one nation has been for a series of years in the habit of importing corn from another, it must have exported some more acceptable produce as an equivalent. The farmers of the corn-growing country will, after this commerce is established, reckon as much upon the demand of the importing country, as on that of their fellow-subjects. They will cultivate an additional quantity of land, raise larger crops, and consequently pay higher rents, solely because they are assured of this vent for their produce. The benefits of this intercourse are therefore reciprocal, and the corn growers, as much as the corn buyers, are interested in the continuance of the traffic, and would suffer as much by its cessation. "When we consider," says Mr Ricardo, "the value of even a few weeks consumption of corn in England, no interruption could be given to the export trade, if the Continent supplied us with any considerable quantity of corn, without the most extensively ruinous commercial distress, distress which no sovereign, or combination of sovereigns, would be willing to inflict on their people; and, though willing, it would be a measure to which probably no people would submit. It was the endeavour of Bonaparte to prevent the exportation of the raw produce of Russia, more than any other cause, which produced the astonishing efforts of the people of that country against the most powerful force, perhaps, ever assembled to subjugate a nation." (*Essay on the Profits of Stock*, p. 19.)

But when a nation adopts a policy like that on which we have till lately acted, and refuses to admit any foreign corn, except when the home price reaches a height indicating scarcity, she must then, it is obvious, enter a market to which no corn has been brought, with a view to her demand. The difficulties we have occasionally experienced in importing have been greatly exaggerated; but they resulted more from the nature of our own policy respecting it, than from anything peculiar to importation. Perpetually fluctuating between bounties, restrictions, and prohibitions, no foreign country could ever rely on our continuing to import their corn. We might buy a million of quarters to-day, but we might buy no more for a couple of twelvemonths. Had our demand been steady, had we regularly imported, additional supplies would have been raised for our markets; rents would have been increased; and foreign farmers, landlords, merchants, shipowners, &c., would have been interested in procuring us whatever quantity of corn we might require; but hitherto we have entered the foreign market as strangers only. Our orders might be expected, but they could not be reckoned on. Whatever supplies we might procure were withdrawn from the *ordinary stock*; so that prices abroad were unnaturally raised, exportation checked, and the home price allowed to reach a comparatively great height.

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When a merely temporary liberty is granted to import, or when the duties on importation vary with the prices, the operations and the enterprise of merchants are alike cramped. They cannot safely order corn from *distant* countries, lest the price should fall before it arrives, and the ports be shut, or the duty have attained to a ruinous height. They are compelled to have recourse to countries in our immediate vicinity; their orders must be given on the spur of the moment, and all that consideration and combination necessary to insure the success of every complex transaction are unavoidably excluded.

The regulations laid down in 1815, and those enacted since, gave liberty to import and warehouse foreign grain duty free, for re-exportation or for home consumption, when the price reached the limit at which it was admissible; but this liberty was not of so much consequence as might be supposed. Corn is at once a bulky and a perishable commodity; and capitalists seldom employ large funds in importing it, unless there be at the time a strong probability that prices will very soon attain the limit when it may be sold. Corn will at all times be stored up for a market like that of Amsterdam, because it may be disposed of at the pleasure of the holder, and its sale is not dependent on any contingent circumstance. In this country the case has been different. An unforeseen change of weather often checked a rise of prices at the time that a further rise was confidently expected; and even the warehousing of any considerable quantity of foreign grain had of itself a similar though a less effect. By giving little freedom to mercantile operations, and preventing the importer from disposing of his commodity when he thought proper, this system, in ordinary years, tended to suppress warehousing altogether, and, consequently, tended to deprive the country of one of its main securities against a sudden rise of prices in deficient years.

It may be further observed, that the wider the surface from which a country derives its supplies of food, the less is it exposed to fluctuations of price arising from favourable or unfavourable seasons. A general failure of the crops of an extensive kingdom is a calamity that but seldom occurs. The weather that is unfavourable to vegetation in one species of soil, is frequently favourable to it in another. If moist clay lands suffer from a wet summer, the crops are rendered more luxuriant in dry rocky districts. The excess of produce in one province compensates for its deficiency in another; and, except in anomalous cases, the total supply is nearly the same. But if this be generally true of a single nation, it is *always* true of the world at large. No instance of universal scarcity darkens the history of mankind. It is constantly found, that when the crops of one country fail, plenty reigns in some other quarter. A free trade, that is, a trade without any duty, or with one that is fixed and constant, is alone wanted to guarantee a country like Britain, abounding in all the varied products of industry, in merchandise suited to the wants of every society, from the evils of scarcity. The nations of the earth are not condemned to throw the dice to determine which of them shall submit to be starved. There is always abundance of food in the world. To enjoy a constant plenty, they have only to lay aside their prohibitions and restrictions, and to cease to counteract the benevolent wisdom of Providence.

The case of Holland strongly corroborates the truth of this statement. In the days of her greatest prosperity she chiefly depended upon imported corn, and the prices at Amsterdam were extremely moderate, and, which is of infinite consequence, were steadier than in any other market of Europe. Even during the convulsions of the late war, and when her former commercial connections were almost all dissolved, prices fluctuated very little.

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II. But, independently altogether of the circumstances already alluded to, it is easy to see that oppressive restrictions on the importation of corn into a country like this necessarily occasion ruinous fluctuations of price, raising it sometimes far above, and at other times sinking it as much below, the common level.

Ability to export essential to equality of prices.

The ability to export is indispensable to the equality of prices in a country that grows nearly its own supply of corn; for, without such ability, all the increased produce of an unusually luxuriant harvest being thrown upon the home market, prices sink to such an extent as to inflict a serious loss on the agriculturists. But the mere absence of any legal obstacle will not insure the power of exportation. This may be about as effectually prevented by the influence of restrictions on importation, as by a prohibition of export. Suppose that a country, either more densely peopled, or less abundantly supplied with fertile land, than her neighbours, lays a restriction on importation, and that, in consequence, her average prices are raised 10s. or 15s. a quarter above those of the surrounding states: This increase of price will give such a stimulus to agriculture, that the corn produced at home may, and most probably will, at no distant period, become adequate to supply the consumption. But should such be the case, it is plain that the first unusually productive harvest will cause a glut of the home market; and that it will be impossible to set about relieving this glut by exporting to other countries, till prices fall to the foreign level—that is, till they sink 10s. or 15s. a quarter more than they would have done, but for the previous enhancement caused by the restriction on importation.

Such ability cannot exist in densely peopled countries, along with restrictions on importation.

The practical operation of the principle thus hypothetically stated, has defeated the expectations, and baffled all the efforts of the landholders of England to keep up prices since 1815. Owing to the extraordinary encouragement given by the high prices to agriculture during the latter years of the war, we grew, in 1811, 1812, and 1813, a sufficient supply for our own consumption, the imports in these years being fully balanced by the exports to the Peninsula on account of the British army. This showed conclusively that the restrictive system had attained its *maximum* degree of influence; and any one who attended to the circumstances might have foreseen that the first particularly luxuriant crop would inevitably occasion a heavy fall of prices. No one, however, seems to have taken this view of the matter; and, in consequence, the agriculturists entertained the most unfounded expectations of relief from the act of 1815. They imagined that the exclusion of foreign corn till prices reached 80s. a quarter, would make them immediately rise to that level, and prevent them from again sinking materially below it. Had the home supply been decidedly under the consumption, or had it been impossible to cultivate any considerable portion of the lands under tillage in 1813 at so low a rate as 80s., the anticipations of the agriculturists might have been realized; but such was very far indeed from being the case. The home production had become about equivalent to the demand; and experience proved that a price considerably under 80s. was sufficient to enable the culture of the greater part of the inferior lands, that had been broken up during the war, to be carried on. It is no doubt true, that a good deal of the fall of price in 1814 and 1815 was apparent rather than real, and resulted as much from the rise that then took place in the value of the currency, in consequence of the destruction of country bank paper, as from an increased supply of corn. Still, however, the fall in the value of corn, brought about by the rise in the value of money, contributed equally with that occasioned by increased production, to disappoint the agriculturists. The exclusion of foreign corn till the home

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price reached 80s., rendered its price in ordinary years, though considerably under that limit, a good deal higher than in the surrounding European countries. But when, as in 1816 and 1817, the crops were materially deficient, the restriction operated with increased efficacy, and powerfully contributed, in the way already pointed out, to stint importation, and consequently to increase the pressure of the scarcity, and to raise prices. Unlooked for, however, as it certainly was, this effect of the restriction proved in the end quite as injurious to the agriculturists as to the other classes; for by adding materially to that rise of prices, which a scarcity must under any circumstances occasion, the stimulus it gives to agriculture is proportionally augmented; so that when a luxuriant crop again occurs, the market is much more overloaded than it would have been under a free system, and prices sink in a corresponding degree.

Owing partly to the deficient crop of 1816, but more to the obstacles in the way of importation, the price of corn in 1817 rose to 96s. 11d., and in 1818 to 86s. 3d. Now mark the effects of these high prices. They revived the drooping spirits of the farmers, who imagined that the corn laws were at length beginning to produce the effects anticipated from them, and that the golden days of 1812, when wheat sold for 126s. a quarter, were about to return! This, however, was only a transient gleam. The increased prices led to a fresh extension of tillage; improvements were recommenced with new energy; vast additional sums were expended upon the land; and these circumstances conspiring with luxuriant harvests, and the impossibility of exportation, sunk prices to such a degree, that they fell, in October 1822, so low as 38s. 1d., the average price of that year being only 44s. 7d.!

It is nugatory, therefore, to attempt to obviate the recurrence of periods of low prices and agricultural distress by imposing severe restrictions on importation. Freedom is, speaking generally, the only effectual security against injurious vicissitudes. Restrictions, unless they be of the most moderate description, and contrived with great care, occasion the very evils they are said to remove or palliate. If they prevent importation in ordinary years, and raise average prices above the common level, they make exportation in favourable seasons impracticable, till prices have sunk unnaturally low. This is a defect inherent in the exclusive system, which nothing but the adoption of the Dutch plan of destroying a portion of the produce of a plentiful harvest will ever be able to get rid of! Protection cannot be carried further than monopoly; and monopoly cannot sustain prices in abundant years in countries where the supply and consumption are nearly balanced, nor prevent the consequent destruction of agricultural capital, and the ruin of a large proportion of the agriculturists.

We should mistake, however, if we supposed that the injury resulting from a heavy fall of prices is confined to the agriculturists. It is idle, indeed, to imagine that a system ruinous to the producers can be otherwise to the consumers. A glut of the market, occasioned by luxuriant harvests, and the want of the power to export, cannot be of long continuance; for, while it continues, it can hardly fail, by distressing all classes of farmers, and ruining many, to check every species of agricultural improvement, and to lessen the extent of land in tillage. When, therefore, an unfavourable season recurs, the re-action is for the most part appalling. The supply, being lessened not only by the badness of the season, but also by a diminution of the quantity of land in crop, falls very far below an average, and a severe scarcity generally ensues. Injudicious restrictions on importation turn what ought to be a blessing into a curse. They make an abundant crop productive of injury to the farmer, and go far to render two or three such crops in succession sure forerunners of scarcity, and perhaps of famine!

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The principles now laid down are so obvious, and are so completely corroborated by the history of the period since 1814, that it is unnecessary perhaps to enlarge further on this part of our subject. But the following extract from a speech of Mr Huskisson in 1825, exposes the principal defects of the late system, in so forcible, and at the same time so popular a manner, that we shall take the liberty to lay it before the reader:

Mr Huskisson's opinion of the corn laws.

"He had always understood that the great desideratum in this important question was to provide for steady prices, and to guard against excessive fluctuations from the vicissitudes of trade. How did the present law provide for these ends? By limiting the markets from which we draw our supplies, by destroying the vent which we should otherwise have for our produce whenever we are blessed with a superabundant harvest, or by exposing us to an alternate fluctuation of high and low prices. To say of a system which affected the price of labour and the comforts of the labourer, and which cramped the resources, not only of the manufacturer, but of the farmer himself—to say of such a system, that it "worked well,"[1] was so completely refuted by the fact, that he was surprised that any man should be bold enough to make it. What did they think of its working well in 1822, when corn was as low as 38s. a quarter? Within two years and a-half the price of corn had varied from 112s. to 38s. a quarter. Such fluctuations deprived the farmer of all security, and converted his business into mere gambling. The man who engaged in a long lease could not at present be aware of the conditions on which he was taking it, nor of the results which it might produce upon his family arrangements. But this was not the only inconvenience of the system. Look at the situation in which we were placed when a bad harvest made it necessary for us to go to foreign markets. The price of corn immediately advanced then. The foreign government, seeing our demand for it, laid a tax upon the article; this further increased the price; and the result was, that our exchanges were suddenly altered, so that we obtained the required supply under the greatest possible disadvantages. He had heard it said, and by gentlemen who had reflected on the subject, that if we had great fluctuations, there was in them, notwithstanding, a *fair average price!* He wondered what this phrase meant when applied to the subsistence of the people. He should like to know how any gentleman accustomed to eat a good dinner every day would like to be kept a week without food, and to be supplied the next with twice as much as he wanted. Would he be satisfied with being told that he had got a fair average quantity of provisions for each day in the two weeks? He thought that the gentleman would not be satisfied; that he would find such an average system was neither wholesome to his constitution nor pleasant to his stomach." (*Debates, 28th April* 1825.)

The previous reasonings and statements have sufficiently established, *1st*, That a prohibition of importation into a country that would generally or occasionally import, occasions an increased cultivation of bad land, and by so doing tends to raise prices and to depress profits; *2d*, That such prohibition tends in so far to throw a country on her own resources, and lessens her ability to profit by the provision made by Providence for equalizing the deficiencies in the harvests of particular countries by a corresponding

[1] Alluding to the statement of a preceding speaker.

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surplus in others; 3*d*, That the prohibition of importation in ordinary years, by raising the average price of corn to a comparatively high level, renders exportation in a peculiarly abundant year impossible, till prices sink so as to be productive of great agricultural distress; and, 4*th*, That this distress, by defeating the plans of the cultivators, discouraging improvements, and lessening the quantity of land sown, tends materially to diminish the home supply; and when the produce of a year, diminished by these causes, happens also to be diminished by a bad season, the combined influence of the two is most disastrous, and there is both an enormous increase of price, and the severest pressure upon the industrious classes.

Such being the inevitable consequences of the restrictions hitherto imposed on the corn trade, it was surely high time that they should be abolished, and a return made to a free system. But we must guard the reader against supposing that this or any other system will suffice to prevent the public feeling the injurious effects of deficient harvests. It will palliate their influence, but it will do nothing more. Should the home supplies of corn under the new system be in ordinary years nearly or about equal to our consumption, we may expect prices to be comparatively steady; for, under such circumstances, we shall have little difficulty in procuring supplies from abroad to meet any deficiency (unless it be of an extraordinary character, as in 1847) in our home produce; and we shall also be able, without any very extraordinary sacrifice, to export the surplus of our crops in unusually productive years. But if we should in ordinary years import any very considerable portion of our supplies, the result of the new system will be less favourable. In that case an unusually luxuriant harvest, and still more a cycle of such harvests, would, by occasioning a glut of the market, and a heavy fall of price, be injurious at once to the agriculturists, and to those depending on them for employment; for, under such circumstances, they would not be able to export till prices had fallen from 12s. or 14s. to 15s. or 20s. a quarter below their usual level. And hence, as this contingency is neither impossible nor improbable, the advantage (as will be afterwards more fully shown) of imposing a moderate duty on importation, accompanied with a corresponding drawback on exportation.

Reasons why the restrictions on importation have not latterly been more injurious.

The restrictions imposed on the trade in corn during the ten or fifteen years preceding the change effected in 1846, were not nearly so injurious as they had previously been, or as they might, on theoretical grounds, have been expected to be. This modified action is wholly, or all but wholly, attributable, 1st, to the extraordinary improvement that has taken place in agriculture in Great Britain since the peace of 1815; and, 2d, though in a very inferior degree, to the increase in the imports of corn from Ireland.

Extraordinary improvement of agriculture in Great Britain.

I. It was for a while contended, that, owing to the fall of prices, agriculture declined materially after 1815, and in particular in the years immediately subsequent to 1820. This view of the matter was strongly supported in the *Report of the Agricultural Committee of* 1833; and it is but too certain that the fall in question involved very many persons, landlords as well as farmers, in very great difficulties; and in some districts, particularly in the southern parts of the island, there may have been, for a while, a pretty general decline. On the whole, however, there is incontestible evidence to prove, speaking of Great Britain generally, that the effects of the sudden and heavy fall of prices in 1814 and 1815, though severe at the time, were very soon overcome, and there has been an all but unparalleled improvement in agriculture since 1815 or 1820. How else could the extraordinary increase of population that has taken place in the interval have been provided for? and how else could the rental of England and Wales in 1842-3 have exceeded by L.5,836,627 its rental in 1814-15?[1] There was no increase, or at least none worth mentioning in a question of this sort, in the quantity of foreign corn retained for home consumption during the twenty years ending with 1840, as compared with the previous twenty years; and yet the population of Great Britain increased during that interval from 14,481,139 to 18,844,434! Now it is impossible that a result of this sort could have taken place without either a very great increase of agricultural produce, or a signal and almost unprecedented falling off in the demand for corn; but the latter supposition is out of the question. Instead of there being any decline in the consumption, there can be no manner of doubt that, speaking generally, the bulk of the population consume, at this moment, more corn, particularly wheat, than at any former period. In fact, wheaten bread has now almost entirely superseded every other sort of bread. The consumption of rye, barley, and oats in the northern and south-western parts of England, and in Wales, is reduced to a mere trifle. All classes subsist mainly on wheaten bread; and, during the last twenty years, there has been a growing indisposition to use even the inferior sorts of such bread. In Scotland the change has been still more decided than in England; and we believe we are quite within bounds, when we express our conviction that fully ten times more wheat is consumed in Scotland at present (1848) than in 1790.

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Imports from Ireland.

II. A part of the extraordinary increase in the home supplies of corn since 1820 has been derived, as stated above, from Ireland; but this part is not so great as is usually supposed. Previously to the recent failures of the potatoe crop (in 1845 and 1846), the annual importations of all sorts of corn from Ireland exceeded by about 1,500,000 quarters their amount in 1820. But between 1820 and 1845 we added about 5,400,000 individuals to the population of Great Britain only; at the same time that, at an average, the consumption of individuals has been materially increased, and that there has been a large increase in the number of horses—the great consumers of oats, the principal article of import from Ireland.

On the whole, therefore, it may be safely affirmed, that the soil and agriculture of Great Britain furnished, in 1846, food sufficient for the comfortable subsistence of at least *five millions* of inhabitants more than in 1820. Little, comparatively, of this wonderful result can be ascribed to the bringing of waste land into cultivation, or to the extension of tillage. It is principally a consequence of improved drainage, improved modes of management, and of the adoption of improved manures, processes, and implements. In proof of the extraordinary change that has taken place, we may mention that, in the wolds of Lincolnshire, the crops of turnips have become from *five* to *ten* times heavier within the last few years, from the application of bone manure to their culture; at the same time that there has been a proportional increase in the productiveness of other crops! Similar improvements, and in some instances quite as great, have been made in other parts of the country. It is gratifying, too, to know that the capacities of improvement are far from being anywhere exhausted. But what has been effected shows what may be done, were the productive energies of the more backward districts better developed by the extension of the improved practices of Norfolk, Northumberland, Lincoln, &c., to other counties. The granting of leases of a reasonable length, and the enforcing of proper conditions as to management, would be the most likely means to bring about so desirable a result.

[1] Descriptive and Statistical Account of the British Empire, 3d Edit. i. 553.

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Improvement of Ireland.

It is impossible, indeed, to say to what extent, under such circumstances, improvement might be carried.

Immense, however, as are the capacities of improvement in Great Britain, they are far exceeded by those of Ireland. The latter, indeed, owing to the humidity of the climate, is better suited for pasturage than for tillage. But any one who has ever been in Ireland, or is aware of the wretched state of its agriculture, and of the amazing fertility of its soil, must be satisfied that were an improved system of husbandry generally introduced, its exports could not fail to be vastly increased. And this may, perhaps, be fairly expected. The mendicant agitation by which Ireland has been so long distracted and disgraced has received a check; and it is to be hoped that such measures may be adopted as may be effectual for the permanent abatement of the nuisance. Till this be done, and till confidence be established, and a complete stop put to the subdivision of the land, the resources of the country cannot be developed. So long as the Catholics were treated as an inferior and degraded *caste*, neither tranquillity nor improvement of any kind could rationally be expected to grow up. Happily, however, this vicious policy has been wholly abandoned; and were adequate provision made for the Catholic clergy, every just ground of complaint on the part of the Irish would be removed. What Ireland now wants is a firm and consistent system of government, which, while it does justice to all classes, without either flattering or irritating popular prejudices, shall, with a strong hand, suppress all attempts at agitation, enforce the empire of the law, and give confidence to the capitalist, and to the landlord anxious to improve his estate. We are not prepared to say whether such a system of government can be established in Ireland without the suspension of some of those political privileges that may be safely entrusted to the people of England, but if not, they should be suspended. Security of life and property is the one thing needful in Ireland; and were it fully established, she might yet, perhaps, assume a respectable place among civilized nations, be distinguished for her agriculture, and be a stay and support, instead of a burden upon and a disgrace, to England.

Popular arguments in defence of the corn laws.

Perhaps the most imposing of the arguments urged against an unrestricted corn trade proceeds on the assumption, that ultimately every agricultural nation will manufacture for itself, and will cease purchasing from abroad. But surely it is not meant to be insinuated that, in the progress of society, there will be no interchange by different nations of manufactured commodities for raw produce. It is evidently impossible that such a state of things can exist unless the price of raw produce were everywhere the same. America may, and it is most probable *will*, at some future period, manufacture cotton goods for her own consumption, but while the cost of raising wheat is less or not more in that republic than in England, it will be sent hither when our crops are deficient, in return for some species of our produce. Nothing but the revival of the enactments of the thirteenth and fourteenth centuries, and prohibiting exportation altogether, can possibly prevent corn finding its way to those places where its value is greatest.

But supposing it were otherwise, is a system injurious to the community to be kept up for the sake of a particular class? The rents of landlords are not to be maintained at an artificial elevation by means that depress profits, and occasion an incessant alternation of glut and scarcity. It was not contended, when the steam-engine, or when Sir R. Arkwright's cotton-mill was introduced, that they should not be employed, because the old clumsy machinery would in consequence be superseded, and the capital vested in it lost. No such ridiculous notion was ever entertained: but in what respect would it have been more absurd than to persist, for the sake of a trifling advantage to landlords, in raising produce from inferior soils at home, if we may purchase supplies at a cheaper rate elsewhere? Why should not the best machinery be employed in raising corn as well as in spinning cotton? If an expenditure of L.1000 suffice to manufacture cottons or hardware at Glasgow or Birmingham, that will exchange for 400 or 500 quarters of Polish or American corn; and if the same sum, applied directly to the raising of corn, will not in this country yield more than 350 or 400 quarters, what folly can be greater than to continue so disadvantageous a production, and to refuse to buy corn from foreigners with manufactured goods? Were private interests in such cases not to give way to the general good, society would at once come to a stand, and mere routine take the place of genius and invention.

Principles of the Corn Laws.

The most popular defence of the corn laws, and the only additional one we shall notice, rests on the ground that, as exclusive advantages are granted to different manufactures, agriculture ought in justice to be placed in the same favoured situation. But it was long ago demonstrated that it cannot be for the interest of a state to manufacture at home when it may purchase cheaper abroad. If, therefore, any of our manufactures could not exist under a free system, it would be for the general advantage that they were abandoned, and the capital vested in them employed in some other way. We doubt, however, whether any of them can be truly said to be in this predicament. The duties on the importation of similar fabrics have been all either repealed or very greatly reduced since 1825, and none seem to have suffered by the change. On the contrary, they have continued to prosper more than at any former period. Even the linen and silk manufactures, the existence of which was formerly supposed to depend on prohibitive duties, have been vastly improved and extended since these were repealed, and the importation of linens and silks permitted under reasonable duties.

Unfounded expectations of manufacturers.

The expectations entertained by the manufacturers of the advantages to be realised from the repeal or modification of the corn laws, appear to have been singularly exaggerated. They believed that there would be a very large increase in the imports of corn, and a corresponding increase of the foreign demand for our manufactured goods. But no such increase of importation could be fairly anticipated, unless the average prices of corn in England had greatly exceeded those at which foreign corn might be imported, which has not been the case for some years past. And it is farther obvious, that were any very large proportion of our supplies of corn derived in time to come from abroad, there would be a like falling off in the supplies produced at home, and consequently, in the demand for manufactured goods by the home growers. A result of this sort would, however, be anything but advantageous to the manufacturers. Their immediate neighbours have always been, and will necessarily continue to be, their best customers. And though they might, perhaps, in the long run, be benefited by a heavy fall in the price of the corn raised at home, the influence that such fall would have in diminishing the home demand for their products, in adding to the pressure of the poor rates, and in reducing wages by the competition of the parties thrown out of agriculture, would, for a lengthened period, make the change most injurious to them. It is not, therefore, by any sudden or considerable fall of price, nor by the substitution of a foreign for a home demand for their produce, that the manufacturing classes will be benefited by the measures adopted in 1846; but by the greater equality of prices that may be expected to result from them, and the consequently diminished frequency and intensity of commercial revulsions.

Principles of the Corn Laws

Our heavy taxation, provided it be equally imposed, and the comparatively high wages of labour in this country, furnish no apology for the restrictive system. Equal taxes affect every part of the community, and do not fall heavier on the agriculturists than on any other class. It is only in the event of taxation being unequal, or of its pressing with greater severity on those engaged in a particular business than on their neighbours, that it affords an adequate ground for laying a duty on the importation of the produce of the overtaxed class, though it can never be a reason why it should be prohibited. Now it is contended that the agriculturists are in this predicament—that is, that the burdens laid on them exceed those laid on the manufacturing and commercial classes, and that they are in consequence entitled to have duties laid on foreign corn and other agricultural produce, when imported, sufficient to countervail the excess of taxes to which they are subject. This, however, has been strenuously denied; and it must be admitted that the question is not quite free from difficulty. But were this a proper place for entering upon such inquiries, it might, we think, be conclusively shown, that, owing to the various local and other direct and indirect burdens laid on the land, those occupying it are really subjected to heavier taxes than any other class. It is difficult, or rather, perhaps, impossible, to estimate with any degree of precision, what the *excess* of taxes laid on the agriculturist beyond those laid on manufacturers and merchants may amount to; but we have elsewhere shown that if we estimate it as making an addition of from 5s. to 7s. to the quarter of wheat, we shall not be far from the mark.[1]

When a duty is laid on the importation of foreign corn, for the equitable purpose of countervailing the peculiar duties laid on the corn raised at home, an *equivalent drawback* should be allowed on its exportation. "In allowing this drawback, we are merely returning to the farmer a tax which he has already paid, and which he must have, to place him in a fair state of competition in the foreign market, not only with the foreign producer, but with his own countrymen who are producing other commodities. It is essentially different from a bounty on exportations, in the sense in which the word bounty is usually understood (and as we have previously considered it); for by a bounty is generally meant a tax levied on the people for the purpose of rendering corn unnaturally cheap to the foreign consumer; whereas what I propose is, to sell our corn at the price at which we can really afford to produce it, and not to add to its price a tax which shall induce the foreigner rather to purchase it from some other country, and deprive us of a trade which, under a system of free competition, we might have selected."—(Ricardo on *Protection to Agriculture* p. 53.)

A duty accompanied with a drawback, as now stated, would not only, under the circumstances supposed, have been an equitable arrangement, but it would have been highly for the advantage of the farmers, without being injurious to any one else. The radical defect, as already shown, of the system followed from 1815 down to 1846, in so far at least as respects agriculture, was, that it forced up prices in years when the harvest was deficient, while it left the market to be glutted when it was abundant. But while the influence of a constant duty of 5s., 6s., or 7s. a quarter, would have done nothing to stint the market in bad years, it would, with the corresponding drawback, have assisted to relieve it, and to maintain prices at a fair level in years when the harvests were redundant.—(See *Post.*) It is surprising the agriculturists did not take this view of the matter. If they were entitled to a duty on foreign corn, on account of their being more heavily taxed than the other classes of their fellow-citizens (and they had no title to it on any other ground), they were also entitled to a corresponding drawback. And it admits of demonstration, that their interests, as well as those of the community, would have been better promoted by such duty and drawback than they ever could have been by any system of mere duties, how high soever they might have been carried.

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Interests of landlords identical with those of the rest of the community.

It is generally believed and alleged, that the landlords were deeply interested in the support of the former system of corn laws, and that they will be materially injured by its repeal. But though it is probable that many landlords are of this opinion, we look upon it as destitute of any good foundation. There is not at bottom any real opposition between the interests of the owners of land and those of the other classes. To borrow the just and forcible expressions of Sir Josiah Child,—"Land and trade are twins, and have always, and ever will, wax and wane together. It cannot be ill with land but trade will feel it, nor ill with trade but land will fall." To those only who take a superficial view of the question, their interests may seem to be opposed; but those who look ever so little below the surface, and reflect on the motives which stimulate the different classes to industry and enterprise, will be satisfied that they are really identical. What is the genuine, and, indeed, only effectual encouragement to agriculture? What is it that stimulates the occupiers to adopt the best system of cultivation, and to make the ground yield the largest crops? Does any one doubt that it is the demand of the other classes for their peculiar products? Flourishing manufactures and commerce are indispensable to a flourishing agriculture. To suppose that the latter should exist without the former, is to suppose that men may be industrious without a motive—that there may be an effect without a cause. But we have seen that the artificial enhancement of the price of corn lessens the rate of profit, and the power to accumulate capital, at the same time that it occasions its transfer to other countries. It must, therefore, be exceedingly injurious to the buyers of corn—that is, to those classes whose prosperity is essential to the prosperity of the agriculturists. Hence it is obvious that any advantage gained in the first instance by the landlords from a restriction on importation, can only be evanescent and illusory. It may be compared to the influence of doses of brandy or opium on the human body, which, while they intoxicate and exhilarate, enfeeble and shatter the constitution, occasioning premature old age and death.

No good grounds for supposing that the repeal of the corn laws will be injurious to the landlords or to agriculture.

But apart from general considerations, and looking at the question with reference merely to the immediate pecuniary interests of the landlords, we do not think they have much, if anything, to apprehend from the measure of 1846. It cannot be injurious to them, unless it should occasion such a reduction in the price of corn and other raw products as may affect rents; and if there be no good grounds on which to anticipate such a reduction, the measure will not be, even in this narrow point of view, adverse to the landlords.

Now, though this be a matter in regard to which there must necessarily be much uncertainty, we are entitled to say, that no reasons have hitherto been alleged for thinking that wheat of the average quality of that of England will be imported even in abundant years, under the new system, at less than from 42s. or 45s. to 48s. a quarter.[2] In years of extraordinary abundance the case may be different, but they are usually of rare occurrence, and, except when they follow for two or three years in

[1] M'Culloch's *Treatise on Taxation*, p. 191.

[2] For proofs of this, see *Post*, and the article *Corn Laws* and *Corn Trade*, in *Commercial Dictionary*.

succession, have little influence over average prices. The expenses of importing wheat into this country, and disposing of it to the millers, may be moderately estimated at from 10s. to 12s. and 14s. a quarter; so that, supposing its cost in the great shipping ports to be from 34s. to 35s. a quarter, it could not be imported and sold under the price specified above. But wheat of the same quality as English wheat is seldom so low as this, either at Dantzic or any other corn shipping port within a reasonable distance; and it is never so low when there is any considerable exportation. It is, no doubt, impossible to say what changes may take place in prices in the course of a few years. But looking at the rapid increase of wealth and population in the countries in the north of Europe, in those round the Black Sea, and in the United States, the presumption is not that prices will fall, but that they will rise.[1] But supposing that, under the new system, they are pretty constant at from 42s. or 45s. to 48s., it is quite clear its introduction can have no very serious influence over agriculture. The average prices of corn in England and Wales during the five years ending with 1835, were 52s. 8d., and during the five years ending with 1845, they were 54s. 9d. a quarter, being only from 6s. to 12s. a quarter above their future probable average range under a perfectly free system. Prices, indeed, were decidedly lower in 1834, 1835, and 1836, years of great agricultural improvement, than there is much probability of their being after the new system has been carried into full effect.

But suppose that prices should fall 10s. or 12s. a quarter, it is the greatest error to suppose that this fall would be productive of any material injury to agriculture. Prices, after allowing for the depreciation of the currency, were, during the five years ending with 1810, 83s. 3d. a quarter; they have since fallen so, that during the five years ending with 1845 they were only 54s. 9d. a quarter, being a fall of no less than 28s. 6d. a quarter in the interval. And yet, as already seen, there has been in the teeth of this immense fall, and coincident with it, an extraordinary improvement of agriculture, accompanied with a vast increase of production, and a very great rise of rent. And such being the case, despite a fall of 28s. 6d. a quarter, it would be contradictory to suppose that agriculture should sustain any very serious or, indeed, sensible injury from a farther fall of 8s. or 10s. or even of 12s. a quarter.

A duty on importation, with an equal drawback, would have lessened the risk attending the repeal of the corn laws, and been productive of various advantages.

At the same time, we are ready to admit that we should have preferred seeing this question settled, by imposing a low fixed duty of 5s., 6s., or 7s. a quarter on wheat and other grain in proportion, accompanied with a corresponding drawback. We make this statement on general grounds, and without any reference to the peculiar burdens that affect the agriculturists, though these should neither be forgotten nor overlooked.[2] In scarce years a duty of this description would fall wholly on the foreigner without affecting prices, or narrowing importation; for in such years the prices of corn are wholly determined by the demand and supply, without reference to the cost of the corn, including therein any reasonable duty with which it may be charged. The latter is then, in truth, deducted from the profits of the foreign grower or merchant, and its repeal would not sensibly affect prices. But, while in scarce years, when importation is necessary, the influence of a low duty is thus innocuous, it lessens or prevents importation in unusually abundant years, when the home supply is sufficient. The drawback by which it is supposed to be accompanied would then also come into play and facilitate exportation, so that their conjoined effect would be to hinder the overloading of the market, and consequently to prevent prices falling so low as to be injurious to the agriculturists and those dependent on them. And it must be borne in mind that the distress of the agriculturists never fails to react on the other classes. When the former are involved in difficulties, their demands for the products of the loom and of our colonial possessions are proportionally diminished, so that the market is glutted with manufactured goods, sugar, &c., as well as with corn. It is, indeed, uniformly found that the injury that is thus occasioned to the manufacturing and trading part of the community, very much exceeds all that they gain by the temporary fall in the price of raw produce. It is plainly therefore a capital mistake to suppose that the duty and drawback now referred to, would be advantageous only to the agriculturists. They would redound quite as much to the advantage of the other classes. And though this were less certain than it appears to be, still, in a matter of such importance as the welfare of agriculture, and of those dependent thereon, a wise government should be extremely cautious about taking any step, of the consequences of which it is not fully assured. But even if our limits permitted, it would be to little purpose to insist on these or any similar considerations. The pertinacity with which the agriculturists opposed every approach to a more liberal system, roused a spirit which would not be satisfied with anything short of a complete abandonment of all restrictions. The time for compromise and arrangement having been allowed to go by, government had to deal with an irritated and an unreasoning populace. *Cum ventre humano tibi negotium est nec rationem patitur, nec æquitate mitigatur, nec ulla prece flectitur populus.* (*Seneca de Brev. Vitæ c.* 18.) Under such circumstances, it was better, perhaps, to make an end of the matter, than by attempting to introduce any intermediate system, however well devised, to prolong, as it would have done, a sense of insecurity and the pernicious trade of agitation. The agriculturists need not, however, despond; they have little to fear from the downfal of the protective system. There is not, in as far as can at present be seen, any real room or ground for thinking that it will occasion such a fall of average prices as will do them any material injury; and should there be at any time so very abundant a season or cycle of seasons in this country and in the north of Europe as to threaten such a fall of prices as might give a serious shock to agricultural industry, the crisis may be averted by some temporary expedient. It is seldom, indeed, that a law enacted under the influence of popular excitement and enthusiasm can be advantageously maintained as a rule of national policy. The practical merits and defects of the arrangement made in 1846 will be gradually disclosed; and it will be the business of Parliament to adopt such measures as may be required to secure the former, and, in as far as practicable, to obviate the latter. And though we should not wish to speak confidently respecting any measure, the working of which must necessarily depend on so many contingencies, our impression is that the imposition of a reasonable fixed duty on corn, accompanied with an equivalent drawback, will be found to be possessed of the double advantage of yielding a considerable revenue, raised in the least burdensome manner, and of giving, at the same time, increased steadiness to prices and security to industry.

But without farther indulging in speculations, the correctness of which it must be left to time to decide, it appears at present to be abundantly certain that the notions current among us respecting the extreme cheapness of corn

[1] The population of Prussia, which amounted to 10,169,899 in 1816, had increased in 1846 to 16,112,948. The increase of population in the Russian provinces round the Black Sea, during the same period, has, we believe, been about as great.

[2] See *Treatise on Taxation*, by the author of this article, p. 190.

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in foreign ports, have no very solid foundation. Though generally sound in principle, and, most likely also, beneficial in its operation, there seem to be good reasons for thinking that the late measure will disappoint alike the fears of the one party and the expectations of the other. Indeed the chances are that the agriculturists will gain by the change, for it will teach them to depend for success on practical skill, science, and industry, and to cease to rely on custom-house regulations and parliamentary majorities; and it will give them increased security by identifying their interests in opinion as well as in fact with those of the public.

III. PRESENT STATE OF THE BRITISH CORN TRADE.

Quantity of corn produced and consumed in great Britain and Ireland.

It has sometimes been attempted to estimate the quantity of corn raised in a country, from calculations founded on the number of acres in tillage, and the average produce per acre. But no accurate account can be obtained of the extent of land under cultivation. It is perpetually changing from year to year; and the amount of produce varies, not only with the differences in the seasons, but with every improvement of agriculture. This method, therefore, has been very generally abandoned, and statisticians are now in the habit of estimating the growth of corn by its consumption. But although this is certainly the preferable mode, still the conclusions to which it leads are necessarily very loose. The consumption varies considerably from one year to another, according as the ability of the consumers to purchase happens to be greater or less. And supposing this to remain the same, the average quantity and species of corn consumed by each person can only be ascertained by approximation. Mr Charles Smith gave a great deal of attention to this important investigation (*Tracts on the Corn Trade*), and his estimate of our aggregate produce deserves particular attention, from its having been corroborated, in its more important particulars, by subsequent researches both at home and abroad, and from its forming the groundwork of almost all the estimates that have been more recently framed. Having taken the population of England and Wales in 1765 at 6,000,000, Mr Smith reckoned the consumers of each kind of grain, the quantity consumed by each individual, and hence the whole consumed by man, as follows:—

Estimated Population of England and Wales.			Average Consumption of each person		Consumed by Man. Quarters.
3,750,000	consumers	of wheat	1 qr.	each	3,750,000
739,000	ditto	of barley	1 3/8	ditto	1,016,125
888,000	ditto	of rye	1 1/8	ditto	999,000
623,000	ditto	of oats	2 7/8	ditto	1,791,225
				Consumed by man	7,556,350
				In addition to this Mr Smith estimated the wheat distilled, made into starch, &c.	90,000
				Barley used in malting, &c.	3,417,000
				Rye for hogs, &c.	31,000
				Oats for horses, &c.	2,461,500
				Total of home consumption	13,555,850
				Add excess of exports over imports	398,624
					13,954,474
				Add seed, *one tenth*	1,395,447
				Total growth of all kinds of grain in England and Wales in 1765	15,349,921

British Corn Trade. — Mr Charles Smith's estimate.

This estimate, it will be observed, does not include either Scotland or Ireland, and later inquiries have rendered it probable that Mr Smith underrated the population of England and Wales by nearly a million. The allowance for seed is also too small.

Mr Chalmers' estimate.

Mr Chalmers, availing himself of the information respecting the numbers of the people, furnished under the population act of 1800, estimated the total consumption of the different kinds of grain in Great Britain at that epoch at 27,185,300 quarters, whereof wheat constituted 7,676,100 quarters. The crops of 1800 and of 1801 being unusually deficient, the importation in these years was proportionally great; but excluding these scarcities, the total average excess of all sorts of grain imported from Ireland and foreign countries into Great Britain over the exports, had previously amounted to about a million of quarters, which, deducted from 27,185,300, leaves 26,185,300, to which, if we add *one seventh* as seed, we shall have 29,925,057 quarters as the average growth of Great Britain in 1800.

According to Dr Colquhoun, the consumption of corn in the united kingdom in 1814 amounted to about 35,000,000 quarters. We subjoin Colquhoun's estimate:—

Dr Colquhoun's estimate.

Species of Grain.	Estimated average of the Population of Great Britain and Ireland.	Each Person averaged.	Consumed by Man.	Consumed by Animals.	Used in Beer and Spirits.	Used in various Manufactures.	Total of Quarters.
		Quarters.	*Quarters.*	*Quarters.*	*Quarters.*	*Quarters.*	
Wheat	9,000,000	1	9,000,000	...	...	170,000	9,170,000
Barley	1,500,000	1¼	1,875,000	210,000	4,250,000	...	6,335,000
Oats	4,500,000	1½	6,750,000	10,200,000	...	...	16,950,000
Rye	500,000	1¼	625,000	59,000	...	1,000	685,000
Beans and Peas	500,000	1	500,000	1,360,000	...	...	1,860,000
Totals	16,000,000	...	18,750,000	11,829,000	4,250,000	171,000	35,000,000

But though this estimate be compiled with greater care, and be entitled to more confidence than most of those put forth by its author, it is in some respects grossly inaccurate. There can, for example, be no manner of doubt that the consumption of oats is underrated by at least 2,250,000 quarters, or by ½ quarter in the quantity assigned to each of the 4,500,000 individuals Dr Colquhoun supposed were fed on them. And besides underrating the consumption of oats, the learned Dr has made no allowance for seed, though it be unnecessary to say that the expenditure of corn as seed is as indispensable, and its consumption as effectual, as if it were employed in the feeding of men or of horses. Adding, therefore, to the 37,250,000 quarters which Colquhoun's estimate should have amounted to, ⅙th for seed, we have, on his data, 43,458,000 quarters for the total consumption of corn in the united kingdom in 1814.

But instead of a population of 16,000,000, which is assumed as the basis of the above estimate, the United Kingdom had, in 1852, a population of above 27,500,000. If, therefore, the estimate of Dr Colquhoun were accurate, and the consumption, as compared with the population, were about the same as in 1814, it should now amount to nearly 75,000,000 quarters. But during the last thirty years the proportion of wheat used as food has been materially in-

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creased; and at present the consumers of barley certainly amount to nothing like 1,500,000 individuals,—probably to not more than 250,000. The consumption of oats has also increased very materially, partly and principally from the great increase in the number of horses and their better keep, and partly, also, from the increase of population in Ireland; but it is abundantly certain that the expenditure of corn on the lower animals, and in breweries, distilleries, &c., does not now amount to anything like twice the quantity at which it was estimated by Colquhoun.

On the whole, we are inclined to think that the consumption of the various kinds of corn in the United Kingdom, exclusive of seed, might, in 1852-53, have been estimated as follows:—

	Qrs.	Total Qrs.
I. Consumed by man:—		
Wheat	15,500,000	
Oats, rye, and maslin (a mixture of rye and wheat)	10,650,000	
Barley for malting, food, &c	6,000,000	
Beans and peas as meal	700,000	
		32,850,000
II. Consumed by the lower animals:—		
Corn (principally oats) used in the feeding of horses and other animals, in distillation, manufactories, &c		16,370,000
Total consumed by man and the lower animals, &c.		49,220,000

But it appears from No. V. of the subjoined tables, that at an average of the seven years ending with 1852, the annual entries of foreign corn for consumption were, wheat and wheat flour 4,231,185 quarters, barley 870,786 do., oats and oatmeal 1,162,546 do., rye 99,510 do., peas 172,393 do., and beans 393,366 do.; making an aggregate importation of 6,930,798 quarters a-year. And, therefore, if from the annual consumption by man and the lower animals—amounting to 49,220,000 quarters—we deduct the above average annual importation, we have 42,289,202, or about 42,300,000 quarters, for the portion of such consumption supplied by the native corn of the United Kingdom; and adding to the latter a reasonable allowance for seed, we have about 50,000,000 quarters for the total average annual growth of all sorts of corn in the United Kingdom.

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The total entries of foreign corn in 1849 amounted to 9,538,705 quarters, being the largest quantity ever entered in any single year. Now as this quantity amounts to little more than $\frac{1}{5}$th part of the entire corn raised at home, it would seem as if the greatest importation could have but a very slight influence over prices. But it has been already shown that a very large proportion of the corn produced in the empire is never brought to market, being partly consumed by the agriculturists, and partly used as seed and in the feeding of farm horses, &c. And allowing for this, an importation of 7,000,000 quarters may be supposed to be equal to about $\frac{1}{7}$d part of the corn brought to market in ordinary years, and could not therefore fail to have a very powerful influence in alleviating the pressure of scarcity, and in reducing prices. It is also to be observed, that these importations are exclusive of a very large and almost wholly unprecedented importation of Indian corn and meal. Through the all but total failure of the potato crop in Ireland and its partial failure in Great Britain in 1846, and the efforts of government to supply the deficit, the imports of 1847, including those of Indian corn, afford no fair criterion of their probable amount in ordinary years. But the average aggregate imports during each of the last seven years, given in table No. V., may perhaps represent with tolerable accuracy their amount for some years to come. On the whole, however, the probability seems to be that they will be increased rather than diminished.

We give below an estimate, on which we have bestowed a good deal of pains, of the extent of land under the different descriptions of crops in the different divisions of the United Kingdom; of the average produce per acre of such crops, with their total produce, value, &c.

Account of the Extent of Land in the United Kingdom under the principal Descriptions of Crops in 1852–53 *; the average Rate of Produce per Acre; the total Produce; the Amount of Seed; the Produce under deduction of Seed; and the total Value of such Produce.*

	Crops.	Acres in Crop.		Produce, per Acre.	Total Produce.	Seed 1-7th of Produce.	Produce under Deduction of Seed	Price per Quarter.	Total Value.	
England.	Wheat	3,000,000		Quarters. 3¾	Quarters 11,250,000	Quarters. 1,607,143	9,642,857	45s.	L. s. d. 20,696,428 5 0	L. s. d.
	Barley	1,000,000		4½	5,400,000	771,428	4,628,572	27s.	6,248,572 4 0	
	Oats and rye	2,000,000		4½	9,000,000	1,285,714	7,714,286	20s.	7,711,286 0 0	
	Beans and peas	500,000		3¾	1,875,000	267,857	1,607,143	28s.	2,250,000 4 0	
					27,525,000		23,592,858			
	Potatoes, turnips, and rape	2,500,000		£7 per acre.		...	...	...	26,000,000 0 0	
	Clover	1,300,000								
	Fallow	800,000								
	Hops	50,000		£15 per acre.	.	.	...	...	780,000 0 0	
	Gardens	250,000		£15 per acre.	.	...	.	...	3,750,000 0 0	
			11,400,000							67,139,286 13 0
Scotland.				Quarters.		Seed 1 6th.				
	Wheat	330,000		3½	1,137,500	189,583	947,917	43s.	2,038,021 11 0	
	Barley	450,000		4	1,800,000	300 000	1,500,000	26s.	1,950,000 0 0	
	Oats	1,200,000		5	6,000 000	1,000,000	5,000,000	20s.	5,000,000 0 0	
	Beans and peas	50,000		3	150,000	25,000	125,000	28s.	175,000 0 0	
					9,087,500		7,572,917			
	Fallow	100,000								
	Potatoes	200,000								
	Turnips	450,000		£7 per acre.	..	...	...	...	7,700,000 0 0	
	Clover	450,000								
	Flax	5,000		£15 per acre.	..	..	...	...	75,000 0 0	
	Gardens	35,000		£15 per acre.	..	..	...	...	525,000 0 0	
			3,290,000							17,463,021 11 0
Ireland.				Quarters.		Seed 1 6th.				
	Wheat	400,000		3	1,200,000	200,000	1,000,000	40s.	2,000,000 0 0	
	Barley	320,000		3½	1,120,000	186,666	933,334	24s.	1,119,999 12 0	
	Oats	2,200,000		5	11,000,000	1,833,333	9,166,667	20s.	9,166,667 0 0	
					13,320,000		11,100,001			
	Potatoes	1,400,000		£8 per acre.	...	...	...	...	11,200,000 0 0	
	Fallow	300,000								
	Flax	140,000		£15 per acre.	..	...	...	...	2,100,000 0 0	
	Gardens	25,000		£12 per acre.	...	...	...	...	300,000 0 0	
			4,765,000							25,886,666 12 0
	Tota'ls		19,475,000		49,932,500	7,666,724	42,265,776			110,788,974 16 0

British Corn Trade.

Tables showing the Prices of the different Sorts of Grain in Great Britain, the Quantities imported and exported, &c.

British Corn Trade.

I.—Account of the Prices of Middling or Mealing Wheat per Quarter at Windsor Market, as ascertained by the Audit-Books of Eton College.

Years.	Prices of Wheat at Windsor, 9 Gallons to the Bushel.			Prices of Wheat reduced to the Winchester Bushel of 8 Gallons			Average of Ten Years according to the Winchester Bushel of 8 Gallons.			Years.	Prices of Wheat at Windsor, 9 Gallons to the Bushel.			Prices of Wheat reduced to the Winchester Bushel of 8 Gallons			Average of Ten Years according to the Winchester Bushel of 8 Gallons.		
	L.	*s*	*d.*	*L.*	*s.*	*d.*	*L.*	*s.*	*d.*		*L.*	*s.*	*d.*	*L.*	*s.*	*d.*	*L.*	*s.*	*d.*
1646	2	8	0	2	2	8				1715	2	3	0	1	18	2¾	2	4	2¼
1647	3	13	8	3	5	5¾				1716	2	8	0	2	2	8			
1648	4	5	0	3	15	6¾				1717	2	5	8	2	0	7¼			
1649	4	0	0	3	11	1¼				1718	1	18	10	1	14	6¼			
1650	3	16	8	3	8	1¾				1719	1	15	0	1	11	1¼			
1651	3	13	4	3	5	2¼				1720	1	17	0	1	12	10¾			
1652	2	9	6	2	4	0				1721	1	17	6	1	13	4			
1653	1	15	6	1	11	6¾				1722	1	16	0	1	12	0			
1654	1	6	0	1	3	1¼				1723	1	14	8	1	10	10¾			
1655	1	13	4	1	9	7½	2	11	7¾	1724	1	17	0	1	12	10¾			
1656	2	3	0	1	18	2¾				1725	2	8	6	2	3	1¼	1	5	4¾
1657	2	6	8	2	1	5¾				1726	2	6	0	2	0	10¾			
1658	3	5	0	2	17	9¼				1727	2	2	0	1	17	4			
1659	3	6	0	2	18	8				1728	2	14	6	2	8	5¼			
1660	2	16	6	2	10	2¾				1729	2	6	10	2	1	7⅛			
1661	3	10	0	3	2	2¾				1730	1	16	6	1	12	5¼			
1662	3	14	0	3	5	9¼				1731	1	12	10	1	9	2¼			
1663	2	17	0	2	10	8				1732	1	6	8	1	3	8½			
1664	2	0	6	1	16	0				1733	1	8	4	1	5	2¼			
1665	2	9	4	2	3	10¼	2	10	5¾	1734	1	18	10	1	14	6¼			
1666	1	15	0	1	12	0				1735	2	3	0	1	18	2¾	1	15	2
1667	1	16	0	1	12	0				1736	2	0	4	1	15	10¼			
1668	2	0	0	1	15	6¾				1737	1	18	0	1	13	9¼			
1669	2	4	4	1	19	5				1738	1	15	6	1	11	6¾			
1670	2	1	8	1	17	0½				1739	1	18	6	1	14	2¾			
1671	2	2	0	1	17	4				1740	2	10	8	2	5	1½			
1672	2	1	0	1	16	5¼				1741	2	6	8	2	1	5¾			
1673	2	6	8	2	1	5¾				1742	1	14	0	1	10	2¾			
1674	3	8	8	3	1	0½				1743	1	4	10	1	2	1			
1675	3	4	8	2	17	5¾	2	0	11¾	1744	1	4	10	1	2	1			
1676	1	18	0	1	13	9¼				1745	1	7	6	1	4	5¼	1	12	1
1677	2	2	0	1	17	4				1746	1	19	0	1	14	8			
1678	2	19	0	2	12	5¼				1747	1	14	10	1	10	11½			
1679	3	0	0	2	13	4				1748	1	17	0	1	12	10¾			
1680	2	5	0	2	0	0				1749	1	17	0	1	12	10¾			
1681	2	6	8	2	1	5¾				1750	1	12	6	1	8	10¾			
1682	2	4	0	1	19	1¼				1751	1	18	6	1	14	2¾			
1683	2	0	0	1	15	6¾				1752	2	1	10	1	17	2¼			
1684	2	4	0	1	19	1¼				1753	2	4	8	1	19	8⅛			
1685	2	6	8	2	1	5¾	2	1	4¼	1754	1	14	8	1	10	9¾			
1686	1	14	0	1	10	2¾				1755	1	13	10	1	10	1	1	1	2¾
1687	1	5	2	1	2	4⅛				1756	2	5	2	2	0	1¾			
1688	2	6	0	2	0	10¾				1757	3	0	0	2	13	4			
1689	1	10	0	1	6	8				1758	2	10	0	2	4	5¼			
1690	1	14	8	1	10	9¾				1759	1	19	8	1	15	3			
1691	1	14	0	1	10	2¾				1760	1	16	6	1	12	5¼			
1692	2	6	8	2	1	5¾				1761	1	10	2	1	6	9¾			
1693	3	7	8	3	0	1¼				1762	1	19	0	1	14	8			
1694	3	4	0	2	16	10¾				1763	2	0	8	1	16	1¾			
1695	2	13	0	2	7	1¼	1	19	6¾	1764	2	6	8	2	1	5¾			
1696	3	11	0	3	3	1¼				1765	0	14	0	2	8	0	1	19	3¼
1697	3	0	0	2	13	4				1766	2	8	6	2	3	1¼			
1698	3	8	4	3	0	9				1767	3	4	6	2	17	4			
1699	3	4	0	2	16	10¾				1768	3	0	6	2	13	9¼			
1700	2	0	0	1	15	6¾				1769	2	5	8	2	0	7			
1701	1	17	8	1	13	5¾				1770	2	9	0	2	3	6¾			
1702	1	9	6	1	6	2¾				1771	2	17	0	2	10	8			
1703	1	16	0	1	12	0				1772	3	6	0	2	18	8			
1704	2	6	6	2	1	4				1773	3	6	6	2	19	1¼			
1705	1	10	0	1	6	8	2	2	11	1774	3	2	0	2	15	1¼			
1706	1	6	0	1	3	1¼				1775	2	17	8	2	11	3¼	2	11	3¾
1707	1	8	6	1	5	4				1776	2	8	0	2	2	8			
1708	2	1	6	1	16	10¾				1777	2	15	0	2	8	10¾			
1709	3	18	6	3	9	9¼				1778	2	9	6	2	4	0			
1710	3	18	0	3	9	4				1779	2	0	8	1	16	1¾			
1711	2	14	0	2	8	0				1780	2	8	6	2	3	1¼			
1712	2	6	4	2	1	2¼				1781	2	19	0	2	12	5¼			
1713	2	11	0	2	5	4				1782	3	0	6	2	13	9¼			
1714	2	10	4	2	4	9				1783	3	1	0	2	14	2¾			

British Corn Trade.

Years.	Prices of Wheat at Windsor, 9 Gallons to the Bushel.	Prices of Wheat reduced to the Winchester Bushel of 8 Gallons.	Average of Ten Years according to the Winchester Bushel of 8 Gallons.	Years.	Prices of Wheat reduced to the Winchester Bushel of 8 Gallons.	Average of Ten Years according to the Winchester Bushel of 8 Gallons.
	L. s. d.	*L. s. d.*	*L. s. d.*		*L. s. d.*	*L. s. d.*
1784	3 0 6	2 13 9¼		1806	4 3 0	
1785	2 14 0	2 8 0	2 7 8½	1807	3 18 0	
1786	2 7 6	2 2 2¾		1808	3 19 2	
1787	2 11 6	2 5 9¾		1809	5 6 0	
1788	2 15 6	2 9 4		1810	5 12 0	
1789	3 3 2	2 16 1⅝		1811	5 8 0	
1790	3 3 2	2 16 1⅝		1812	6 8 0	
1791	2 15 6	2 9 4		1813	6 0 0	
1792		2 13 0		1814	4 5 0	
1793		2 15 8		1815	3 16 0	4 17 6
1794		2 14 0		1816	4 2 0	
1795		4 1 6	2 14 3¾	1817	5 16 0	
1796		4 0 2		1818	4 18 0	
1797		3 2 0		1819	3 18 0	
1798		2 14 0		1820	3 16 0	
1799		3 15 8		1821	3 11 0	
1800		6 7 0		1822	2 13 0	
1801		6 8 6		1823	2 17 0	
1802		3 7 2		1824	3 12 0	
1803		3 0 0		1825	4 4 0	3 18 8½
1804		3 9 6		1826	3 13 0	
1805		4 8 0	4 1 2½			

* From this year inclusive the account at Eton College has been kept according to the bushel of eight gallons, under the provision of the act 31 Geo III. cap 30, sect 82.

II.—Account of the Average Prices of British Corn per Imperial Quarter, in England and Wales, since 1771, as ascertained by the Receiver of Corn Returns.

Years.	Wheat.	Barley.	Oats.	Rye.	Beans	Peas.
	L. s. d.	*L. s. d.*	*L. s. d.*	*L. s. d.*	*L. s. d.*	*L. s. d.*
1771	2 7	1 6 5	0 17 2	1 15 4	1 9 4	...
1772	2 12 3	1 6 1	0 16 8	1 17 9	1 10 11	...
1773	2 12 7	1 9 2	0 17 8	1 14 4	1 14 0	...
1774	2 14 3	1 9 4	0 18 4	1 15 4	1 12 1	...
1775	2 9 10	1 6 9	0 17 0	1 13 10	1 9 6	...
1776	1 19 4	1 0 9	0 15 5	1 7 8	1 7 3	...
1777	2 6 11	1 1 1	0 16 1	1 8 10	1 9 4	...
1778	2 3 3	1 3 4	0 15 7	1 9 2	1 8 6	...
1779	1 14 8	1 0 1	0 14 5	1 4 0	1 4 11	...
1780	1 16 9	0 17 6	0 13 2	1 2 10	1 2 10	...
1781	2 6 0	0 17 8	0 14 1	1 7 8	1 3 8	...
1782	2 9 3	1 3 2	0 15 7	1 9 8	1 6 9	...
1783	2 14 3	1 11 3	1 0 5	1 16 9	1 15 11	...
1784	2 10 4	1 8 8	0 18 10	1 13 2	1 13 2	...
1785	2 3 1	1 4 9	0 17 8	1 8 10	1 11 7	...
1786	2 0 0	1 5 1	0 18 6	1 8 0	1 14 2	...
1787	2 2 5	1 3 4	0 17 2	1 8 6	1 12 9	...
1788	2 6 4	1 2 8	0 16 1	1 8 6	1 8 0	...
1789	2 12 9	1 3 6	0 16 6	1 10 9	1 8 0	...
1790	2 14 9	1 6 3	0 19 5	1 15 0	1 11 11	...
1791	2 8 7	1 6 10	0 18 1	1 12 7	1 11 5	1 13 2
1792	2 3 0	...	0 16 9	1 9 10	1 11 7	1 12 4
1793	2 9 3	1 11 1	1 0 6	1 16 2	1 17 6	1 19 11
1794	2 12 3	1 11 9	1 1 3	1 17 5	1 19 3	2 8 5
1795	3 15 2	1 17 5	1 4 5	...	...	...
1796	3 18 7	1 15 4	1 1 10	...	...	...
1797	2 13 9	1 7 2	0 16 3	...	...	...
1798	2 11 10	1 9 0	0 19 5	...	...	...
1799	3 9 0	1 16 2	1 7 6	...	...	...
1800	5 13 10	2 19 10	1 19 4	...	...	...
1801	5 19 6	3 8 6	1 17 0	...	...	...
1802	3 9 10	1 13 4	1 0 4	...	...	...
1803	2 18 10	1 5 4	1 1 6	...	...	...
1804	3 2 3	1 11 0	1 4 3	...	...	...
1805	4 9 9	2 4 6	1 8 4	...	...	...
1806	3 19 1	1 18 8	1 7 7	...	...	...
1807	3 15 4	1 19 4	1 8 4	...	...	...
1808	4 1 4	...	1 13 4	...	...	...
1809	4 17 4	2 7 0	1 11 5	...	...	...
1810	5 6 5	2 8 1	1 8 7	2 19 5	2 14 4	2 16 11

British Corn Trade.

Years.	Wheat.	Barley.	Oats.	Rye.	Beans.	Peas.
	L. s. d.	*L. s. d.*	*L. s. d.*	*L. s. d.*	*L. s. d*	*L. s. d.*
1811	4 15 3	2 2 3	1 7 7	2 8 4	2 9 4	2 13 11
1812	6 6 6	3 6 9	2 4 6	3 18 7	3 14 7	3 16 10
1813	5 9 9	2 18 6	1 18 6	3 11 11	3 16 4	4 1 11
1814	3 14 4	1 17 4	1 5 8	2 4 8	2 6 2	2 11 10
1815	3 5 7	1 10 3	1 3 7	1 18 1	1 16 2	1 19 4
1816	3 18 6	1 13 11	1 7 2	2 5 1	1 19 4	1 19 10
1817	4 16 11	2 9 4	1 12 5	2 18 3	2 11 7	2 13 4
1818	4 6 3	2 13 10	1 12 5	2 15 4	3 3 7	3 1 9
1819	3 14 6	2 5 9	1 8 2	2 9 6	2 14 1	2 16 1
1820	3 7 10	1 13 10	1 4 2	2 2 0	2 3 3	2 5 10
1821	2 16 1	1 6 0	0 19 6	1 12 0	1 10 11	1 12 8
1822	2 4 7	1 1 10	0 18 1	1 0 10	1 4 5	1 6 4
1823	2 13 4	1 11 6	1 2 11	1 11 10	1 13 1	1 14 11
1824	3 3 11	1 16 4	1 4 10	2 1 5	2 0 0	2 0 7
1825	3 8 6	2 0 0	1 5 8	2 2 3	2 2 9	2 5 4
1826	2 18 8	1 14 4	1 6 8	2 1 1	2 4 3	2 7 7
1827	2 18 6	1 17 7	1 8 2	2 0 2	2 9 0	2 9 0
1828	3 0 5	1 12 10	1 2 6	1 14 2	1 18 4	2 0 6
1829	3 6 3	1 12 6	1 2 9	1 14 10	1 16 8	1 16 8
1830	3 4 3	1 12 7	1 4 5	1 15 10	1 16 1	1 19 2
1831	3 6 4	1 18 0	1 5 4	2 0 0	1 19 10	2 1 11
1832	2 18 8	1 13 1	1 0 5	1 14 7	1 15 4	1 17 0
1833	2 12 11	1 7 6	0 18 5	1 12 11	1 13 2	1 16 5
1834	2 6 2	1 9 0	1 0 11	1 12 9	1 15 3	1 19 4
1835	1 19 4	1 9 11	1 2 0	1 10 4	1 16 11	1 16 6
1836	2 8 6	1 12 10	1 3 1	1 13 4	1 19 1	1 18 4
1837	2 15 10	1 10 4	1 3 1	1 14 9	1 18 7	1 17 6
1838	3 4 7	1 11 5	1 2 5	1 15 1	1 16 8	1 17 2
1839	3 10 8	1 19 6	1 5 11	2 2 0	2 1 3	2 1 2
1840	3 6 4	1 16 5	1 5 8	1 17 0	2 3 5	2 2 5
1841	3 4 4	1 12 10	1 2 5	1 16 9	1 19 10	2 0 4
1842	2 17 3	1 7 6	0 19 3	1 13 0	1 12 5	1 12 11
1843	2 10 1	1 9 6	0 18 4	1 10 7	1 9 2	1 11 1
1844	2 11 3	1 13 8	1 0 7	1 13 11	1 14 5	1 13 5
1845	2 10 10	1 11 8	1 2 6	1 12 6	1 18 11	1 18 8
1846	2 14 8	1 12 8	1 3 8	1 15 0	1 19 0	1 19 0
1847	3 9 9	2 4 2	1 8 8	2 9 0	2 10 6	2 11 6
1848	2 10 6	1 11 6	1 0 6			
1849	2 4 3	1 7 9	0 17 6	1 5 8	1 10 2	1 11 2
1850	2 0 3	1 3 5	0 16 5	1 3 3	1 6 10	1 7 4
1851	1 18 6	1 4 9	0 18 7	1 5 6	1 8 7	1 7 2
1852	2 0 9	1 8 6	0 19 1	1 9 10	1 12 3	1 10 7

British Corn Trade.

N.B.—The Imperial bushel contains 2218 192 cubic inches, the Winchester bushel 215042 do., the former being about one-thirty-second th part larger than the latter.—See WEIGHTS and MEASURES

III.—Account of the Quantities of Wheat and Wheat Flour (stated as Quarters of Wheat) imported into the United Kingdom during each of the Ten Years ending with 1852, exhibiting the quantities brought from each country, and the Annual Average Imports of the said Ten Years.

Countries.	1843.	1844.	1845.	1846.	1847.	1848.	1849.	1850.	1851.	1852.	Annual Average for Ten Years
	Qrs.	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs*	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*
Russia	33,668	104,526	33,781	204,850	850 587	523,138	599,556	638,613	699,684	733,734	442,216
Sweden and Norway	678	10,782	679	218	8,647	5,346	6,494	356	6	546	3,375
Denmark	69,864	94,499	74,170	61,563	73,568	191,787	243,213	162,207	168,768	218,834	135,847
Prussia	659,503	551,015	424,539	360,881	492,928	528,156	618,690	835,650	696,175	452,292	561,983
Germany, viz., Hanseatic Towns, Oldenburg, Hanover, and Mecklenburg	126,521	108,922	154,271	126,572	154,839	532,591	498,984	380,944	264,721	179,631	252,800
Holland	858	11,772	1,614	473	11,800	163,978	308,482	293,465	66,414	124,963	98,382
Belgium	332	1,101	983	3,064	27,469	178,398	366,099	201,922	69,046	25,961	87,437
France	3,131	44,875	35,809	73,774	179,259	320,010	742,023	1,145,146	1,193,433	459,418	419,688
Spain	1	11	4,016	74,041	24,700	917	498	2,186	115	6,321	11,281
Italy	5,206	80,280	57,403	194,256	64,850	83,170	281,530	117,323	241,852	65,103	119,097
Malta	3,155	6,163	4,120	11,099	46,251	8,576	9,049	10,596	10,585	17,106	12,670
Greece	...	...	3,240	11,595	...	4,129	61,136	6,292	165	...	8,656
Turkey, includ. Syria, Egypt, Wallachia, and Moldavia	14,899	44,790	7,030	41,557	266,779	40,340	295,542	382,793	873,130	533,524	250,038
Cape of Good Hope	. .	83	2	87	2	2	1	. .	1	...	18
British East Indies	3,624	2,303	1,204	361	203	2,755	2,028	690	22	...	1,319
Australian Settlements	1,292	4,210	14,035	20,346	13,690	5,559	15,699	14,584	104	...	8,952
British N. Am. Colonies	113,446	228,069	229,349	327,105	398,793	186,254	142,295	80,394	129,680	110,033	194,542
U. States of America	26,090	85,853	93,622	808,178	1,834,142	296,102	617,131	537,030	911,855	1,231,894	644,190
All other parts	2,674	8	2,090	24,122	16,250	11,023	26,830	19,812	4,656	5,272	11,274
Total	1,064,942	1,379,262	1,141,957	2,344,142	4,464,757	3,082,231	4,835,280	4,830,263	5,330,412	4,164,602	3,263,781

British Corn Trade

IV.—Account of the Quantities of the different Varieties of Corn and Grain, Flour and Meal, imported into the United Kingdom in 1852, specifying the Countries whence the same were brought, and the Quantities brought from each, in Imperial Quarters.

British Corn Trade.

Countries from which Imported.	Wheat and Wheat Flour.	Barley and Barley-Meal.	Oats and Oat-Meal.	Rye and Rye-Meal.	Indian Corn and Meal.	Other Grain and Meal.	All Sorts
	Qrs.	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*
Russia—Northern Ports	27,112	5,997	304,448	6,085	...	306	343,948
Russia—Ports within the Black Sea	706,622	14,070	1,290	829	233,816	1,250	957,877
Sweden and Norway	516	759	56,272		...	93	57,640
Denmark	218,834	254,870	247,104	301		49,087	770,196
Denmark—Iceland					...		...
Prussia	452,292	54,207	24,693			23,510	554,702
Mecklenburg Schwerin	120,544	15,580	2,239			7,344	145,707
Hanover	9,158	833	133,131	...		6,222	149,344
Oldenburg and Kniphausen	442		39,865		...	4,377	44,684
Hanseatic Towns	49,487	37,083	41,386	66		39,835	167,857
Holland	124,963	1,001	79,176	35	...	16,384	221,559
Belgium	25,961	10,190	1			9,556	45,708
Channel Islands (Foreign Produce)	1,640	99	...		...	4	1,743
France	459,418	100,292	56,458	357	92,116	36,520	745,161
Portugal Proper	1		...		9,646	...	9,647
Portugal—Azores	...	2			6,144		6,146
Portugal—Madeira			...				
Spain and the Balearic Islands	6,321	8,441	...	...	1,186	4	15,952
Spain—Canary Islands	...	...				...	...
Gibraltar	7	...	...	...	...	...	7
Italy and the Italian Islands, viz.:							
Sardinian Territories	57	...	...		674		731
Tuscany	11,696	2,306	...		1,351	...	15,353
Papal Territories	22,732			...	...		22,732
Naples and Sicily	26,635		1,928		...	12,693	41,256
Austrian Territories	3,983		...		106,005	3,914	113,902
Malta and Gozo	17,106	41,389			3,408	1,616	63,519
Ionian Islands	1,431		...		9,512		10,943
Turkish Dominions, exclusive of Wallachia, Moldavia, Syria, Palestine, and Egypt	40,341	16,103		1,261	138,314		196,019
Wallachia and Moldavia	86,140	55		968	626,714		713,877
Syria and Palestine	12,375	3,664		...	338		16,377
Egypt	394,668	54,248		17	71,590	257,222	777,745
Algeria	...	3,746				...	3,746
Morocco		569				2	571
Africa, West Coast, not particularly designated	...	...	...		518	...	518
Mauritius	163	...	...		...	...	163
Aden		...	...	...		...	...
British Territories in the East Indies	34		...	...	4	18	56
China	3	...		...			3
British Settlements in Australia	12	...	...				12
British North America	110,033	90	1,454	...	3	14,660	126,240
British West India Islands, and British Guiana	2	...		...	...		2
Foreign West Indies, viz.:							
Cuba	621		...	...	1,014	...	1,635
St Thomas	1,353	...	...		400	...	1,753
United States of America	1,231,894	8	133	72	167,663	788	1,400,558
Brazil	1		...		1,074	...	1,075
Peru	1	...	...	...	...	...	1
Southern Whale Fishery	3	...	...	...	...	...	3
Total	4,164,602	625,602	989,578	9,991	1,471,490	485,405	7,746,668

British Corn Trade.

V.—Account showing the Quantities of the different Varieties of Foreign and Colonial Grain entered for Consumption in the United Kingdom in each of the 18 Years ending with 1852, with the Total Quantities so entered, and the Annual Entries at an Average of the above Period, with a similar Account for Indian Corn and Meal for the 10 and 7 Years ending with 1852.—(Compiled from various Parliamentary Papers.)

British Corn Trade.

Years.	Wheat and Flour.	Barley.	Oats and Oat-Meal.	Rye and Rye-Meal.	Peas and Peas-Meal.	Beans and Bean-Meal.	Total entered.	Indian Corn and Meal.
	Qrs.	*Qrs.*	*Qrs.*	*Qrs*	*Qrs*	*Qrs*	*Qrs.*	*Qrs.*
1835	28,554	136,853	176,142	3	25,184	69,824	436,560	...
1836	30,107	110,021	97,197	18	80,928	87,796	406,067	.
1837	244,272	47,475	334,024	19,576	87,615	109,076	842,038	.
1838	1,848,475	8,192	11,072	2,517	11,618	54,240	1,936,114	...
1839	2,711,723	594,301	862,789	152,182	170,270	123,597	4,615,262	
1840	2,401,436	619,801	517,052	1,857	159,457	129,517	3,829,120	
1841	2,647,808	222,837	27,918	518	132,857	267,697	3,299,635	..
1842	2,989,645	49,969	295,437	28,516	80,450	43,279	3,487,296	. .
1843	990,523	223,543	45,254	2,724	45,383	45 702	1,353,129	10,225
1844	988 515	1,020,766	258,235	28,779	106,375	225,680	2,628,350	38,711
1845	315,615	299,130	587,434	23	81,735	197,919	1,492,156	42 295
1846	2,962,928	404,644	779,442	1,710	181,801	209,874	4,540,399	757,609
1847	4,612,110	782,686	1,788,057	253,510	193,078	476,253	8,105,694	4,023,918
1848	2 193.755	888,925	872,553	55,481	164,771	448,704	4.624,189	1,637,419
1849	5,592.594	1,544 888	1,375,585	259,936	283,092	482,612	9,538,705	2,255,961
1850	4,845,854	1,023 907	1,153,279	93,431	179,738	444,612	7,740,821	1,276.958
1851	5,275,677	826,390	1,193,566	23.002	98,602	318,506	7,735.823	1,808,748
1852	4,135,376	624,062	982,278	9,576	105,517	372,975	6,229,784	1,471,097
Totals	44,814,968	9,428,690	11,354,376	933,284	2,188,628	4,107,889	72,841,315	13,321,942
Average annual consumption for the 18 years ended 1852...	2,489,720	523,816	630,798	51,849	121,590	228,216	4,046,739	1,332,194
Average annual consumption for the 7 years ended 1852.	4,231,185	870,786	1,162,546	99,510	172,393	393,366	6,930,798	1,890,101

VI.—Account of the Quantities of Grain, Flour, Meal, and Malt, of Irish Growth, annually imported into Great Britain from Ireland, from 1809 to 1851, both inclusive.

Years.	Wheat and Wheat Flour	Barley, including Bear or Bigg.	Oats and Oat-Meal	Rye.	Peas.	Beans.	Malt.	Total.
	Qrs	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*	*Qrs.*
1809	66,944	16,619	845,783	425	38	2,669	...	932,478
1810	126,388	8,321	492,741	20	216	3,541	...	631,227
1811	147,245	2,713	275,757	21	50	4,081	...	429,867
1812	158,352	43,138	390,629	178	51	5,008	. .	597,356
1813	217,154	63,560	691,498	420	77	4,455	...	977,164
1814	225,478	16,779	564,010	4	460	5,731	...	812,462
1815	189,544	27,108	597,537	207	425	6,371	.	821,192
1816	121,631	62,254	683,714	43	239	5,984	...	873,865
1817	55,481	26,766	611,117	...	12	2,275	..	695,651
1818	105,179	25,387	1,069,385	4	10	4,768	. .	1,204,733
1819	153,850	20,311	789,613	2	..	3,904	...	967,680
1820	403,407	87,095	916,251	134	439	8 396	...	1,415,722
1821	569,700	82,884	1,162,249	550	2474	4,959	...	1,822,816
1822	463,004	22,532	569,237	353	728	7,235	...	1,063,089
1823	400,068	19,274	1,102,487	198	586	5,540	.	1,528,153
1824	356,384	44,699	1,225,085	112	756	5,791	1,173	1,634,000
1825	396,018	154,256	1,629,856	220	1431	11,355	10,826	2,203,962
1826	314,851	64,885	1,303,734	77	1452	7,190	1,203	1,693,392
1827	405,255	67,791	1,343,267	256	1282	10,037	572	1,828,460
1828	652,584	84,204	2,075,631	1424	4826	7,008	853	2,826,590
1829	519,017	97,140	1,673,628	568	4435	10,445	2,011	2,307,244
1830	529,717	189,745	1,471,252	414	2520	19,053	2,820	2,215,521
1831	557,498	185,409	1,655,701	515	4142	15,029	10,888	2,429,182
1832	790,293	123,639	2,051,867	294	1915	14,530	8,229	2,990,767
1833	844,211	101,767	1,762,520	166	2646	19,114	7,017	2,737,441
1834	779,505	217,855	1,769,503	983	2176	18,771	3,865	2,792,658
1835	661,776	156,242	1,822,767	614	3447	24,235	10,357	2,679,438
1836	598,757	184,156	2,132,138	483	2920	17,604	22,214	2,958,272
1837	534,465	187,473	2,274,675	1016	60	25,630	4,174	3,030,293
1838	542,583	156,467	2,742,807	628	5232	21,584	5,001	3,474,302
1839	258.331	61,676	1,904,933	2331	1484	11,535	2,861	2,243,151
1840	174,439	95,954	2,037,835	122	1403	14,573	3,456	2,327,782
1841	218,708	75,568	2,539,380	172	855	15,907	4,935	2,855,525
1842	201,998	50,297	2,261,435	76	1551	19,831	3,046	2,538,234
1843	413,466	110,449	2,648,032	371	1192	24,329	8,643	3,206,482
1844	440,152	90,656	2,242,308	264	1091	18,580	8,153	2,801 204
1845	779,113	93,095	2,353,985	165	1644	12,745	11,144	3,251,901
1846	393,462	92,854	1,311,592	...	2227	14,668	11,329	1,826,132
1847	184,024	47,527	703,468	1498	4659	22,361	5,956	969,490
1848	304,873	79,885	1,546,568	15	2572	12,314	6,365	1,952,592
1849	234,680	46,400	1,123,469	414	3369	22,450	5,181	1,435,963
1850	176,566	40,779	1,075,388	360	4360	21,551	8,425	1,327,429
1851	95,116	44,479	1,141,976	...	3781	25,002	6,431	1,316,785

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IV. FOREIGN CORN TRADE.

1. *Polish Corn Trade.* Dantzic is the port whence we have hitherto always derived the largest portion of our supplies in deficient seasons; and as it is most probable that our principal importations will continue to be drawn from the same source, it becomes peculiarly important to ascertain the cost of wheat in Dantzic, and the expense of its importation into this country.

According to the data collected by Mr Jacob in his reports on the agriculture and corn trade of the north of Europe, the ordinary price of wheat at Dantzic, free on board, would amount to about 40s. a quarter, made up as follows:—

Cost of wheat at Warsaw, . . .	28s.	0d. per quarter.
Conveyance to the boats, and charges for loading and stowing, and securing it with mats,	0	6
Freight to Dantzic, ...	5	0
Loss on the passage by pilfering, rain, &c.,	3	0
Expenses at Dantzic in turning, drying, screening, warehousing, and loss of measure, ...	2	0
Profit or commission, as the case may be, to the merchant in Dantzic, . . .	1	6
Cost at Dantzic, exclusive of shipping charges, which amount to about 10d. a quarter,	40	0

Now, if to this we add 10s. or 12s. a quarter for the expense of importing the wheat into England, and delivering it to the miller, including the profit of the importer, it is plain that it could not, supposing Mr Jacob's estimate of the cost to be nearly accurate, be sold in London, free of duty, for less than 50s. or 52s. a quarter.

It has, no doubt, been alleged that the cost of wheat in Dantzic is overrated in the above estimate; and in seasons when there is little or no demand for corn from abroad, this allegation may be well founded. But this estimate is not meant to apply to such years, but to those when there is some considerable foreign demand; and whenever this is the case, it will be found, that though some of the items which go to make up the cost may vary, the result is nearly correct; and that there are really no good grounds for supposing that corn could, in the seasons in question, be shipped from Dantzic for less than about 40s. a quarter.

In further corroboration of this statement we may mention, that owing to the deficient harvest of 1845, the average price of wheat in January 1846, in Warsaw, exceeded 40s. a quarter, and it is stated in a despatch from the consul in that city, that at an average of the twenty years ending with 1845, prices had been as follows, viz.: wheat from 26s. 6d. to 30s. per imp. quarter; barley, 17s. 10d. to 20s. 6d. per do.; and oats 8s. 6d. to 10s. per do. It is plain, therefore, that Mr Jacob's estimate of the cost of wheat at Warsaw is not in any degree overstated; and we are well assured that this also is the case with his estimate of the expense of conveying it down the Vistula to Dantzic.

We subjoin a statement by Mr Grade of Dantzic, of the average price from ten to ten years, from 1770 to 1820, of the different species of corn, free on board, per quarter, in sterling money at Dantzic.

	Wheat.		Rye.		Barley.		Oats.	
	s.	d	s.	d	s.	d	s.	d.
From 1770 to 1779....	33	9	21	8	16	1	11	1
1780 1789....	33	10	22	1	17	11	12	4
1790 1799....	43	8	26	3	19	3	12	6
1800 1809....	60	0	34	10	25	1	13	1
1810 1819....	55	4	31	1	26	0	20	4
Aggregate average price of 49 years	45	4	27	2	20	10	13	10

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It appears from this table, that, at an average of the 20 years ending with 1819, the price of corn in Dantzic was no less than 57s. 8d. a quarter! But it is to be observed that these prices were powerfully influenced by the scarcity and high price in this country in 1800 and 1801, and by the obstructions which the war threw in the way of agriculture, and of the conveyance of corn to Dantzic. But the prices of wheat at this great emporium have not latterly been subject to any such disturbing influences. The countries whence Dantzic draws her supplies of corn have enjoyed uninterrupted tranquillity during the last 20 years, and though during some of these years we have made large importations, we have hardly, in a still greater number, brought away a single bushel of corn; so that the average prices of this period may be taken as pretty correctly representing the prices of corn in Dantzic in seasons when the export is rather under a medium.

Account exhibiting the Lowest, the Highest, and the Average Prices of Wheat in Dantzic, in Sterling Money, per Imperial Quarter, in each of the 11 Years, from 1831 to 1841, both inclusive, with the Averages for the whole Period.

Years.	Lowest Prices per Quarter.	Highest Prices per Quarter.	Average Prices per Quarter.
	s. d	s. d.	s d.
1831	41 1	51 6	46 3½
1832	32 5	43 7	38 0
1833	28 5	32 9	30 7
1834	25 1	29 11	27 6
1835	21 0½	26 3½	23 8
1836	22 3	35 7	28 11
1837	24 9	34 8½	29 8¾
1838	26 6½	61 9	44 1¾
1839	31 9	61 1	46 5
1840	39 0	62 9	50 10½
1841	45 9	57 0	51 4½
Average of 11 years from 1831 to 1841	30 8¾	45 2	37 11

It appears from this table that the average price of wheat in Dantzic during the 11 years ending with 1841 was 37s. 11d. a quarter; making, with the addition of 10d. a quarter for shipping charges, its average price free on board, 38s. 9d. a quarter. Now, if to this last sum we add 12s. or 13s. for the expense of its importation and delivery to the millers in London, it is plain, judging from the experience of these 11 years, that the average cost of Dantzic wheat in England, independent of duty, may be estimated, in round numbers, at from 51s. to 52s. a quarter.

It is material, however, to bear in mind that no very large quantity could be shipped at the above prices. They represent only average years: and whenever there is any unusual demand for corn, or when from 200,000 to 300,000 quarters are wanted for this country, the price immediately rises, as seen above, to from 45s. to 50s. a quarter and upwards. During the course of 1847 the average price of the wheat shipped at Dantzic exceeded 55s. a quarter.

Quality of Dantzic wheat. The price of wheat in Dantzic is usually about 7s. a quarter above its average price in Hamburg, and about 2s. above the average of Amsterdam. This difference is entirely owing to the superior quality of the Dantzic wheat. Though small grained, and not so heavy as several other sorts, it is remarkably thin-skinned, and yields the finest flour. Some of the best white, or as it is technically termed, "high mixed" Dantzic wheat, is superior to the very best English; but the quantity of this sort is but limited, and the average quality of all that is exported from Dantzic is believed to approach very nearly

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to the average quality of English wheat. Allowing for its superior quality, it will be found that wheat is, speaking generally, always cheaper in Dantzic than in any of the Continental ports nearer to London. There are but few seasons, indeed, in which Dantzic wheat is not largely imported into Amsterdam; and it frequently, also, finds its way into Hamburg. But it is quite impossible that such should be the case, unless, taking quality and other modifying circumstances into account, it were really cheaper than the native and other wheats met with in these markets. When there is any considerable importation into England, it is of every day occurrence for merchants to order Dantzic wheat in preference to that of Holstein, or of the Lower Elbe, though the latter might frequently be put into warehouses here for 20s. a quarter less than the former! It is, therefore, quite indispensable, in attempting to draw any inferences in regard to the comparative prices of corn in different countries, to make the requisite allowances for differences of quality. Unless this be done, whatever conclusions may be come to can hardly fail of being false and misleading; and when they happen to be right, they can only be so through the merest accident.

Dantzic being by far the greatest port for the exportation of corn in the north of Europe, its price may be assumed as the general measure of the price in other shipping ports. At all events, it is certain that when Dantzic is exporting, wheat cannot be shipped, taking quality into account, at a cheaper rate from any other place. The importer invariably resorts, to what he believes to be, all things considered, the cheapest market; and it is a contradiction and an absurdity to suppose that he should burden himself with a comparatively high freight, and other charges for wheat in Dantzic, provided he could buy an equally good article in so convenient a port as Hamburg at the same or a lower price.

If, therefore, we are right in estimating the lowest price at which wheat could be imported from Dantzic free of duty in ordinary years at about 50s., we may be assured that this is the lowest importation price. The greater cheapness of the imports from other places is apparent only, and is uniformly countervailed by a corresponding inferiority of quality.

2. *Corn Trade of the Elbe, &c.* Next to Dantzic, Hamburg is, perhaps, the greatest corn market in the north of Europe, being a depot for large quantities of Baltic corn, and for the produce of the extensive countries traversed by the Elbe. The exports of wheat from Hamburg amounted, at an average of the eleven years ending with 1841, to 210,871 quarters a year. The price of wheat, as already stated, is frequently less in Hamburg than in Dantzic; but this lowness of price is altogether ascribable to the inferiority of the Holstein and Hanover wheats, which are generally met with in great abundance in Hamburg. Wheat from the Upper Elbe is of a better quality. Bohemian wheat is occasionally forwarded by the river to Hamburg; but the charges attending its conveyance from Prague amount to full 15s. a quarter, and prevent its being sent down, except when the price is comparatively high. In 1841 the shipments of wheat from Hamburg amounted to 507,400 quarters, of which 460,900 were for England. Perhaps we might be able, did our prices average about 50s., to import in ordinary years from 300,000 to 400,000 quarters of wheat from Denmark and the countries intersected by the Weser and the Elbe.

3. *French Corn Trade.* It appears from the accounts given by the Marquis Garnier, in the last edition of his translation of the *Wealth of Nations*, that the price of the *hectolitre* of wheat at the market of Paris amounted, at an average of the nineteen years beginning with 1801 and ending with 1819, to 20 fr. 53 cents, which is equal to 30 fr. 80 cents the septier; or, taking the exchange at 25 fr. to 45s. 6d. the quarter. Count Chaptal, in his valuable work *Sur l' Industrie Francoise*, tom. i. p. 226, published in 1819, estimates the ordinary average price of wheat throughout France at 18 fr. the hectolitre, or 42s. 10d. the quarter. The various expenses attending the importation of a quarter of French wheat into London may be taken at a medium at about 6s. a quarter. France, however, has very little surplus produce to dispose of; so that it would be impossible for us to import any considerable quantity of French corn without occasioning a great advance of price; and in point of fact our imports from France have been at all times quite inconsiderable.

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The mean of the different estimates framed by Vauban, Quesnay, Expilly, Lavoisier, and Arthur Young, gives 61,519,672 septiers, or 32,810,000 quarters, as the total average growth of the different kinds of grain in France. (*Peuchet Statistique Elémentaire*, p. 290.) We, however, took occasion in a former article on this subject to observe, that there could not be a doubt that this estimate was a great deal too low; and the more careful investigations of late French statisticians fully confirm this remark. The annual produce of the harvest of France was lately (1843) estimated, from returns obtained under official authority, at 69,558,000 hectolitres of wheat, and 112,958,000 ditto of other sorts of grain; making in all 182,517,000 hectolitres, or 62,740,000 imperial quarters. Of this quantity it is supposed that about 16 per cent. is consumed as seed, 19 per cent. in the feeding of different species of animals, and 2 per cent. in distilleries and breweries.

The foreign corn trade of France was regulated, till within these few years, by a law which forbade exportation, except when the home prices were below certain limits, and which restrained and absolutely forbade importation, except when they were above certain other limits. The prices regulating importation and exportation differed in the different districts into which the kingdom was divided. Latterly, however, importation has been at all times allowed under graduated duties, which, like those recently existing in this country, become prohibitory when the prices sink to a certain level. The frontier departments are divided into four separate districts, the prices in each district governing the duties on importation into it, so that it sometimes happens that corn warehoused in a particular port, where it is not admissible except under a high duty, has been carried to another port in another district, and admitted at a low duty. An official announcement is issued on the last day of each month, of what the duties are to be in each district during the succeeding month.

4. *Spanish Corn Trade.* The exportation of corn from Spain was formerly prohibited under the severest penalties. But in 1820 grain and flour were both allowed to be freely exported, and in 1823 this privilege was extended to all productions *(frutos)* the growth of the soil. There is now in fact no obstacle whatever, except the expense of carriage, to the conveyance of corn to the sea-ports, and thence to the foreigner. Owing, however, to the corn-growing provinces being principally situated in the interior, and to the extreme badness of the roads, which renders carriage to the coast both expensive and difficult, the exports are comparatively trifling: this difficulty of carriage frequently gives rise to very great differences of prices at places in all parts of the country only a few leagues distant.

5. *Corn Trade of Odessa.* Odessa, on the Black Sea, is the only port in southern Europe from which any considerable quantity of grain is exported. We believe, indeed, that the fertility of the soil in its vicinity has been much exaggerated; but the wheat shipped at Odessa is principally brought from Volhynia and the Polish provinces to

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the south of Cracow, the supplies from which are susceptible of an indefinite increase. Owing to the cataracts in the Dnieper, and the Dniester having a great number of shallows, most part of the corn brought to Odessa comes by land carriage. The expense of this mode of conveyance is not, however, nearly so great as might be supposed. The carts with corn are often in parties of 150; the oxen are pastured during the night, and they take advantage of the period when the peasantry are not occupied with the harvest, so that the charge on account of conveyance is comparatively trifling.

Both soft and hard wheat are exported from Odessa; but the former, which is by far the most abundant, is only brought to England. Supposing British wheat to sell at about 60s., Odessa wheat in good order would not be worth more than 52s. in the London market; but it is a curious fact, that in the Mediterranean the estimation in which they are held is quite the reverse; at Malta, Marseilles, Leghorn, &c., Odessa wheat fetches a decidedly higher price than British wheat.

The hard wheat brought from the Black Sea comes principally from Taganrog. It is a very fine species of grain; it is full ten per cent. heavier than British wheat, and has less than half the bran. It is used in Italy for making macaroni, vermicelli, and things of that sort. Very little of it has found its way to England.

The voyage from Odessa to Britain is of uncertain duration, but generally very long. It is essential to the importation of wheat in a good condition, that it should be made during the winter months. When the voyage is made in summer, unless the wheat be very superior, and be shipped in exceedingly good order, it is almost sure to heat, and has sometimes indeed been injured to such a degree as to require to be dug from the hold with pickaxes. Unless, therefore, means be devised for lessening the risk of damage during the voyage, there is little reason to think that Odessa wheat will ever be very largely imported into Britain.

The entire expense of importing a quarter of wheat from Odessa to London may be estimated at from 16s. to 18s. The exports of wheat from Odessa, and other ports on the Black Sea, to Constantinople, the Levant, Italy, the south of France, &c., have latterly been very large indeed. In 1846 the exports from Odessa only amounted to 1,279,502 quarters, and in 1847 to 2,016,692 ditto; the latter being, we believe, the largest exportation that ever took place in a single year from any single port. Owing to the scarcity in this country, above 400,000 quarters of the above quantity were shipped for England, but the speculation entailed a heavy loss on the importers. The price free on board at Odessa considerably exceeded 40s. a quarter.

6. *American Corn Trade.* The prices of wheat at New York and Philadelphia may be taken at an average at from 37s. to 40s. a quarter; and as the cost of importing a quarter of wheat from the United States to England amounts to from 8s. to 12s., it is seen that no considerable supply could be obtained from that quarter were our prices under 50s. or 52s. It ought also to be remarked, that prices in America are usually higher than in the Baltic; so that but little can be brought from the former, except when the demand is sufficient previously to take off the cheaper wheats of the northern ports. The usual price of wheat in Canada, when there is a demand for the English market, is about 40s. a quarter; but taking it as low as 35s., if we add to this 10s. a quarter as the expenses of carriage, it will make its cost price in Liverpool 45s.; and being spring wheat, it is not so valuable, by about 6s. a quarter, as English wheat.

Owing to the failure of the potato crop in Ireland, Belgium, and other parts of Europe, the exports of flour and of Indian corn and meal from America in 1846 and 1847 were extremely large. Those sent to this country were, however, completely overdone, and occasioned a heavy loss. —We subjoin

Foreign Corn Trade.

An Account of the Exports of Flour and Wheat, Indian Corn and Indian Corn Meal, Rye, Ship-bread, &c., from the United States, during the Year ending 30th June 1847, specifying the Countries to which the same were sent, and the Quantities sent to each.

TO AMERICA.

Articles.	British N. American Colonies.	The West Indies generally.	South America generally.	North America generally.
Flour, ... bbls	272,299	483,571	328,937	66 993
Wheat..... bush	919,053	15,103	...	200
Indian corn ..... —	119 615	593,029	3,964	23,925
Corn meal ..... bbls.	39,936	176,418	2,750	10,351
Rye meal ..... —	27,401	3,480	101	180
Rye, oats, and other small grain and pulse ..... value	D 24,312	D 113,355	D.2,291	D.18,599
Ship bread ..... bbls.	20,506	51,788	1,711	21,218
—— ..... kegs	220	13,267	7,437	673

TO EUROPE

Articles.	Great Britain.	Ireland	France.	Spain and Portugal	Other parts of Europe
Flour ..... bbls.	2,144,581	342,495	612,011	1,312	113,429
Wheat..... bush.	2,078,652	465,911	749,242	...	170,421
Indian corn ..... —	7,527,586	7,998,939	7,218	4,892	22 203
Corn meal ..... bbls	426,070	287,013	4,101	...	605
Rye meal ..... —	4,050	2,362	3,006	...	8,332
Rye, oats, and other small grain and pulse ..... value	D 565,322	D 66,580	D.50,697	...	D 752,081
Ship bread ..... bbls.	34,736	11,994	3,771	...	1,728
—— ..... kegs	6,647	556	16	...	548

TO OTHER COUNTRIES.

Articles.	Asia generally.	Africa generally.	South Seas and Pacific Ocean.	Total quantity to all parts.	Total value of exports.
Flour ..... bbls	8,674	36,800	764	4,382,496	D.26,133,811
Wheat..... bush.	1,362	...	...	4,399,951	6,019,360
Indian corn ..... —	175	24,474	...	16,326,050	14,395,212
Corn meal ..... bbls.	77	436	...	948,060	4 301,334
Rye meal..... —	...	...	...	48,092	225,502
Rye, oats, and other small grain and pulse ..... value	D.4,596	D 2,368	131	...	1,000,962
Ship bread ..... bbls	3,166	5,609	1,753	160,980	556,266
—— ..... kegs	163	1,482	100	31,082	
Total value.....	...	...	...		D 53,262,477

Inferences from the above Review of Prices. We may, we think, satisfactorily conclude, from this review of the state of the foreign corn trade, that, after 1849, when the new system is carried into full effect by the abolition of all restrictions on importation, the price of foreign wheat of about the same quality as average English wheat will, in ordinary years, be but little below 50s. a quarter. But supposing it were to fall to 45s. or even 40s., the latter is a price at which agricultural improvements may be successfully carried on. A most extraordinary improvement has taken place in agriculture since 1820, notwithstanding the heavy fall of prices in the interval. And such being the case, it would be unreasonable to suppose that such a further fall as should reduce our average prices from 54s. or 55s. to 45s., or even less, should have any disastrous influence over agriculture? Improvements of all sorts have seldom been more vigorously prosecuted than in 1834, 1835, and 1836, and yet the average price of corn in those years did not exceed 44s. 8d.; that is, it did not exceed its probable future price with open ports and no duty.

These details with respect to the foreign corn trade have been extracted from the article Corn Trade and Corn Laws in the last edition of Mr M'Culloch's *Commercial Dictionary.* In it the reader will find accounts specifying the different items of charge on the importation of corn from Dantzic, Odessa, the United States, &c.; and to it he is referred for further particulars. (J. R. M.)

Cornage || Corneille.

CORNAGE, an ancient tenure of lands, which obliged the tenant to give notice of invasion by blowing a horn. This tenure was very frequent in the northern counties of England, near the Pictish wall; but by the statute 12th Car. II. all tenures are converted into free and common soccage. An old rental calls cornage *newt-geldt*, or *neat-geldt*. Lord Coke says that in old books it is called *horngeld*.

CORNARISTS, in *Ecclesiastical History*, the disciples of Theodore Cornhert, secretary of the states of Holland, an enthusiast who wrote against the Catholics, Lutherans, and Calvinists simultaneously. He maintained that every religious communion needed reformation; but he added, that no person had a right to engage in accomplishing it without a mission supported by miracles. He also maintained that a person might be a good Christian without being a member of any visible church.

CORNARIUS, or HAGENBUT, JOANNES, a celebrated physician, born at Zwickau, Saxony, in 1500. He was professor of medicine at Marburg, and subsequently at Jena, where he died in 1558. He spent the greater part of his life in translating the works of the Greek physicians, whose systems he wished to inculcate in preference to those of the Arabians. With this view he translated the works of Hippocrates, Ætius, Paulus Ægineta, Dioscorides, and several of those of Galen. He translated also some of the works of the Greek fathers, and wrote *Universæ rei medicæ epigraphe*. Cornarius was at one time engaged in a violent controversy with Fuchs the distinguished botanist.

CORNARO, LUIGI (1466-1566), a Venetian nobleman, famous for his treatises on a sober life. From some dishonesty on the part of his relations he was deprived of his rank, and induced to retire to Padua, where he acquired the experience in regard to food and regimen which he has detailed in his works. In his youth he was of a delicate constitution, and had nearly fallen a victim to his intemperance, when by the advice of his physicians he subjected himself to a severe regimen. He restricted himself to a daily allowance of twelve ounces of solid and fourteen ounces of liquid food; and so much habituated did he become to this simple diet, that when he was above seventy years of age the addition by way of experiment of two ounces a-day had nearly proved fatal. At the age of eighty-three he wrote his treatise on the *The sure and certain methods of attaining a long and healthful life*; and this was followed by three others on the same subject, composed at the ages of eighty-six, ninety-one, and ninety-five, respectively. They are written, says Addison (*Spectator*, No. 195), "with such a spirit of cheerfulness, religion, and good sense, as are the natural concomitants of temperance and sobriety." An English translation of Cornaro's work reached its thirty-ninth edition in 1845.

CORNBRASH, the local name for a member of the Oolitic formation—a rubbly limestone which forms a soil extensively used in Wiltshire for the cultivation of corn.

CORNEA. See ANATOMY, vol. iii. p. 43.

CORNEILLE, PIERRE, the celebrated dramatic author, was born at Rouen in 1606. He was educated for the bar, but soon abandoned law for pursuits more congenial to his taste. A little amorous adventure first developed his poetical talent, the incidents of which are said to have formed the groundwork of *Mélite*, his first comedy. This play contains some ingenious comic combinations, and met with extraordinary success. *Mélite* was succeeded by several other pieces which seemed to indicate no great power; but the genius of Corneille suddenly took a loftier flight, and produced the tragedy of *Médée*. His fame, however, was not completely established till the appearance of the *Cid* in 1637, which at once placed him in the first rank of dramatic writers, and drew down the envy and persecution of Richelieu, who was as despotic in the realm of criticism as in that of state policy. But the cardinal found taste to be more stubborn than politics; and the man who swayed kingdoms could not crush the fame of a poet. The *Cid* was so universally admired, that it became proverbial to say of anything beautiful, *Cela est beau comme le Cid*. This excellent tragedy was followed by the *Horace*, *Cinna*, *Pompée*, *Polieucte*, the comedy of *Le Menteur*, and numerous other dramatic pieces. Corneille, who is said to have been of a devout and melancholy cast, wrote a translation in verse of Kempis' *Imitation of Jesus Christ*, and some smaller poems. He was dean of the French Academy at the time of his death, which took place in 1684, in the seventy-ninth year of his age. Corneille.

From the appearance of the *Cid* the literary age of Louis XIV. dates its commencement; and to Corneille is generally assigned the honourable title of the father of dramatic art in France, which was afterwards so successfully cultivated by Racine, Molière, and Voltaire. His best works display forcible conception and delineation of character. He raises sentiment into true poetical pathos and sublimity, and exhibits the contending passions, affections, and interests of human nature in all their turbulence and impotency, with great vigour of thought and expression. Many of his descriptive passages are marked with singular beauty: his dialogues are skilfully conducted, giving rise to bold declamation, replete with rich imagery, and glowing with fervour and energy. The vividness with which some of the replies are made is one of the most striking characteristics of his dramas. The celebrated exclamation of the elder Horace, *qu'il mourût*, is a well-known illustration of this peculiar quality in the colloquial power of Corneille. His style is occasionally rather formal and pompous, and his sentiments forced and even wire-drawn. But in general he is true to nature, and few writers have been more successful in re-animating and reproducing on the stage the heroes of antiquity. The tragedies of Corneille contain some of the best specimens of chaste diction, and varied and harmonious versification, which are to be found in the French language. The dramatic works of Corneille, with commentaries by Voltaire, were published at Geneva in 1764, in 12 vols. 8vo. This edition has been several times reprinted. An edition of his whole works, with observations by Palissot, was published at Paris in 1802, in ten large octavo volumes. See DRAMA. (A. H.)

CORNEILLE, *Thomas*, brother of the preceding, was born at Rouen in 1625. He gave early indications of his poetical talent; and his plays, when first produced on the stage, attained the very highest popularity. They are remarkable for the purity of their style; but from the haste and carelessness of their composition, they have long since been forgotten. He was elected a member of the French Academy; and on the death of his brother he contributed to the *Dictionnaire*. He also wrote *A Translation of Ovid's Metamorphoses, and some of Ovid's Epistles*, Paris, 1669; *Remarks on "Vaugelas on the French Language,"* Paris, 1687, 2 vols. 12mo; *A Dictionary of Arts and Sciences*, 2 vols. fol., Paris, 1694-1732; *A Universal Geographical and Historical Dictionary*, 3 vols. fol., Paris, 1708; and some other works. Thomas Corneille died at Andelys in 1709, having lost the use of his sight during the latter years of his life.

CORNEILLE, *Michael* (1642-1708), a celebrated painter, was born at Paris, where his father was a painter of considerable merit. Having gained a prize at the academy, young Corneille was rewarded with a pension from Louis XIV. and sent to Rome, where that prince had founded a school for young artists of genius. After studying there for some time, he gave up his pension, and applied with great industry to the study of the antique. He is said to have equalled the Caracci in drawing, but in colouring he was deficient. Upon his return from Rome he was made a

Cornelia ‖ Cornwall.

professor in the academy of Paris, and was employed in all the great works then in progress at Versailles and the Trianon, where some specimens of his genius are still to be seen.

CORNELIA, a celebrated Roman lady, the younger daughter of Scipio Africanus the elder, and mother of the two tribunes Tiberius and Caius Gracchus. On the death of her husband she was left with twelve children, and refused even the solicitations of Ptolemy to make her his queen. The rest of her children dying in infancy, she became the more devoted to her only daughter Cornelia (afterwards the wife of Scipio Africanus the younger), and to her two sons. She is said to have presented these sons to a Campanian lady, who displayed her ornaments and asked a sight of her jewels in return, "as the only jewels of which she could boast." After the murder of Caius she retired to Misenum, where she devoted herself to literature and domestic pursuits. After her death a statue was erected to her memory, bearing this inscription—"Cornelia, mother of the Gracchi."

CORNET, in *Music*, a small horn. A wind instrument anciently used in war. The pistoned cornet is of recent invention.

CORNET (Ital. *cornetta*, a small flag), in modern military economy, an officer of cavalry who bears the standard or colours of a troop.

Some derive the term from *cornu*, because the cornet is placed on the wings, which form the points or *horns* of an army. See COMMISSION.

CORNICULARIUS, in *Antiquity*, an officer in the Roman army who led the wing of a small division of troops; or, according to some, an adjutant of a centurion, tribune, &c. The term is derived from *corniculum*, a little horn, with which the cornicularius was presented on promotion. Salmasius, however, derives it from a horn-shaped crest worn on the helmet as a reward of valour.

In the civil service, the term *cornicularius* was used for a secretary or assistant; in which sense the word is supposed to come from *corniculum*, a little horn to contain ink.

CORNU. See HORN.

CORNU AMMONIS, a shell shaped like a ram's horn; a name sometimes applied to the fossil shells called *ammonites*.

CORNUCOPIA (*Cornu Copiæ*), among the ancient poets, is the emblem of fruitfulness and plenty, and was represented under the form of a horn out of which proceeded fruits, flowers, and abundance of all things. This, according to the fable, was one of the horns of the goat Amalthæa, by which Jupiter was suckled. (See AMALTHÆA.) The interpretation of the fable (according to Diodorus, iii. 68) is, that in Libya there was a small but exceedingly fertile territory, shaped not unlike a bull's horn; and this was bestowed by King Ammon on his bride Amalthæa, who nursed the infant Jupiter with the milk of a goat.

The cornucopia is frequently represented in works of art. On medals, as observed by Joubert, the cornucopia is given to all deities.

> First Ceres, in her chariot seated high,
> By harness'd dragons drawn along the sky;
> A cornucopia fills her weaker hand,
> Charged with the various offspring of the land,
> Fruit, flowers, and corn.
>
> Hughes—*The Triumph of Peace.*

CORNUS, a genus of *Caprifoliaceæ*, including many ornamental shrubby plants and trees. The *cornel* or *C. mascula*, *C. sanguinea*, *C. seriaca*, are of this number.

CORNWALL is the most westerly county in England, and also stretches farthest to the south. It is bounded on all sides by the sea, except on the east, where it meets Devonshire in a few places, and is separated from it for the most part by the river Tamar. From this last boundary its breadth diminishes till it terminates on the west at the Land's End, in west longitude 5. 41. 31., and on the south at the Lizard Point, in north latitude 49. 57. 30., assuming somewhat of the form of a cornucopia; its boundaries, the Bristol Channel on the north, and the English Channel on the south, meeting in a point at the promontory on the west. It is situated in the diocese of Exeter, belongs to the western circuit, covers an area of 854,770 acres or about 1136 square miles, contains nine hundreds, 201 parishes, twenty-eight market towns, and, in 1851, 355,558 inhabitants, being over 396 to the square mile. The population of the county has increased 54,242 since 1831. Since 1801 the increase has been 84 per cent. The waste lands are about one-fifth of the whole. The surface is very irregular, exhibiting a rapid succession of ascents and descents. The interior is high and generally barren, consisting for the most part of rugged heaths and moors; yet Brown Willy, the highest hill, is only 1368 feet above the level of the sea at low water. Some beautifully picturesque valleys intervene, richly diversified with corn, wood, coppices, orchards, rivulets, and verdant meadows. The stupendous rocks which form the great barriers against the ocean, particularly about the Land's End and the Lizard, are calculated to impress powerfully the imagination of the beholder; whilst the remains of an early age, military, civil, and religious, dispersed over the county, present, in striking contrast, the small scale on which the works of man are conducted, and the instability of human affairs. Throughout the higher lands the soil is a light black earth, intermixed with gravel, the detritus of the granite, or *growan*, as it is here called; but a light loam, mixed with slaty matter, is most prevalent on the gentle declivities and lower grounds. Clay of various qualities is found in different places, and is made into bricks for furnaces, or into moulds for casting metals. For nine months in the year the wind blows from points between the west and south, bringing with it from the Atlantic vast bodies of clouds, which, being broken by the narrow ridge-like hills of the county, descend in frequent showers. Storms are more frequent and violent than in the inland parts of England, particularly from the north-west; but from this quarter the wind is generally dry, and brings fair weather. The climate is healthy, and the instances of longevity are numerous. Snow seldom lies for more than a few days. The myrtle, the balm of Gilead, and many other tender plants and shrubs, thrive in the open air; yet the most hardy trees on the sea coast sustain much injury from the violence of the westerly wind, and the sea spray, which it drives with great force before it. The only shrub which seems to bear the sea air is the tamarisk (*Tamarix anglica*), a native plant with a bitter astringent bark, which grows to the height of ten or twelve feet in seven years in situations most exposed to the sea, forming an admirable shelter, and which, as it bears cutting, might be useful also as a fence; yet it is destroyed by severe frosts. It is easily propagated by cutting. Plantations of the pinaster (*Pinus Pinaster*) have been raised within the present century as a protection to more tender trees. The sea air will ever present an insuperable barrier to the wooding of this county. The principal rivers are the Tamar, the Lynher, the Looe, the Fawy, the Camel or Alan, and the Fal. The Tamar is the most considerable. It rises on the summit of a moor in the parish of Morvinstow, the most northern in the county, and, taking a southerly direction, falls along with several tributary streams into the spacious basin called the Hamoaze. Issuing thence between Mount Edgecumbe and the Devil's Point, it unites with the waters of the Plym; and the conflux of these rivers with the sea forms the noble roadstead named Plymouth Sound.

Cornwall.

The landed property of Cornwall is very much divided, few estates producing a rent of more than L.3000, exclusive of the revenues from mines, which are continually fluctuating. What are called the Duchy lands are far more extensive. The income derived from them, and from the

Cornwall. duty on the "coinage" of tin, is the only part unalienated of the immense hereditary revenues which formerly constituted an independent provision for the heir-apparent to the crown. This provision was originally made by Edward III. for his eldest son, Edward the Black Prince, whom he created Duke of Cornwall, with special limitation to the first begotten sons of him and his sons, kings of England for ever. The occupiers of these estates are lessees under the Duke of Cornwall, and generally purchase an interest in the land during three lives, the consideration being a fine paid at the time of the grant, and also a reserved rent during the lease. A lease for three lives is common on church lands, and formerly was not unfrequent also on private estates. Leases at rack-rent seldom exceed fourteen years. The farms are in general very small, and, in the western and mining districts, they are chiefly cottage holdings. Agriculture, being but a subordinate concern here, is not generally pursued with much spirit or success; and the fines paid for their long leases deprive the farmers of that capital which should be invested in the improvement of the soil from year to year. Their best cattle are of the North Devon breed, and are much employed in labour. The oxen are generally put into harness at three years old, and continue until they attain the age of seven or eight, when they are fed for the market. Owing to the roughness of some of the roads it is necessary to have them shod. Four or six oxen are frequently put into a plough. The breed, which is said to be a cross between the Alderney and old Cornish, is light and active, and possessed of considerable powers of endurance. The native sheep of the county, now nearly extinct, belonged to one of the worst breeds in Britain. A great many different breeds have been introduced from other districts. The backs of horses or mules are used more frequently than carts or waggons as the means of transport. Barley, oats, and potatoes are grown in greater quantities than are necessary for the wants of the county; but a large quantity of wheat or flour is imported for the mining districts. In the neighbourhood of Penzance two crops of potatoes are commonly obtained every year. Sea-sand, sea-weed, and damaged pilchards, are used to a considerable extent as manure. With this manure the soil generally yields 70 to 80 bushels of barley, or from 300 to 600 bushels of potatoes to the acre.

Cornwall has long been distinguished by its mineral treasures, of which the most valuable are tin and copper. The strata in which these metals are found extend from the Land's End, in a direction from west to east, to the Dartmoor Hills, in Devonshire, and consist chiefly of granite and a variety of the grauwacke, here called *killas*. The chief seat of the mines now lies in the neighbourhood and to the westward of St Austel, from which place to the Land's End the principal mines are to be found, extending along the northern coast, and keeping a breadth of about seven miles. These metals are commonly found in veins or fissures called *lodes*, of which the sides or walls do not always consist of the same substance, nor are they equally hard; for, though one side of the fissure may be a dense stone, the other is sometimes as soft as clay. Many lesser veins branch from the great lodes like the boughs of a tree, and at last terminate in threads. The indications of a vein of metal are various, such as scattered fragments of ore, called *shodes*, the metallic taste of springs, and the lustre of pebbles in the beds of streams. Many rich lodes have been discovered by working *drifts* across the county, in the directions of north and south. From the course of the metals being from west to east, the lode will thus be cut at right angles. The use of the divining rod, now become obsolete, is said to have been introduced by the Phœnicians, who worked the tin mines long before the Christian era. See MINING.

Tin is found collected and fixed, and also in a loose and dispersed form. In the former state, it is either in a lode, or a *floor* which is a horizontal layer of the ore; or interspersed in grains and small masses in the natural rock. The same lode that has continued perpendicular for several fathoms is sometimes found to extend suddenly into a floor. Cornwall. In its dispersed form it is met with either in a pulverized state, in separate stones called *shodes*, or in a continued course of stones called a *stream*. These streams are of different breadths, seldom less than a fathom, and often scattered, though in different quantities, over the whole tract in which they are found. When several streams meet they frequently make a very rich floor. The principal stream work is at Carnon, between Truro and Penryn.

The most common state in which tin ore is found in this county is the calciform, or glass-like; and its most prevalent matrix is either an argillaceous or a siliceous substance, or a stone composed of both, called by the miners *caple*. None of the calcareous kinds ever appear contiguous to the ore, except the *fluors*. The oxides of iron and arsenic are those with which the tin is most frequently blended. When raised from the mine it is divided into as many shares or *doles* as there are lords and adventurers. Every mine possesses the privilege of having the ore distributed on the adjacent fields. It is generally pounded or stamped on the spot; and when it is small enough to pass through the holes of an iron grate fixed in one end of the box where the *lifters* work, it is carried by a small stream into pits, from which it is transferred into a large vat, washed, and rendered sufficiently clear for the smelting-house. The tin, when wrought into metal, is cast into blocks weighing from $2\frac{3}{4}$ to $3\frac{3}{4}$ cwt. each, which are not saleable till assayed by the proper officers, and stamped with the duchy seal. This is termed *coining* the tin. Since the reign of Henry VIII. the coinages have been held regularly four times annually, at Lady Day, Midsummer, Michaelmas, and Christmas, at the stannary towns of Launceston, Lostwithiel, Truro, and Helston, to which Penzance was added by Charles II. The annual produce of the tin mines is about 500 tons. The value of the metal is at present L.70 per ton.

Copper ores are found in great abundance and variety. Veins are frequently discovered in cliffs that are laid bare by the sea. The most encouraging indication of a rich ore is an earthy iron ochre, called *gossan*, which is of a brownish colour, and crumbles in the atmosphere. The ore does not lie at any particular depth; but it is a general rule, that, when copper is discovered in any fissure, the lode should be sunk upon, as it commonly proves best at some distance below the surface. When the metal has been properly refined, it is poured into oblong iron moulds, each containing about 150 lb. weight. The annual produce of copper is about 10,000 tons, valued at about L.95 per ton. Copper mines were not worked in Cornwall before 1700.

Many other minerals have been found in this county, and much capital and labour have been employed in working some of them, without their yielding any adequate return; yet the success has been in a few instances so great, that new mines are opened as fast as the old ones are abandoned. We can only mention some of the more important. *Lead* mines are not numerous; and the kind of ore most frequently found is *galena*, or sulphuret of lead, which is met with both crystallized and in masses. The principal mines are Huel Pool and Huel Rose, near Helston. *Gold* has been discovered, but until lately not in such quantity as to warrant operations to procure it. Within a short time it has been found diffused in the *gossan* in minute particles that promise a remunerative return. *Silver* is reported to have been obtained here in so large a quantity, in the reigns of Edward I. and Edward III., as materially to aid the warlike enterprises of these monarchs; but recent searches have not been so successful. *Iron* ores, *sulphuret of iron*, of various colours, often intermixed with the copper lodes, *bismuth*, *zinc*, *antimony*, *cobalt*, *arsenic*, *manganese*, *wolfram*, *titanium*, and *molybdena* or sulphuret of molybdenum, are all found here, most of them in considerable abundance. According to Phillips' map of the mines in 1800, there were

Cornwall. wrought at that time forty-five of copper, twenty-eight of tin, eighteen of copper and tin, two of lead, one of silver, one of lead and silver, one of copper and silver, one of copper and cobalt, one of tin and cobalt, and one of antimony.

Among the other mineral substances of this county, those that deserve to be mentioned for their value are *slate*, of which there is an excellent quarry wrought near Tintagel, in the northern part of the county; a *freestone*, resembling the Portland and Bath stone, in the parishes of Carantoc and the lower St Colomb; and the celebrated *soap-rock* steatite, between the Lizard and Mullion, used in the manufacture of porcelain, and rented by the proprietors of an earthen-ware establishment in Worcester. But the most important of these substances is what is called the *China-stone*, found in the parish of St Stephen, near St Austel, which forms a principal ingredient in all the Staffordshire pottery. It is a decomposed granite, the felspar of which has lost the property of fusibility. At Truro it has been manufactured into retorts and crucibles. To these may be added the *Cornish diamonds*, supposed to be the finest in England, consisting of beautifully transparent quartz, crystallized in six-sided prisms; and a curious production called the *swimming stone*, found in a copper mine near Redruth, the cellular structure of which renders it lighter than water.

Fisheries. Of the fish which frequent the Cornish coast, the pilchard is the most common and valuable. In size and form it differs but little from the common herring. Immense shoals appear during the summer and autumn, the first generally arriving at the Land's End in the middle of July. The principal fisheries on the southern coast are in Mount's Bay, and thence eastward to Devonshire; and, on the northern side, at St Ives. The pilchards are caught in nets called *seines*, each of which is managed by three boats, containing from seventeen to twenty-four men. The largest of these nets is two hundred and twenty fathoms long, sixteen fathoms deep in the middle, and fourteen at each end. When brought on shore the fish are carried to storehouses, or *cellars* as they are termed, where the small and broken fish are picked out. They are then disposed in layers on the pavement of the cellar, salt being strewed between every layer. In this state they remain for about six weeks, after which they are taken up, washed, and placed in hogsheads, in which, by means of a powerful lever, they are pressed so closely as when turned out to appear in a compact state. By this process the oil is extracted, which runs out of the casks through holes made for the purpose. Forty-eight hogsheads generally yield a tun of two hundred and fifty-two gallons. The annual take of pilchards averages about 21,000 hogsheads. The *blower* or *fin fish*, the *grampus*, the *porpesse* or *sea-hog*, the *blue shark*, and the *sea-fox*, visit the coasts of this county. Among the Squalidæ is the *Squatina angelus*, named *the monk* or *angel-fish*. The *turbot*, the *sea-pike*, and the singular fish called the *sun-fish*, are often taken. *Mackerel* is caught in great plenty on the southern coast; as also the *red mullet*, and the *John Dory*; and *conger eels* of an extremely large size, weighing from sixty to a hundred and twenty pounds, are met with near the shores. *Oysters* are also found in great abundance.

Antiquities. The name of Cornwall is supposed by some to be compounded of *Carn*, signifying "a rock" in the British language, and *Gauls* or *Waals*, the name which the Saxons gave to the Britons. Others, however, think it is derived from the Latin *cornu*, or the British *kern*, "a horn;" on account of its running out into the sea somewhat in the form of a horn. Hither the ancient Britons, as in Wales, retired on the intrusion of the Saxons, and opposed their further conquests. In this part of the island they formed a kingdom (A.D. 446) which existed for many years afterwards under different princes, amongst whom were Ambrosius Aurelius, and the justly celebrated Arthur; nor were they subdued till the middle of the seventh century; from which time Cornwall was considered as subject to the West Saxon kings, who began their sovereignty in 519, and continued it till 828, under eighteen sovereigns, the last of whom was the great Egbert, who subdued all the others, and, by uniting them, formed the kingdom of England. On that occasion this county was included in the county of Devon, then the ninth division. In 1337 Edward III. erected it into a dukedom, and invested with it Edward the Black Prince. But this privilege, according to the express words of the grant, is limited to the first-born son and heir; on which account Richard II. was created Duke of Cornwall by charter. So was Henry V. by his father Henry IV. Henry VI. delivered the duchy to his son Prince Edward, and Edward IV. created his son Edward V. Duke of Cornwall, as did Henry VII. his son, afterwards Henry VIII. upon the death of his elder brother Arthur. James I created his son Henry Duke of Cornwall, which title on his decease came to his brother Charles. The eldest sons of succeeding kings have enjoyed this title by inheritance. These not only appoint the sheriff, but all writs, deeds, &c. are made out in their name, and not in that of the king. Cornwallis.

Language. The Cornish language is a dialect of that which, till the Saxons came in, was common to all Britain, and more anciently to Ireland and part of Gaul; but the inhabitants of this island being dispersed before those conquests, and driven into Wales and Cornwall, and thence into Bretagne, the same language, for want of frequent intercourse, became differently pronounced and written, and in different degrees mixed with other languages. Hence arose the Welsh, the Cornish, and the Armoric dialects, the roots of which are so much alike that they are known and admitted by the inhabitants of either country; but the grammar is so varied that they cannot converse. The Cornish is reckoned the most pleasing of the three. It was spoken so generally here down to the reign of Henry VIII. that Dr John Moreman, vicar of Mynhinet, is said to have been the first who taught his parishioners the Lord's prayer, the creed, and ten commandments, in English; and at the Reformation the natives desired to have the service in English.

Among the old churches in the county may be mentioned St Neot's at Truro, with its celebrated stained windows; Duloe with its curious sculptures in slate; and the cathedrals of St Germains and Bodmin.

Cornwall returns four members to parliament for the county, and ten for the burghs.

CORNWALLIS, CHARLES, the first Marquis, second Earl, and sixth Baron Cornwallis, was born Dec. 31, 1738, of an ancient and honourable family, which had been settled during many centuries in the county of Suffolk. He was educated at Eton School, and afterwards entered of St John's College, Cambridge, by the name and title of Lord Brome. Having exhibited an early partiality for the military profession, he entered the army when about 17 or 18 years of age, and in 1758 attained the rank of captain in Colonel Crawford's light infantry. Three years afterwards he accompanied the Marquis of Granby to the Continent, in the capacity of aide-de-camp, and with the rank of major; and in consequence of his good conduct he was soon afterwards promoted to be lieutenant-colonel of the twelfth regiment of foot. At this period he had also a seat in the House of Commons, as the representative of his patrimonial borough of Eye. Upon the demise of his father in 1762, he became a peer of Great Britain, under the title of Earl Cornwallis. In 1765 he was nominated one of the lords of the bed-chamber; and about the same time he was appointed aide-de-camp to his Majesty George III., which gave him the rank of colonel in the line. The favours conferred on him by the court, however, had not the effect of corrupting the natural integrity of his mind. He carefully distinguished between his duties as a senator and as a soldier; and in his capacity of peer of parliament, he displayed

Cornwallis. the independence of his character in several important questions, by voting against the measures of the administration. From the very beginning, he showed himself inimical to those steps which led to the contest with the American colonies; and was one of four peers who joined Earl Camden in opposing the bill for extending the legislative power of Great Britain to our Transatlantic provinces. He also protested against the proceedings of ministers in the case of Mr Wilkes. In 1766 he was promoted to the command of the 33d regiment of foot; and two years afterwards he married Jemima, daughter of James Jones, Esq.

But although Lord Cornwallis had uniformly and decidedly opposed those coercive measures which produced the contest with America, he did not hesitate to repair thither, in the service of his country, when his professional exertions were required. Accordingly, when his regiment was ordered for embarkation, although special leave of absence had been obtained for him from the king, he resolved to share the fatigues and dangers of foreign service, and took leave of his wife, who was so much affected by the separation that she sunk under the weight of her grief into a premature grave.

Having proceeded to his destination, Cornwallis took an active part in the subsequent campaigns. Soon after his arrival in America, he served, with the rank of major-general, under Sir William Howe, and distinguished himself as an able and enterprising partizan; in the month of November 1776, he landed on the New Jersey shore; and finding Fort Lee evacuated, he immediately penetrated into the country, and took possession of the province. His lordship, however, soon discovered that this was a contest in which the triumphs of skill, valour, and discipline, were not attended with the usual consequences of victory; and that the nature of the country, and the mode of warfare adopted by the provincial generals, opposed many obstacles to a speedy and successful termination of hostilities. At the end of the campaign he repaired to New York, with the view of embarking for England, in order that he might have an opportunity of explaining to the British ministry the real situation of affairs; but having received information of the disasters at Trenton, he deferred his voyage, and returned to the Jerseys.

The first enterprise of Lord Cornwallis, in the campaign of 1777, was an attempt to surprise an American post in his neighbourhood, in which he partly succeeded. Soon afterwards he received orders from General Howe to abandon the Jerseys; and in the month of July he embarked with the English commander-in-chief on the expedition to the Chesapeak. In several of the subsequent events of this campaign Cornwallis was actively engaged. At the passage of the Brandywine river he commanded a considerable body of troops; and after driving the enemy before him, he entered and took possession of Philadelphia on the 24th of September 1777. From that period he seems to have had little opportunity of signalizing himself until the campaign of 1779–1780, when he embarked as lieutenant-general, with Sir Henry Clinton, on the expedition to South Carolina. At the siege of Charlestown, Lord Cornwallis performed eminent services, having attacked and dispersed a body of militia which was hastening to the relief of the place. On the surrender of the town, the command of the province of South Carolina, with about 4000 troops, devolved upon him. He was opposed by General Gates, who had previously distinguished himself in the actions with Burgoyne, and who was now appointed to the chief command of the provincial forces in South Carolina. Gates, having received intelligence of the situation of the royal troops, advanced rapidly towards Cambden, with the design of making an attack on the British lines. Lord Cornwallis, however, having determined not to await the approach of the Americans, left his position, and marched against them with a greatly inferior force. The two armies met on the 16th of August, Cornwallis. in a narrow place, where the colonial troops could not avail themselves of their superior numbers. The British general, perceiving the advantage which the ground afforded him, commenced the assault, and the action soon became general. The determined gallantry of the British troops, who charged with the bayonet, at length compelled the enemy to give way, and they were pursued nearly twenty miles from the field. Many of the colonial troops fell in this engagement; 1000 men were taken prisoners; and seven pieces of cannon, together with the greater part of the ammunition and stores of the provincial army, remained in possession of the British. But this success, brilliant as it was, produced no permanent advantage to the cause of the royalists, and was more than compensated by the misfortunes which ensued. In 1781, Lord Cornwallis, having withdrawn with the force under his command into York Town, was surrounded by a numerous American army commanded by Washington; and finding all attempts to repel the besiegers, or to escape through their lines, ineffectual, he was under the necessity of submitting to a capitulation, by which his whole army became prisoners of war.

Lord Cornwallis now returned to his native country. During the political contests which took place in 1782 and 1783, his lordship was deprived of his situation as constable of the Tower, which, however, was restored to him in 1784. For some years following, his talents were not called into exercise by any conspicuous public employment. But when the affairs of India began to assume a very critical aspect, he was selected as the person best qualified to fill the important situation of governor-general; and he was at the same time invested with the Order of the Garter. Soon after his arrival in India, the Company were involved in a war with the formidable sovereign of the Mysore, Tippoo Sultan, son of the famous Hyder Ali. The conduct of hostilities was at first intrusted to the Madras government; but towards the end of the year 1790 the governor-general assumed the command of the grand army, and took the field in person. As the events of this war will be detailed in another part of this work, it is unnecessary for us to recapitulate the narrative here. It is sufficient to observe that, by a combination of vigour and prudence, the contest was brought to a successful termination in the course of two campaigns. Tippoo, beaten in the field, and forced to confine his efforts to the defence of his capital, was at length compelled by necessity to submit to such terms as the British commander choose to dictate, and to purchase peace by the sacrifice of half his dominions, and a large portion of treasure. The power of the sultans of Mysore, the most formidable enemies of the British government in India, was thus effectually undermined, and the train laid for its subsequent annihilation.

At the conclusion of the war in India, Lord Cornwallis returned to England. He was now (1792) created a marquis; admitted a member of the privy-council; and, in addition to his other appointments, he was nominated to the lucrative office of master-general of the ordnance, which gave him a seat in the cabinet. A few years afterwards his talents were again required for the public service. Ireland being in a state of ferment, harassed with insurrection, and menaced with foreign invasion, the Marquis of Cornwallis was invested with the viceregal powers, and assumed the government in 1798. His administration was short but successful: an invading army was made captive; some of the abuses which prevailed in the internal government of the kingdom were reformed, and tranquillity was restored. On the union of Ireland with great Britain, he resigned the government of the country, and returned to England. In 1801 he was appointed plenipotentiary to the congress assembled for the purpose of negotiating a general peace, which terminated in the definitive treaty of Amiens.

Coro ‖ Coromandel.

Having been thus from his early years actively, and almost uninterruptedly, engaged in the service of his country, it might have been supposed that his lordship, who had now attained an advanced age, would have been permitted to pass the remainder of his life in the enjoyment of domestic repose. But the new and extensive acquisitions of the East India Company had brought their affairs into a state of embarrassment; and the talents and experience of the Marquis of Cornwallis pointed him out as the individual most likely to restore order and tranquillity to our territorial possessions in Asia. He accordingly repaired thither a second time in 1805, as governor-general and commander-in-chief of the forces.

On his arrival at Calcutta, he found the finances of the country in a most deplorable state; whilst several of the most powerful of the native princes were still in arms, or preparing anew for hostilities. His first object, therefore, was to adopt a variety of arrangements for the purpose of introducing order and economy into the civil department; and he then resolved to place himself at the head of the army. But at this critical moment our eastern empire was unfortunately deprived of his services. Bodily fatigue, mental exertion, and the vicissitudes of climate, had undermined his constitution; and his health was now so much impaired, that he was obliged to perform his journey by slow and easy stages. Nature at length became completely exhausted; and he died Oct. 5, 1805, at Ghazepore, in the province of Benares, in the sixty-sixth year of his age. He was buried with great pomp; and every mark of respect was paid to his merit. The inhabitants of Calcutta voted a mausoleum, and those of Bombay a statue, to his memory. His lordship was only once married, and left two children, a son and a daughter.

Marquis Cornwallis was endowed in no small degree with those qualities which lead to distinction both in the cabinet and in the field, and rendered important services to his country as a statesman and a general. In council, he displayed moderation and coolness; in conduct, firmness, resolution, and vigour. In public life, he was distinguished by independence of character and inflexible integrity; in private, he was respected and esteemed for his humanity and benevolence. (J. C.)

CORO, a maritime town of Venezuela, and at one time its capital, but now the capital of a province of its own name. The town is meanly built, with few public edifices; and its trade with the West Indies, formerly considerable, has greatly declined. Pop. probably about 8000. Lat. 11. 23. N.; Long. 69. 48. W.

COROLLA (Lat. *corolla*, a little crown), in *Botany*, the most conspicuous part of a flower, surrounding the organs of reproduction, and composed of one or more flower-leaves called petals. According as there may be one, two, or three petals, the corolla is said to be monopetalous, dipetalous, tripetalous, &c.

COROLLARY (Lat. *corollarium*, a gift or donation over and above what is due), a conclusion or consequence drawn from something already advanced or demonstrated. Thus, it being demonstrated that a triangle which has two equal sides has also two angles equal, it follows as a corollary, that a triangle which has three sides equal has also its three angles equal.

COROLLET, or COROLLULE, in *Botany*, a term denoting the little partial flowers which make up a compound one.

COROMANDEL. This coast extends along the western side of the Bay of Bengal, from Point Calymere in Lat. 10. 17. to the mouths of the Krishna river, and is about 350 miles in length. By license, however, the term "Coast of Coromandel" is usually extended so as to include the coast northward as far as Point Palmyras in Lat. 20. 45., a further distance of 550 miles. Along the whole extent of this coast there is not a good harbour, though there are several flourishing towns; and, with the exception of the Bay of Coringa, there is an extreme difficulty in landing, on account of the surf, except where proper boats are provided. The northerly winds generally begin to blow on the coast of Coromandel and in the Bay of Bengal about the middle of October; and for the first three months with such violence that it is very unsafe to approach. This is the north-east monsoon. About the middle of April the southerly winds commence, and continue till October, during which period vessels may approach the coast in perfect security. The north-east monsoon is accompanied at its commencement with violent thunder and tempests; and these storms continue from October to December, and sometimes even to January. During summer, from April to October, when the north-east monsoon commences, a hot wind blows during the day over the land, and parches up everything; so that the country resembles a barren wilderness, nothing appearing green except the trees. At night the heat is relieved by refreshing breezes from the sea. These hot winds, however oppressive and adverse to vegetation, are supposed to purify the air; and it is accordingly observed by all Europeans, that the longer they continue, the ensuing months are more healthy. During the season of the periodical rains vegetation is hastened, the plants revive, and a beautiful verdure is spread over the country. (E. T.)

Coron ‖ Corona.

CORON, or KORON, a seaport of Messenia, in the Morea, on the Gulf of Kalamata, representing the ancient Colonides. The town is small, but it has a strong citadel. The harbour is open to the south, and the shores are oozy.

CORONA, or HALO, in *Optics*, a luminous circle surrounding the sun, the moon, the planets, or fixed stars. Sometimes these circles are white, and sometimes coloured like the rainbow; sometimes one only is visible, and sometimes several concentric coronas make their appearance at the same time. Those which have been seen about Sirius and Jupiter were never more than three, four, or five degrees in diameter; those which surround the moon are also sometimes no more than three or five degrees; but these, as well as those which surround the sun, are of very different magnitudes, viz., of 12° 0′, 22° 35′, 30° 0′, 38° 0′, 41° 2′, 45° 0′, 46° 24′, 47° 0′, and 90°, or even larger than this. Their diameters also sometimes vary during the time of observation, and the breadths both of the coloured and white circles are very different, viz. of two, four or seven degrees.

The colours of these coronas are more diluted than those of the rainbow; and they are in a different order, according to their size. In those which Newton observed in 1692, they were in the following order, reckoned from the inside: In the innermost were blue, white, and red; in the middle were purple, blue, green, yellow, and pale red; in the outermost, pale blue and pale red. Huygens observed red next the sun, and a pale blue outwards. Sometimes they are red on the inside and white on the outside. Weidler observed one that was yellow on the inside and white on the outside. In France one was observed in 1683, the middle of which was white; after which followed a border of red; next to it was blue, then green, and the outermost circle was a bright red. In 1728 one was seen of a pale red outwardly, then followed yellow, and then green, terminated by a white.

These coronas are very frequent. In Holland, says Muschenbroeck, fifty may be seen in the day-time, almost every year; but they are difficult to be observed, unless the eye be so situated that not the body of the sun, but only the neighbouring parts of the heavens, can be seen. Middleton remarks, that this phenomenon is very frequent in North America, there being generally one or two about the sun every week, and as many about the moon every month.

Corona. Halos round the sun are very frequent in Russia. Æpinus relates, that from the 23d of April to the 20th of September 1758, he himself had observed no less than twenty-six, and that he has sometimes seen twice as many in the same space of time.

Coronas may be artificially produced by placing a lighted candle in the midst of steam in cold weather; also, if glass windows be breathed upon, and the flame of a candle be placed some feet from it, while the spectator is also at the distance of some feet from another part of a window, the flame will be surrounded with a coloured halo; and if a candle be placed behind a glass receiver, when air is admitted into the vacuum within it, at a certain degree of density, the vapour with which it is loaded will form a coloured halo round the flame. This was observed by Otto Guericke. In December 1756 Muschenbroeck observed, that when the glass windows of his room were covered with a thin plate of ice on the inside, the moon appearing through it was surrounded with a large and variously coloured halo; and on opening the window, he found that it arose entirely from that thin plate of ice, for none was seen except through it.

Similar in some respects to the halo was the remarkable appearance which Bouguer describes, as observed by himself and his companions on the top of Pichincha, in the Cordilleras. When the sun was just rising behind them, so as to appear white, each saw his own shadow projected in the air, and no other. The distance was such, that all the parts of the shadow were easily distinguishable, as the arms, the legs, and the head; but what was most surprising was, that the head was adorned with a kind of glory, consisting of three or four small concentric crowns, of a very lively colour, each exhibiting all the varieties of the primary rainbow, and having the circle of red upon the outside. The intervals between these circles continued equal, though the diameters of them all were constantly changing. The last was very faint; and at a considerable distance was another great white circle which surrounded the whole. As nearly as Bouguer could compute, the diameter of the first of these circles was about 5⅔ degrees, that of the second 11, that of the third 17, and so on; but the diameter of the white circle was about 76 degrees. This phenomenon never appeared but in a cloud consisting of frozen particles, and never in drops of rain like the rainbow. When the sun was not in the horizon, only part of the white circle was visible, as frequently observed afterwards by Bouguer.

Similar also to this curious appearance was one observed in Scotland. The observer saw a rainbow round his shadow in the mist, when he stood upon an eminence above it. In this situation the whole country seemed, as it were, buried under a vast ocean, nothing but the tops of distant hills appearing here and there rising above the flood. In those upper regions the air was at that time very pure and agreeable to breathe. At another time the same individual observed a double range of colours round his shadow in these circumstances. The colours of the outermost range were broad and very distinct, and everywhere about two feet distant from the shadow. Then there was a darkish interval, and after that another narrower range of colours, closely surrounding the shadow, which was very much contracted. He was of opinion that these ranges of colours are caused by the inflection of the rays of light, the same that occasioned the ring of light which surrounds the shadows of all bodies, observed by Maraldi and others. But the prodigious variety in which these appearances are exhibited seems to show that many of them do not result from the general laws of reflection, refraction, or inflection, belonging to transparent substances of a large mass; but depend upon the alternate reflection and transmission of the different kinds of rays, peculiar to substances reduced to the form of thin plates, or consisting of separate and very minute parts. But where the dimensions of the coronas are pretty constant, as in the usual and larger halo, which is about half the diameter of the rainbow, they may perhaps be explained on the general principles of refraction only. Corona.

Sir Isaac Newton does not appear to have given any particular attention to the subject of halos, but he has hinted at his sentiments concerning them occasionally; by which we perceive that he considered the larger and less variable appearances of this kind as produced according to the common laws of refraction, but that the less and more variable appearances depend upon the same cause with the colours of thin plates.

He concludes his explication of the rainbow with the following observations on halos and parhelia:—"The light which comes through drops of rain by two refractions, without any reflection, ought to appear the strongest at the distance of about twenty degrees from the sun, and to decay gradually both ways as the distance from him increases; and the same is to be understood of light transmitted through spherical hailstones; and if the hail be a little flatted, as it often is, the transmitted light may be so strong, at a little less distance than that of twenty-six degrees, as to form a halo about the sun or moon; which halo, as often as the hailstones are duly figured, may be coloured, and then it must be red within by the least refrangible rays, and blue without by the most refrangible ones; especially if the hailstones have opaque globules of snow in their centres to intercept the light within the halo (as Mr Huygens has observed), and make the inside of it more distinctly defined than it would otherwise be; for such hailstones, though spherical, by terminating the light by the snow, may make a halo red within and colourless without, and darker within the red than without, as halos are used to be. For of those rays which pass close by the snow, the red-making ones will be the least refracted, and so come to the eye in the straightest lines."

Some further thoughts of Newton on the subject of halos are subjoined to the account of his experiments on the colours of thick plates of glass, which he conceived to be similar to those which are exhibited by thin ones. "As light reflected by a lens quicksilvered on the back side makes the rings of the colours above described, so," he says, "it ought to make the like rings in passing through a drop of water. At the first reflection of the rays within the drop, some colours ought to be transmitted, as in the case of a lens, and others to be reflected back to the eye. For instance, if the diameter of a small drop or globule of water be about the 500th part of an inch, so that a red-making ray, in passing through the middle of this globule, has 250 fits of easy transmission within the globule, and all the red-making rays which are at a certain distance from this middle ray round about it have 249 fits within the globule, and all the like rays at a certain further distance round about it have 248 fits, and all those at a certain further distance 247 fits, and so on; these concentric circles of rays, after their transmission, falling on a white paper, will make concentric rings of red upon the paper, supposing the light which passes through one single globule strong enough to be sensible; and in like manner the rays of other colours will make rings of other colours. Suppose now that in a fair day the sun should shine through a thin cloud of such globules of water or hail, and that the globules are all of the same size, the sun seen through this cloud ought to appear surrounded with the like concentric rings of colours, and the diameter of the first ring of red should be $7\frac{1}{4}°$, that of the second $10\frac{1}{4}°$, that of the third 12° 33′, and according as the globules of water are bigger or less, the ring should be less or bigger."

This curious theory, Newton informs us, was confirmed by an observation which he made in the year 1692. He saw by reflection, in a vessel of stagnating water, three halos,

Corona || Coronach.

crowns, or rings of colours about the sun, like three little rainbows concentric to its body. The colours of the first or innermost crown were blue next the sun, red without, and white in the middle, between the blue and red. Those of the second crown were purple and blue within, and pale red without, and green in the middle; and those of the third were pale blue within, and pale red without. These crowns inclosed one another immediately, so that their colours proceeded in this continual order from the sun outward; blue, white, red; purple, blue, green, pale yellow, and red; pale blue, pale red. The diameter of the second crown, measured from the middle of the yellow and red on one side of the sun to the middle of the same colour on the other side, was 9½ degrees or thereabouts. The diameters of the first and third he had not time to measure, but that of the first seemed to be about five or six degrees, and that of the second about twelve. The like crowns appear sometimes about the moon. In the beginning of the year 1664, on February 19th, at night, he saw two such crowns about her. The diameter of the first or innermost was about three degrees, and that of the second about five degrees and a half. Next about the moon was a circle of white; and next about that the inner crown, which was of a bluish-green within, next the white, and of a yellowish and red without; and next about these colours were blue and green on the inside of the outer crown, and red on the outside of it.

At the same time there appeared a halo at the distance of about 22° 35′ from the centre of the moon. It was elliptical, and its long diameter was perpendicular to the horizon, verging below farthest from the moon. He was told that the moon had sometimes three or more concentric crowns of colours encompassing one another next about her body. The more equal the globules of water or ice are to one another, the more crowns of colours will appear, and the more lively the colours will be. The halo, at the distance of 22½ degrees from the moon, is of another sort. By its being oval and more remote from the moon below than above, he concludes that it was made by refraction in some kind of hail or snow floating in the air in a horizontal posture, the refracting angle being about 50 or 60 degrees. Dr Smith, however, makes it sufficiently evident that the reason why this halo appeared oval and more remote from the moon towards the horizon, is a deception of sight, and the same with that which makes the moon appear larger in the horizon. See CHROMATICS.

CORONA, in *Botany*, the circumference or margin of a radiated compound flower. It corresponds to the *radius* of Linnæus.

CORONA Australis, or *Meridionalis*, the Southern Crown, a constellation of the southern hemisphere, the stars of which in Ptolemy's catalogue are thirteen, and in the British catalogue twelve.

CORONA Borealis, the Northern Crown, or Garland, in *Astronomy*, a constellation of the northern hemisphere, the stars of which in Ptolemy's catalogue are eight, in Tycho's as many, and in Flamsteed's twenty-one.

CORONA, in *Roman Antiquity*. See CROWN.

CORONACH, among the Scotch and Irish, the custom of singing at funerals, anciently prevalent in Scotland and Ireland, and still practised in various parts of these countries. Of this custom the following account is given by Pennant:—"I had not the fortune to be present at any in North Britain, but formerly assisted at one in the south of Ireland, where it was performed in the fulness of horror. The cries are called by the Irish the *ulogohne* and *hullulu*, two words very expressive of the sound uttered on these occasions; and being of Celtic stock, etymologists would swear to be the origin of the ολολυγη of the Greeks, and *ululatus* of the Latins. Virgil is very fond of using the last whenever any of his females are distressed; as are others of the Roman poets, and generally on occasions similar to this. It was my fortune to arrive at a certain town in Kerry at the time that a person of some distinction departed this life. My curiosity led me to the house, where the funeral seemed conducted in the purest classical form.

Coronation || Coroner.

Quocunque aspicerem, luctus gemitusque sonabant,
Formaque non taciti funeris intus erat.

In short, the *conclamatio* was set up by the friends in the same manner as Virgil describes that consequential of Dido's death;

Lamentis gemituque et fœmineo ululatu
Tecta fremunt

Immediately after this followed another ceremony, full described by Camden in his account of the manners of the ancient Irish; the earnest expostulations and reproaches given to the deceased for quitting this world, where she enjoyed so many blessings, so good a husband, such fine children. This custom is also of great antiquity; for Euryalus' mother makes the same pathetic address to her dead son.

——————— Tune, illa senectæ
Sera meæ requies, potuisti linquere solam,
Crudelis?

But when the time approached for carrying out the corpse, the cry was redoubled,

Tremulis ululatibus æthera complent;

a numerous band of females waiting in the outer court to attend the hearse, and to pay (in chorus) the last tribute of their voices. The habit of this sorrowing train, and the neglect of their persons, were admirably suited to the occasion: their robes were black and flowing, resembling the ancient *palla;* their feet naked, their hair long and dishevelled: I might truly say,

Vidi egomet nigrâ succinctam vadere pallâ
Canidiam; pedibus nudis, passoque capillo,
Cum Sagana majore ululantem.

The corpse was carried slowly along the verge of a most beautiful lake, the ululatus was continued, and the whole procession ended among the venerable ruins of an old abbey."—(*Tour in Scotland*, vol. i., p. 113.)

CORONATION, the ceremony of investing with a crown, particularly applied to the crowning of kings, upon their accession to the sovereignty.

CORONATION OATH, the oath taken by a sovereign at his coronation.

CORONELLI, VINCENZIO, a well-known geographer, was born at Venice. Having by his skill in the mathematics become known to the Count d'Estrées, Coronelli was employed by the count to make globes for Louis XIV. With this view Coronelli spent some time at Paris, and left a great number of globes there, which were much esteemed. In 1685 he was appointed cosmographer to the republic of Venice, and four years afterwards public professor of geography. He founded an academy of cosmography at Venice, and died in that city in 1718. He published about 400 geographical charts, an abridgment of cosmography, several books on geography, and other works.

CORONER (*coronator*), an ancient officer in England. He is so called because he hath principally to do with pleas of the crown, or such wherein the sovereign is more immediately concerned. And in this light the lord chief justice of the Queen's Bench is the principal coroner in the kingdom, and may, if he pleases, exercise the jurisdiction of a coroner in any part of the realm. But there are also particular coroners for every county of England; usually four, but sometimes six, and sometimes fewer. This officer is of equal antiquity with the sheriff, and was ordained with him to keep the peace, when the earls gave up the wardship of the county. He is still chosen by all the freeholders in the county."—(Blackstone's *Commentaries*.)

Before the statute of Magna Charta, coroners held pleas

Coronet || Corporal.

of the crown, but by that statute, cap. 17, their power is taken away. By the statute of Westminster it was enacted that none but lawful and discreet knights should be chosen; and there is an instance in the 5th Edw. III. of a man being removed from his office because he was merely a merchant; but now it seems sufficient that a man have land enough to be made a knight; that is, of the value of L.20 per annum. Blackstone complains that in his time this office had been suffered to fall into disrepute, and that coroners only desired to be chosen for the sake of the perquisites or fees allowed for attendance by the statute 3d Henry VII., cap. 1. In this, however, a great improvement has taken place, the persons generally elected to the office being either attorneys or medical men. The fees are regulated by the 25th Geo. II., cap. 29, and 7th Will. IV., and 1st Vict., cap. 68.

The coroner is chosen for life, but may be removed either by being made sheriff, which is an office incompatible with the other; or by the writ *de coronatore exonerando*, for a cause to be therein assigned, as that he is engaged in other business, is incapacitated by age or sickness, has no sufficient estate in the county, or lives in an inconvenient part of it; or for extortion, neglect, or misbehaviour (25th Geo. II., cap. 29).

The office and power of a coroner are, like those of the sheriff, either judicial or ministerial, but principally judicial. This is in a great measure ascertained by statute 4th Edw. I. *De officio Coronatoris;* and his duty consists principally in inquiring, when any person is killed or dies suddenly, or in prison, concerning the manner of his death. This inquest must be held *super visum corporis;* for if the body be not found the coroner cannot sit. He was formerly obliged to sit at the very place where the death happened; but by the 6th and 7th Vict., cap. 12, the coroner within whose jurisdiction the body shall be lying dead is to hold the inquest, though the cause of death may not have arisen within his jurisdiction; and in cases of the body being found dead in the sea, or any creek, river, or navigable canal within the flowing of the sea, where there is no deputy coroner for the admiralty, the inquest shall be held by the coroner having jurisdiction at the place where the body was first brought to land. The inquisition must be found with the concurrence of at least twelve of the jury, and it cannot be quashed for certain technical defects enumerated in the 6th and 7th Vict., cap. 83, as was formerly the case. If any by this inquest be found guilty of murder, the coroner is to commit the accused to prison for further trial, and is also to inquire concerning their lands, goods, and chattels, which are thereby forfeited. Formerly the coroner also inquired whether any deodand accrued to the king or the lord of the franchise by the death, and certified the inquisition to the Court of Queen's Bench, or the next assizes; but by the 9th and 10th Vict., cap. 62, all forfeiture of any chattel by a death was abolished. Another branch of the coroner's office is to inquire concerning shipwrecks, and to certify whether a wreck has taken place or not, and who is in possession of the goods. In the matter of treasure-trove, his duty is to inquire concerning the finders, where the treasure is, and whether any one be suspected of having found and concealed a treasure.

The ministerial office of the coroner is only as the sheriff's substitute; for when just exception can be taken to the sheriff on suspicion of partiality, as that he is interested in the suit, or of kindred to either plaintiff or defendant, the process must then be awarded to the coroner instead of the sheriff, for execution of the king's writs.

The office of coroner was formerly known in Scotland. (Hume's *Comment.* ii. 24.) (R. M—M.)

CORONET, an inferior kind of crown worn by princes and noblemen, as distinctive badges of their several degrees. These are described under HERALDRY.

CORPORAL (Ital. *caporale*, from Lat. *caput*), the lowest officer in a company of infantry, next below a serjeant. He has charge over one of the divisions of the company, places and relieves sentinels, &c. In the ranks he does duty as a private, but his pay is rather more.

Corporale || Corporation.

LANCE-CORPORAL, originally denoted a cavalry soldier disabled by the loss of his lance or his horse during action, and retained for the time as a volunteer in the infantry; but the term is now applied to a private who, without superior pay, does the duty of a corporal, previous to his promotion to that grade.

CORPORAL of a Ship of War, an officer under the master at arms, employed to teach the officers the exercise of small arms, to attend at the gangway on entering ports, and to see that no spirituous liquors are brought into the ship, except by permission; to extinguish all lights at a certain hour, &c.

CORPORALE, in the Romish and Greek Churches, is the fine linen cloth in which the eucharist is deposited. It is an object of great veneration. It is also called Καλυμμάτιον, *Palla*, *Sindon*, and *Antimensia*. The expression *corporal oath* is derived from the ancient usage of touching the corporale to add solemnity to an oath.

CORPORATION is the term applied in Britain to a body of men by special law endowed with the power and means of acting collectively, with the distinctness and individuality of one man pursuing the dictates of his own will, while their existence is kept up by a perpetual succession, so that the collective body acts like an individual man with a perpetuated vitality. Though the corporation might be deemed, from the admiration bestowed on it by professional writers, to be the peculiar creation of English genius, there is little doubt that the system was derived from the *municipia*, *universitates*, and *collegia* of the Romans; and there is even reason to believe that there are corporations which date their history back to the institutions of the Western empire. (See MUNICIPAL CORPORATIONS.) The adage, indeed, expressed by a Roman jurisprudent, that it required three to make a college—*tres facere collegium* (50 *Dieg.* 16, 85)—shows a practical consciousness of the most effective means of strengthening the action of a small corporation, in an adjustment, by which equal numbers with the chances of balanced divisions are to be avoided, and that number is selected which always affords a majority of two to one.

Corporation law has been a favourite field for the indulgence of the English legal propensity for creating fictions. The commentators have exhausted their ingenuity in analogies between the individual human being and the body corporate or collective which acts like one man; and Sir Edward Coke is happy in discovering, that the reason why corporations cannot be excommunicated, is because they have no souls, being in the eye of the law mere bodies. In its love of fictions the English law has applied to certain holders of office the expression "corporation sole;" so that after having exercised its ingenuity in endowing groups of men with the characteristics of individuality, where this individuality is real, the law reverses the process and bestows on it the collective qualities of an aggregate body. "Corporations sole," says Blackstone, "consist of one person only, and his successors in some particular station, who are incorporated by law, in order to give them some legal capacities and advantages, particularly that of perpetuity, which in their natural persons they could not have had. In this sense the king is a sole corporation; so is a bishop; so are some deans and prebendaries, distinct from their several chapters; and so is every parson and vicar." He gives reasons for this fiction, in the possibility that without it the public property held by the parson might become feudally vested in his heir. "The law therefore has wisely ordained that the parson, *quatenus* parson shall never die any more than the king, by making him and his successors a corporation, by which means all the original rights of the parsonage are preserved entire to the successor," &c. (B. I.

Corporation.

ch. 18). In England, however, as in other countries, the nature of a systematic succession to office, and the separation of public from private property, could be effectually understood without recourse to a supposition which only tends to throw confusion on the notions of a real corporation.

It is another fiction of the law of England, but one which has tended beneficially to define the power of incorporation in later times, that corporations can have no other foundation than royal authority. In reality, though some of the corporate bodies have risen silently along with the monarchical and other institutions of the country, yet the law treats them as having sprung directly from the prerogative of the crown; "such as the city of London and many others, which have existed as corporations, time whereof the memory of man runneth not to the contrary, and therefore are looked upon in law to be well created. For though the members thereof can show no legal charter of incorporation, yet in cases of such high antiquity, the law presumes there once was one; and that, by the variety of accidents which a length of time may produce, the charter is lost or destroyed." (Ib.) Both the spontaneous rise of such great corporations, and the power of the crown to create them, have now virtually departed, and all great corporate powers arising in later times have been created by statute.

Blackstone and other commentators give many divisions of corporations, as into lay and ecclesiastical, civil and eleemosynary. There is a division, however, not known in law, but more important in practice than any of the technical divisions. It exists between those corporations which, like banking or trading companies, are created for the profit of the members, and those which, like municipal institutions, are created for the benefit of the public through the performance of public duties. There are corporations in which the two functions are in some measure mixed together in a modified shape; such as associations of literary men and artists, by whom a public service is done by the promotion of intellectual education, while the members to some extent hold personal privileges, and act to the extent of their powers for their own advantage. It is worthy of observation, that this kind of body, containing a moderate amount of the characteristics of both the main classes of coporations, is the only kind now virtually incorporated by the crown. It has ceased to incorporate municipal bodies with governing powers, as these can only now be satisfactorily communicated by act of parliament. The power to confer monopolies or other commercial privileges, long viewed with jealousy, scarcely survived the Patents Act in the reign of James I.; and any privileges now granted by charter to commercial bodies merely involve the right to transact their business, hold their property, and conduct litigations in a corporate name without the intervention or involvement of individual members of the corporation.

The phraseology of the English law of corporations has migrated to Scotland, and brought with it in some measure the corresponding practice. But it is probable, that if a sufficient inquiry were made into the origin and nature of collective bodies associated for common action in Scotland, they would be found to be very different in their fundamental constitution from an English corporation. It is certain that there exist in Scotland many such bodies, which neither in reality, nor by admitted fiction of law, were created by the crown; and some of the burgal corporations have, from time to time, by "seals of cause," as they were termed, exercised the power of creating distinct corporate bodies with specific internal powers. Though it has been the practice to append the great seal to Scottish charters of incorporation, it has been doubted whether this be necessary. In England nothing was more clearly established than the law, that the members of a corporation are not under any personal responsibility for its debts or other obligations. This arises from the method in which its fictitious individuality is represented by the common seal. "For a corporation," says Blackstone, "being an invisible body, cannot manifest its intention by any visible act or oral discourse; it therefore acts and speaks only by its common seal. For though the particular members may express their private assents to any act by words, or signing their names, yet this does not bind the corporation; it is the fixing of the seal, and that only, which unites the several assents, who compose the community, to make one joint assent of the whole." The seal is often adopted in Scotland in imitation of English practice, but it is not admitted to have the same mysterious capacity of representing the ideal individuality, nor is it a fixed point that the members of a trading body can be exempt, in Scotland, from their liability as partners by mere incorporation, or by any other authority than a special statutory limitation. In 1825, on the understanding that the act of incorporation by the crown is an absolute exclusion of personal responsibility, an act was passed for enabling the crown to grant charters of incorporation, containing provisions for the liability of the members for the debts of the corporation. By an act of 1836, amended in 1837 (7th Will. IV., and 1 Vict., cap.73), arrangements were made for enabling the mere commercial privileges of a corporation, including representation by office-bearers, and partial or total exemption from personal responsibility, to be conferred by the crown in a more simple manner than incorporation by letters patent. The objects of a large portion of the old corporation laws are now superseded by the mass of legislation relating to banking, railway, and other joint-stock public companies. See JOINT STOCK. (J. H. B.)

Corporeity || Corpulence.

CORPOREITY, the state of having a body, or of being embodied; materiality. The corporeity of God was the capital error of the Anthropomorphites. Some authors have charged Tertullian with maintaining the corporeity of the Deity; but in the works of that author the term *body* seems to be synonymous with *substance*. The Mohammedans reproach the Samaritans at this day with a belief in the corporeity of God.

CORPULENCE (from *corpus*), an obese state of body, or the condition of a person overloaded with flesh or fat.

Among the Lacedæmonians a kind of infamy attached to corpulency. In some eastern countries on the contrary, at the present day, the perfection of female beauty is supposed to consist in a state of obesity that incapacitates its victim for using her feet. The following instances of obesity are selected as being among the most remarkable on record:—A man and a woman are mentioned by Sennertus, an eminent German physician of the 17th century, whose respective weights were 600 and 450 pounds. Bright, of Malden in Essex, a respectable tallow-chandler and grocer, who died in 1750, aged twenty-eight, weighed 616 pounds. It has been said that the capacity of his waistcoat was such that it could inclose seven persons of ordinary size, and that his stocking would easily admit a child of four years of age. Daniel Lambert, who died in 1809, in his fortieth year, supposed to have been the heaviest man that ever lived, was of the enormous weight of 52 st. 12 lb., or 740 pounds. It is related of Ciapino Vitelli, Marquis of Cortona, a noted general under the Duke of Alba, that by drinking vinegar he so reduced his body from a state of enormous obesity, that he could fold his skin about him like a garment. Whatever degree of credit may be accorded to the effects produced upon the marquis, it is well known that vinegar is a favourite remedy for corpulence among the ignorant, and that many have had occasion to deplore their temerity by experience of its baneful effects upon the system.

The most approved remedy for excessive corpulence (provided it be not engendered or accompanied by other disease) is *liquor potassæ*. Dr Chambers, in his excellent little treatise "*On Corpulence*," observes of this remedy, that "if given in milk-and-water, we may safely commence

Corpus Christi || Correction.

with half a drachm, and raise the dose to a drachm, and a drachm and a half, three times a-day." He also illustrates its use in a variety of cases, including that of a lady who was upwards of 28 stones in weight, and unable to walk, but who derived so much benefit from its use that in no long time she was able to walk several miles a-day with comfort. It may be necessary, however, to caution the inexperienced against the indiscreet employment of this powerful alkaline remedy, which should in no instance be resorted to without the sanction of a competent medical adviser.

CORPUS CHRISTI (*i. e.* body of Christ), a festival of the Church of Rome, observed on the first Thursday after Trinity Sunday, in honour of the eucharist. It was instituted by Pope Urban IV., A.D. 1264. Corpus Christi is also the name of one of the colleges of Oxford.

CORPUSCLE, in *Physics*, a minute particle, or physical atom, such as those of which a natural body is composed. This term is not applied to the elementary principles of matter, but to such particles, whether simple or compound, as are not dissolved or dissipated by ordinary degrees of heat.

CORPUSCULAR PHILOSOPHY, a system of physics which accounts for the various phenomena of nature by the physical properties and arrangement of the corpuscles or atoms supposed to be the constituent materials of all natural bodies; such as their motion, figure, rest, position, attraction, or repulsion. This system is of great antiquity. It was taught in Greece by Leucippus and Democritus; and the noble poem of Lucretius, *De Rerum Natura*, is devoted to its explanation. It is otherwise called the Atomic Philosophy. This ancient system, divested by Newton and others of numerous absurdities, has now become the basis of mechanical and experimental philosophy. (See the article EPICUREAN PHILOSOPHY.)

CORRADI, DOMENICO, (1449–93), a Florentine painter and artist in mosaic, commonly called *Ghirlandaio* from the trade of his father. He may be considered as the instructor of M. Angelo in painting; but it is said that, dreading the competition of his illustrious pupil, he directed his attention to sculpture. His outline as a painter was dry, but he possessed a fertile invention, combined with rare facility and diligence. He is said by Lanzi to have been the first of the Florentines who, by attention to perspective, gave a good disposition and depth to his compositions. Some of his remaining pictures are executed on a gold ground, especially those in Florence. Many of his pictures are in the Vatican and other galleries of Rome, at Rimini, Pisa, and Volterra.

CORRADINI DI SEZZA, *Pietro Marcellino*, a learned antiquary, was born at Sezza in 1658. He acquired the esteem and confidence of Clement XI., and afterwards of Innocent XIII., by whom he was made a cardinal. The works by which he is chiefly remembered are his *Vetus Latium, profanum et sacrum*, 2 vols. folio; and his *History of Sezza*, in 4to. He died at Rome in 1743.

CORRADO, SEBASTIAN, at Italian grammarian of the sixteenth century. He taught the Greek and Latin tongues at Reggio, where he formed an academy of polite literature; and afterwards removed to Bologna, in the university of which town he professed the languages of ancient Greece and Rome. He wrote several works, the most esteemed of which is *Questura in qua Ciceronis vita refertur*, Venice, 1537, 8vo. He died in 1556.

CORRECTION, in *Printing*, the act of noting the errors and defects in a printed sheet, with a view to their amendment by the compositor; which is done in the first instance by the printer's reader, previous to transmitting the proof-sheet to the author or editor for such further alterations as may be requisite. The corrections are placed on the margin of each page, opposite the line where the faults occur; as in the following example:—

(It is to be observed, that the *figures* on the margin are not used in correcting, except where, by the corrections being very numerous, the printer might be led to mistake one alteration for another. The figures are here only used for the sake of explanation.) Correction.

Though a variety of opinions exists as to the individual by whom the art of printing was first discovered; 1 *ca* 2 *g*
yet all authorities concur in admitting Peter Schoeffer 3 *L. Caps.*
to be the person who invented *cast metal types*, having
learned the art of ~~of~~ *cutting* the letters from the Gut- 4
tembergs; he is also supposed to have been the first 5 6
who engraved on copper plates. The following testi- 7 8
mony is preseved in the family of Jo. Fred. Faustus 9 *r*
of Aschaffenburg: || "Peter Schoeffer of Gernsheim, 10 || *N.P.* 11 *S Cap.*
perceiving his master Fausts design, and being him- 12 *l*
self desirous ardently to improve the art, found out 13 *tr.*
(by the good providence of God) the method of cutting 14 |
~~(incidendi)~~ the characters in a *matrix*, that the letters 15 *Stet.*
might easily be singly *cast*, instead of being *cut*. He 16 *et*
privately *cut matrices* for the whole alphabet: + Faust 17 + *See below.*
was so pleased with the contrivance, that he promised 18 *wf.*
Peter his only daughter Christina in marriage, a promise which he soon after performed. 20 *No break.*
But there were many difficulties at first with these 21 *as* 22 *Rom* 23 *Ital.*
letters, as there had been before with wooden ones, the
metal being too soft to support the force of the im- 24
pression; but this defect was soon remedied, by mixing a substance with the metal which sufficiently har- 25 *tr.*
dened it;" 26

+ and when he showed his master the letters cast from those matrices,

When corrected according to these Marks, the above will read thus:—

Though a variety of opinions exists as to the individual by whom the art of printing was first discovered; yet all authorities concur in admitting PETER SCHOEFFER to be the person who invented *cast metal types*, having learned the art of *cutting* the letters from the Guttembergs: he is also supposed to have been the first who engraved on copper-plates. The following testimony is preserved in the family of Jo. Fred. Faustus of Aschaffenburg:

"PETER SCHOEFFER of Gernsheim, perceiving his master Faust's design, and being himself ardently desirous to improve the art, found out (by the good providence of God) the method of cutting (*incidendi*) the characters in a *matrix*, that the letters might be easily singly *cast*, instead of being *cut*. He privately *cut matrices* for the whole alphabet: and when he showed his master the letters cast from these matrices, Faust was so pleased with the contrivance, that he promised Peter his only daughter Christina in marriage, a promise which he soon after performed. But there were as many difficulties at first with these letters, as there had been before with *wooden ones*, the metal being too soft to support the force of the impression; but this defect was soon remedied, by mixing the metal with a substance which sufficiently hardened it."

EXPLANATION OF THE CORRECTIONS.

A *wrong letter* in a word is noticed by drawing a perpendicular line through it, and marking the proper letter on the margin, opposite the faulty letter. See No. 1.

A *turned letter* is noticed by making a dash under it, and by the mark No. 2 on the margin.

If letters or words are to be *altered from one character to another*, a parallel line or lines should be marked underneath the word or letter, viz. for large CAPITALS, three lines; small CAPITALS, two lines; and *italics*, one line: and on the margin opposite should be written L. Caps, S. Caps, or Ital. See Nos. 3, 11, 22, 23.

When letters or words are *set double*, or are required to be taken

out, a line is drawn through the superfluous letter or word, and the mark Nos. 4 and 5 placed on the margin.

Where the *punctuation requires to be altered*, the semicolon, colon, &c. should be marked on the margin with a score behind them, as shown by No 6; but the period should be encircled, as represented by No. 26.

When a *space is wanting* between two words or letters, which are to be separated, a caret should be made where the separation ought to be, and the sign No 7 placed opposite on the margin

No 8 describes the manner in which the *hyphen* and *ellipsis line* are marked.

Should a *letter* or *word have been omitted*, a caret is put at the place, and the letter or word is marked on the margin, as Nos. 9 and 21.

Where a *new paragraph* is required, a parallel line or lines should be made, and the same mark placed on the margin, with the letters *N. P.* or *N. L.* See No. 10.

No.12 shows the way in which the *apostrophe, inverted comma, asterisk*, and other references and superior letters and figures, are marked.

Where *two* or *more* words or letters are *transposed*, they should be marked with a line above and below, and *tr* marked opposite, as done in No. 13, or as shown in Nos. 16 and 25.

Where a *space* sticks up between two words, a perpendicular line is put on the margin No. 14.

Where *words have been struck out that have afterwards been approved of*, dots should be marked under such words, and in the margin should be written *Stet.* No 15.

Where several *lines* or *words* are *added*, they should be written at the top or bottom of the page, with a reference mark, a corresponding reference being made at the place where the insertion begins (See No. 17); or if the addition be on a separate sheet, then the words *See paper apart* should be written on the margin.

When a *smaller* or *larger letter* than that in which the work is printed is improperly introduced into the page, it is noticed by a perpendicular line being drawn through it, and the mark *wf* (wrong fount) written on the margin. No. 18.

Where *letters* or *lines stand crooked*, they are noticed by drawing lines above and below them. No. 19.

If a *paragraph* be improperly made, a line should be drawn from the one sentence to the other, and the words *No break* written on the margin, as in No. 20.

Where *words* or *letters* that should *join* are separated, the mark No. 24 must be placed under the separation, and the junction signified by the same on the margin.

In all cases, but particularly in those where the author has it not in his power to see the proof sheets, accuracy and distinctness of copy are particularly desirable. If attention be paid to right spelling of proper names of persons, places, technical terms, &c., the finishing of sentences marked by the period, that the author's ideas may not be misunderstood, and the handwriting tolerably legible, much time and a very considerable expense will be saved, and the great object of accuracy gained, by those who communicate their sentiments to the public through the medium of the press.

When a proof is returned, finally corrected, for press, the word *Press* should be written on the first page; or the word *Revise*, if another proof be wanted.

CORRECTION, *House of*, a place where vagrants and persons guilty of minor offences are confined, and punished by being obliged to labour for a certain period, according to the nature of the offence. The benefits arising to society, and the reformation of offenders, from this mode of punishment, have been variously estimated by different writers, according to the views which they have taken of the effects and consequences of the confinement and restraint to which the criminal is subjected. See PUNISHMENTS.

CORREGIDOR, the title of the chief magistrate of a town in Spain, and in countries subject to the Spanish government.

CORREGIO, a town of Italy, duchy of Modena, and delegation of Reggio, 10 miles N.W. from Modena. It is chiefly remarkable as the birth-place of Antonio Allegri, better known as Corregio.

CORREGIO. See ALLEGRI.

CORRELATIVE, that which is opposed to something else in a certain relation. Thus father and son are correlatives; while light and darkness, motion and rest, are correlative and opposite terms.

CORRÈZE, an inland department of France, part of the old province of Limousin, is bounded N. by the departments of Haute-Vienne and Creuse, E. by Puy-de-Dôme and Cantal, S. by Lot, and W. by Dordogne. Area 2276 square miles. The surface of the country is generally mountainous; but in the southern and western parts are some districts of low land. The soil is for the most part poor and thin; the high lands being covered with heath, and the low lands but moderately fertile. The climate is in general cold and damp, as the summits of some of the higher mountains are covered with snow for several months in the year; but in the valleys the heat in summer is excessive. The principal productions are wheat, barley, oats, rye, maize, hemp, and flax. Cattle, sheep, and goats, are reared in considerable numbers. Chestnuts are very plentiful, and constitute the staple of the food of the people, who by boiling and drying them preserve them throughout the year. The principal rivers are the Dordogne and the Vezère, with its affluent the Corrèze, from which the department takes its name. The department is rich in minerals, as iron, copper, coal, lead, marble, alabaster, porphyry, &c. There are a few small mines of iron and copper, as well as of coal; but the want of facilities for transport render these of little advantage. The chief articles of manufacture are fire-arms, glass, bricks, leather, coarse woollens, wax candles, and nut oil. The department is divided into three arrondissements, which, with their subdivisions and populations, are as follows:—

Arrondissements.	Cantons.	Communes.	Pop. in 1851.
Tulle	12	118	138,111
Brives	10	101	116,640
Ussel	7	74	66,113
Total	29	293	320,864

The capital is Tulle, containing 10,748 inhabitants.

CORRIB LOUGH. See GALWAY.

CORRIDOR (Ital. *corridore*), in *Architecture*, a gallery or long passage in a building, into which several chambers open. In fortification the term is applied to the covered way that surrounds the whole compass of the fortifications of a place.

CORROSION, the action of eating or wearing away by degrees, as by the action of acids on metals, &c.

CORRUISK, or CORRISKIN, a small lake in the isle of Skye, near its south coast, celebrated for the wild and majestic scenery by which it is surrounded. It is about two miles in length from north to south, half a mile in breadth, and contains several small islets.

Corriskin is frequently mentioned in Scott's poems. The opinion of that great author as to the unrivalled majesty of the scenery of the lake may be inferred from the following lines in the introduction to the fourth canto of *The Lord of the Isles*:—

> Such feelings rouse them by dim Rannoch's lakes,
> In dark Glencoe such gloomy raptures rise,
> Or further where beneath the northern skies
> Chides wild Loch Eribol his caverns hoar;
> But, be the minstrel judge, they yield the prize
> Of desert dignity to that dread shore
> That sees grim Coolin rise, and hears Corriskin roar.

CORRUPTICOLÆ, a name given to a sect of the Monophysites, who sprung up in Egypt about the beginning of the sixth century. They held the corruptibility of Christ's body; and from them sprung up the Agnoetæ, who denied the omniscience of Christ's human nature. They were also called *Creaticolæ*, *Phthartolatræ*, and also *Severiani* from the name of their founder.

CORRUPTION *of Blood*, in *Law*. See ATTAINDER.

CORSAIR (Ital. *corsare*, from *corso*, a course or career; Lat. *cursus*, from *curro*, to run;) a pirate, one who scours the seas in an armed vessel without commission from any prince or power, in order to plunder merchant ships. This name was particularly given to the piratical cruisers of Bar-

Corselet || Corsica.

bary under the two Barbarossas, about the beginning of the sixteenth century. See BARBAROSSA, and BUCANEER.

CORSELET, or CORSLET (Ital. *corsaletto*, Lat. *corpus*, a body), a small cuirass, or a piece of armour to protect the whole body; anciently worn by pikemen, who were placed in the front and flanks to resist the enemy's assaults, and to guard the soldiers behind them.

CORSEUL, a town of France, department of Côtes-du-Nord, arrondissement of Dinan, and six miles W.N.W. of that town. Pop. 4236. There are here numerous remains of an ancient town, supposed to be the Roman Fanum Martis.

CORSHAM, a decayed market-town of Wiltshire, 97 miles from London. It is well built, in a healthy situation, and consists of one long street, near the centre of which is a handsome market-house. Some broad cloths are still made at Corsham, but the manufactures of the town have greatly declined of late years. Pop. of parish (1851) 3172.

CORSICA (in Greek Κύρνος, in Latin CORSUS and CORSICA, in French CORSE), a large island in the Mediterranean, 58 miles distant from Italy, and about 180 from France, lies between N. Lat. 41. 20. and 43.; and E. Long. 8. 30. and 9. 30. At its southern extremity it is separated from the island of Sardinia by the Fossa or Strait of Bonifacio. The extreme length of the island is 116 miles, its greatest breadth 52 miles. The greater part of the surface of Corsica is occupied by ranges of lofty and rugged mountains, diverging in all directions from the central ridge, the Mons Aureus or Golden Mount of the ancients, the Monte Rotondo of modern times. On the western and southern sides of the island these spurs either terminate abruptly on the shore, or run out to a great distance into the sea, forming bays and gulfs, some of which afford excellent harbours. On the eastern side, there intervenes between the mountains and the sea a considerable tract of low country, which in certain seasons of the year is extremely unhealthy from the presence of malaria. The central ridge of the Mons Aureus, which is the highest elevation in the island, attains a height of 9068 feet, and is covered with snow during the greater part of the year. In this mountain the two largest rivers of the island have their source,—the Rhotanus, now called the Tavignano, and the Tavola or Taiola, the modern Golo. These rivers have both an easterly course; and fall into the sea, the former near the ruins of the ancient Aleria, and the latter near those of Mariana. The other rivers of the island are comparatively unimportant. Of these the chief are the Liamone (the ancient Circidius), the Talava, Gravone, Prunelli and Valinco, which all flow into the sea on the western side of the island. From the rugged and indented outline of the coast there is an unusually great number of bays and harbours, which afford admirable facilities for commerce, but are rendered almost useless from the difficulty of communication with the interior. Of the former the most important on the western side of the island are Porto, Sagone, Ajaccio, and Propriano: of the latter, St Florent, Ile Rousse, Calvi, and Ajaccio. On the eastern side, which is much less rugged and broken, the only harbours worth mentioning are Bastia and Porto Vecchio (the Portus Syracusanus of the ancients), and the only gulf that of Santa Manza. Near the northern extremity of the island is the large inlet of Bigugli. At the extreme south are the harbour and town of Bonifacio, giving name to the strait which separates Corsica from Sardinia.

Of the internal resources of the island, the most important consist of those vast forests that cover the summits of the hills, and which furnished timber for the navies of antiquity. Partly, however, from the indolence of the inhabitants and partly from the difficulties of land carriage, this source of wealth is comparatively neglected. The mountain pastures are, however, made available for the rearing of cattle, horses, asses, and mules. Sheep of a peculiar black breed with four and sometimes six horns, as well as goats and pigs, abound in the island. Wild animals, birds, and reptiles infest the uncultivated districts, which are generally overgrown with a thick tangled underwood, consisting of arbutus, myrtle, thorn, laurel, broom, and other shrubs, and called by the natives *maquis*. This jungle is easily cleared off by burning, and the vegetable matter furnishes an excellent manure. Throughout the island the growth of the cereal crops is generally abandoned for the easier cultivation of the olive and vine. Chestnuts constitute an important article of food, but wheat, maize, and barley are also cultivated. The backward state of agriculture is caused principally by the minute subdivision of the land, a system which perpetuates the social evils of hereditary feuds and jealousies, by which Corsica has long been distracted. A large proportion of the exports of the island consists of honey and wax, which are procured from the forests. The former of these has a somewhat bitter flavour, from the yew and box trees on which the bees feed. The mineral wealth of Corsica is considerable, but altogether undeveloped. Iron, lead, marble, and abundance of granite of various hues, may be procured. Beyond the making of oil, soap, bricks, and coarse glass, the Corsicans are entirely destitute of manufacturing industry, and their commerce consists for the most part of the spontaneous produce of the island. The fisheries of tunny, pilchard, and anchovy are extensively prosecuted for the supply of the Italian markets; but comparatively few of the native Corsicans are engaged in this department of industry. Corsica is divided into five arrondissements, which are subdivided and peopled as follows:— Corsica

Arrondissements.	Cantons.	Communes.	Population (1851.)
1. Ajaccio	12	72	55,008
2. Sartene	8	46	29,735
3. Bastia	20	93	70,288
4. Calvi	6	34	24,390
5. Corte	15	110	56,830
Total	61	355	236,251

It is not clearly known who the original inhabitants of Corsica were. The ancients believed them to have sprung from some Ligurian traders who had sailed down to the coast in quest of wood or water, and who, finding the soil fertile and the climate agreeable, established themselves on the island. At an early period they seem to have had commercial transactions with the Spaniards, whose dress they adopted, and whose manners and customs they introduced into Corsica. From this circumstance it has been conjectured, though on insufficient grounds, that the original settlers were in part at least of Spanish extraction. The Phocæans of Ionia were the first civilized people that established settlements in Corsica. About the year 560 B.C. they landed for the first time on the island, and founded the city of Aleria, which after a short occupation they were compelled to abandon. After an interval of a few years they again returned, rebuilt Aleria, which they fortified, and endeavoured to maintain their ground against the natives. After a struggle of some years they were again compelled to leave the island. The next foreign occupants of Corsica were the Tuscans, who founded the city of Nicæa, and reduced to subjection the natives of the adjoining country. They in their turn were compelled to give way before the growing maritime power of the Carthaginians, whose jurisdiction in the island was unquestioned till the beginning of the first Punic war. On that occasion the Romans sent out a fleet, drove the Carthaginians from the island, and exacted at least a nominal homage from the native population. They did not, however, fully establish their power in the island till about thirty years later, and even then re-

Corsned ‖ Cort.

bellions and revolts were of yearly occurrence. The first step made towards the real subjugation of the island was the establishment of the two colonies on its eastern coast—that of Aleria by Sulla, and that of Mariana by Marius. Had the Roman conquest been systematically prosecuted, there can be no doubt that the whole island would ultimately have owned their dominion. But in the time of the emperors the island had fallen into disrepute among the Romans, by whom it was used chiefly as a place of banishment for political offenders. One of the most distinguished of these sufferers was the younger Seneca, who spent eight years of his life in exile on the island, and was only recalled at length (A.D. 49) through the influence of Agrippina, who had at that date just married her uncle the Emperor Claudius.

On the downfall of the Roman empire in the West, Corsica passed into the hands of the Vandals. These barbarians were driven out by Belisarius, but after the death of that illustrious general, A.D. 565, the resistless hordes of Totila once more regained possession of the island. Since that period it has successively owned the dominion of the Goths, the Saracens, the Pisans, and the Genoese. It was ceded by the Genoese to the French in 1768; and for a few years after the French Revolution of 1793 it was placed under the protection of Britain. Since 1814, however, it has been in undisturbed possession of the French; and under Napoleon III. a vigorous system of internal government has been introduced into the island. Corsica is famous as the birth-place of Pascal Paoli and Napoleon.

CORSNED, or MORSEL of EXECRATION (Sax. *corsnæde*, compounded of *corse*, curse, and *snæd*, a mouthful or piece), a kind of trial or purgation practised in ancient times in England. A piece of bread consecrated with a form of exorcism was to be swallowed by a suspected person, as a trial of his innocence. If guilty, it was supposed that the bread would produce convulsions and paleness, and find no passage; but if innocent, it was believed that it would turn to wholesome nourishment. At the same time also the person received the holy sacrament, if indeed the corsned was not, as some have suspected, the sacramental bread itself. In our ancient historians it is related, that Godwin earl of Kent, in the reign of Edward the Confessor, after abjuring the death of the king's brother, at last appealed to his corsned, *per buccellam deglutiendam abjuravit*, which stuck in his throat and caused his death. A remnant of this superstition subsists still in certain phrases of abjuration retained among the common people: as, "I will take the sacrament upon it!" "May this morsel be my last!" and the like.—(Blackstone's *Commentaries*, iv. 345.)

CORSTORPHINE, a village and parish in Mid-Lothian, three miles west of Edinburgh, near the line of the Edinburgh and Glasgow railway. The parish church of Corstorphine, which has been recently restored, is one of the most ancient ecclesiastical buildings in Scotland. A little to the south of the village are the ruins of an old castle, formerly the seat of the Forresters, barons of Corstorphine. Pop. of parish (1851) 1499, of village 380.

CORT, CORNELIUS, a celebrated engraver, born at Hoorn in Holland, in 1536. Having learned the first principles of drawing and engraving, he went to Italy, and visited all the places famous for the works of the great masters. At Venice he enjoyed the friendship of Titian. He afterwards settled at Rome, and there died in 1578. According to Basan, he was "the best engraver with the burin or graver only that Holland ever produced. We find in his prints," he adds, "correctness of drawing, and exquisite taste." It is no small honour to this artist, that Agostino Caracci was his scholar, and imitated his style of engraving rather than that of any other master. Cort engraved several prints from Titian, Coreggio, Michel Angelo, and Raffaello. His industry, when we consider the shortness of his life, will appear great, since he produced 151 works, many of them of large size and first-rate excellence.

Corte ‖ Cortes.

CORTE, the capital of a cognominal arrondissement in the island of Corsica, with (1851) 4313 inhabitants. It stands near the confluence of the Orta and Tavignano, and is defended by a strong castle.

CORTES *of* SPAIN, a term purely Spanish, literally signifying the *courts*, and applied to the States, or assembly of the States, of the kingdom. See SPAIN.

CORTES, HERNAN, conqueror of Mexico, was born at Medellin, a small town of Estremadura, in 1485. He was descended from a noble family of decayed fortune, who destined him for the bar, and sent him at an early age to the university of Salamanca. But being soon disgusted with a species of study ill suited to his ardent genius, he embraced the military profession, in hopes of signalizing himself, under the celebrated Gonsalvo de Cordova. A dangerous malady, however, having prevented his embarking for Naples, his hopes were baffled; but when his health was re-established he turned his attention towards the West Indies, which were then a source of riches and glory to the Spaniards. In 1504 Cortes set out for St Domingo, where he was kindly received by Ovando, the governor. He was then only nineteen, and remarkable for a graceful physiognomy and amiable manners, as well as for skill and address in all military exercises. He remained in St Domingo, where Ovando had successively conferred upon him several lucrative and honourable employments, until 1511, when he accompanied Diego Velasquez in his expedition to the island of Cuba, where he became alcalde of St Iago, and displayed great talents on several trying occasions. To the fire and impetuosity of youth had now succeeded an indefatigable activity, united with the coolness and self-command which are so necessary for the execution of great designs. Grijalva, lieutenant of Velasquez, had just discovered Mexico, but without attempting to effect a settlement. This displeased the governor of Cuba, who superseded Grijalva, and intrusted the conquest of the newly-discovered country to Cortes. The latter hastened his preparations, and, on the 18th of November 1518, he set out from St Iago, with ten vessels, six or seven hundred Spaniards, eighteen horsemen, and some pieces of cannon. Scarcely had he set sail, however, when Velasquez, repenting his choice, and apprehensive that his lieutenant would carry off all the glory as well as profit of the enterprise, recalled the commission which he had granted to Cortes, and even ordered him to be put under arrest; but the attachment of the troops, by whom he was greatly beloved, enabled him to disconcert all the designs of the governor; and on the 4th of March 1519 he landed on the coast of Mexico. Advancing along the gulf, sometimes caressing the natives, and sometimes spreading terror by his arms, he took possession of the town of Tabasco. The noise of the artillery, the appearance of the floating fortresses which had transported the Spaniards over the ocean, and the horses on which they fought, all new objects to the natives, inspired them with astonishment mingled with terror and admiration; they regarded the Spaniards as gods, and sent them ambassadors with presents. Cortes here learned that the native sovereign was called Montezuma; that he reigned over an extensive empire, which had lasted for three centuries; that thirty vassals, called caciques, obeyed him; that his riches were immense and his power absolute. No more was necessary to inflame the ambition of Cortes, who hesitated not to undertake the conquest of this great empire, which could only be effected by combining stratagem and address with force and courage. He laid the foundation of the town of Vera Cruz, caused himself to be elected captain-general of the new colony, and, like Agathocles, burned his vessels, to cut off the possibility of retreat, and

Cortes

show his soldiers that they must either conquer or perish. He then penetrated into the interior of the country, drew to his camp several caciques hostile to Montezuma, and induced these native princes to facilitate his progress. The republic of Tlascala alone opposed him; but he routed its army, which had resisted all the forces of the Mexican empire, dictated peace on moderate terms, converted the people into powerful auxiliaries, and, surmounting all obstacles, arrived, with six thousand natives and a handful of Spaniards, in sight of the immense lake on which was built the city of Mexico, the capital of the empire. Montezuma received him with great pomp, and his subjects, believing Cortes to be a descendant of the sun, prostrated themselves before him. The first care of Cortes was to fortify himself in one of the beautiful palaces of the prince; and he was only thinking how to get hold of the riches of so opulent an empire, when intelligence reached him that a general of the emperor, who had received secret orders, had just attacked the garrison of Vera Cruz and killed several of his soldiers. This event undeceived the Mexicans, who had hitherto believed the Spaniards to be immortal, and overturned the whole policy of Cortes. Struck with the greatness of the danger, surrounded by enemies, and having only a handful of soldiers, he conceived and instantly executed a most daring project. Having repaired with his officers to the palace of the emperor, he announced to Montezuma that he must either accompany him or perish. Being thus master of the person of the monarch, he then demanded that the Mexican general and his officers who had attacked the Spaniards should be delivered into his hands; and when this had been done he caused these unfortunate men, who had only obeyed the orders of their sovereign, to be burned alive before the gates of the imperial palace. During this cruel execution Cortes entered the apartment of Montezuma, and caused him to be loaded with irons, in order to force him to acknowledge himself a vassal of Charles V. The unhappy prince yielded, and was restored to a semblance of liberty on presenting the fierce conqueror with six hundred thousand marks of pure gold, and a prodigious quantity of precious stones. Scarcely had he reaped the fruits of his audacity, however, when he was informed of the landing of a Spanish army, under Narvaez, which had been sent by Velasquez to compel him to renounce his command. In this emergency Cortes acted with his usual decision and courage. Leaving two hundred men at Mexico, under the orders of his lieutenant, he marched against Narvaez, whom he defeated and made prisoner, and then enlisted under his standard the Spanish soldiers who had been sent to attack him. On his return to the capital, however, he found that the Mexicans had revolted against the emperor and the Spaniards, and that dangers thickened around him. Montezuma perished in attempting to address his revolted subjects; upon which the latter, having chosen a new emperor, attacked the headquarters of Cortes with the utmost fury, and, in spite of the advantage of fire-arms, forced the Spaniards to retire, which alone saved them from destruction. Their rearguard, however, was cut in pieces, and they suffered severely during the retreat, which was continued during six days. Elated with their success, the Mexicans offered battle in the plain of Otumba. This was what Cortes desired, and it proved their destruction. Cortes gave the signal for battle, and, on the 7th of July 1520, gained a victory which decided the fate of Mexico. Immediately afterwards, he proceeded to Tlascala, assembled an auxiliary army of natives, subjected the neighbouring provinces, and then marched a second time against Mexico, which, after a gallant defence of several months, was retaken on the 13th of August 1521. These successes were entirely owing to the genius, valour, and profound but unscrupulous policy of Cortes; and the account of them, which he transmitted to Spain, excited the admiration of his countrymen. The extent of his conquests, and the ability he had displayed, effaced the censure which he had incurred by the irregularity of his operations; and public opinion having declared in his favour, Charles V., disregarding the pretensions of Velasquez, appointed him governor and captain-general of Mexico, at the same time conferring on him the valley of Guaxaca, which was erected into a marquisate, with a considerable revenue. But although his power was thus confirmed by royal authority, and although he exerted himself to consolidate Spanish domination throughout all Mexico, the means he employed were such that the natives, reduced to despair, took arms against the Spaniards. This revolt, however, was speedily subdued, and the Mexicans were everywhere forced to yield to the ascendency of European discipline and valour. Guatimozin, who had been recognised as emperor, and a great number of caciques, accused of having conspired against the conquerors, were publicly executed, with circumstances of great cruelty, by order of Cortes. Meanwhile the court of Madrid, dreading the ambition and popularity of the victorious chief, sent commissioners to watch his conduct and thwart his proceedings; and whilst he was completing the conquest of New Spain, his goods were seized by the fiscal of the Council of the Indies, and his retainers imprisoned and put into irons. Indignant at the ingratitude of his sovereign, Cortes returned in person to Spain, to appeal to the justice of the emperor, and appeared there with great splendour. The emperor received him with every mark of distinction, and decorated him with the order of St Iago. Cortes returned to Mexico with new titles but diminished authority, a viceroy having been intrusted with the administration of civil affairs, whilst the military department, with permission to push his conquests, was all that remained to Cortes. This division of powers became a source of continual dissension, and caused the failure of the last enterprises in which he engaged. Nevertheless, in 1536, he discovered the peninsula of California, and surveyed a part of the gulf which separates it from Mexico. At length, tired of struggling with adversaries unworthy of him, whom the court took care to multiply, he returned to Europe, hoping to confound his enemies. But Charles V. received him coldly. Cortes dissembled, redoubled the assiduity of his attendance on the emperor; accompanied him in the disastrous expedition to Algiers in 1541, served as a volunteer, and had a horse killed under him. This was his last appearance in the field, and if his advice had been followed, the Spanish arms would have been saved from disgrace, and Europe delivered nearly three centuries earlier from the scourge of organised piracy. Soon afterwards he fell into neglect, and could scarcely obtain an audience. One day, however, having forced his way through the crowd which surrounded the emperor's carriage, and mounted on the door-step, Charles, astonished at an act of such audacity, demanded to know who he was. "I am a man," replied the conqueror of Mexico, proudly, "who has given you more provinces than your ancestors left you cities." This haughty declaration of important services ill-requited could scarcely fail to offend a monarch on whom fortune had lavished her choicest favours; and Cortes, overwhelmed with disgust, withdrew from court, passed the remainder of his days in solitude, and died, near Seville, on the 2d of December 1554, being then in the sixty-third year of his age. The only writings of Cortes are four letters, on the subject of his conquests, which he addressed to Charles V., and which have fortunately been given to the world. The best edition of them is that of Don Francisco Anto-

Cortes.

Cortese ‖ Corundum.

nio Lorenzana, archbishop of Mexico, entitled *Historia de Nueva-España escrita por su esclarecido conquistador, Hernan Cortes, aumentada con otros documientos y notas* (Mexico, 1770, 4to); a work the noble simplicity of which attests the truth of the recital it contains. The conquests of Cortes have been described with pompous elegance by the historian Antonio de Solis, and with more truth and simplicity by Bernardo Diaz del Castillo. (J. B—E.)

CORTESE, JACOPO. See BORGOGNONE.

CORTLAND, the chief town of a cognominal county in the state of New York, North America. It has several manufactures, and the vicinity is highly cultivated. Pop. (1850) 7758.

CORTOMARCK, a market-town of Belgium, province of W. Flanders and arrondissement of Dixmude, 15 miles S.S.W. of Bruges. Pop. (1851) 4358, principally engaged in the manufacture of woollens.

CORTONA, the CORYTHUS of Virgil, one of the oldest and most powerful cities of the Etrurian Dodecapolis, was situated on the top of a lofty hill about half-way between the Tiber and its tributary the Clanis. From its position it was regarded as impregnable by the successive conquerors of Italy who passed through the rich territory which surrounds it; and to this fact may be attributed the comparative rarity with which the name of Cortona is found in the ancient classics. The origin of the city is due to the Umbrians, from whose hands it passed into those of the Pelasgi, when that people began to extend its conquests in Etruria. Towards the close of the fourth century B.C., Cortona was still one of the most important cities in that part of Italy, both in political influence and in population. When it received the Roman yoke is not known, but it was probably before the invasion of Hannibal, who laid waste the adjoining country before the battle of Thrasymene. It was only once colonized from Rome, apparently about the end of the second century B.C.; but as the colony was never renewed, the city fell into decay, and is not mentioned among the other colonies of the Roman empire either by Pliny or by Ptolemy. In its subsequent history the most interesting fact is, that it was one of the first bishoprics of the early Christian church.

On the site of the ancient Cortona, a modern city of the same name has been built, which is also the see of a bishop. Its present population is about 5000. The town derives its chief interest from the very valuable remains of antiquity dug up from the ruins of the ancient city. The most interesting of these are the fragments of the *Cyclopean* walls, one portion of which, 120 feet in length and of admirable workmanship, is in a high state of preservation. Some bronzes of exquisite beauty have also been unearthed; among them the celebrated bronze lamp, which is held by connoisseurs to be one of the finest specimens of ancient Etruscan art that has ever been discovered. (See Dennis' *Cities and Cemeteries of Etruria*, p. 442.) Cortona contains a number of handsome churches, some of which are adorned with valuable paintings of the early masters. Of these the finest is the cathedral, which among other curiosities contains the great sarcophagus, in which the local antiquaries, eager to identify everything with Hannibal's invasion, maintain (without any good foundation) that the bones of the unfortunate consul Flaminius were deposited after the battle of the Thrasymene Lake.

CORUNCANIUS, TIBERIUS, a distinguished Roman jurist, is said by Cicero to have been a native of Tusculum. He was appointed dictator B.C. 246, and was the first plebeian who filled the office of pontifex maximus. A few fragments of his legal treatises have been preserved by Pliny, and his opinions are frequently quoted by Cicero.

CORUNDUM. Adamantine spar.—Korund and Demantspath, *Werner;* Telesie, Corindon, *Haüy.*

This mineral was long known in Europe under the name of adamantine spar. It was imported from India, where it was used in cutting and polishing gems; but its history was wholly unknown until the late Right Honourable Charles Greville, to whom the science of mineralogy is so much indebted, obtained a clue by which he arrived at one locality of this interesting mineral. Corundum.

In the year 1767, Mr Berry, a very eminent seal-engraver in Edinburgh, received from Dr Anderson of Madras a box of crystals of adamantine spar, with information that it was with this substance all stones except diamond were cut and polished in India. Mr Greville obtained from his friend Colonel Cathcart some crystals, which that gentleman had also got from Dr Anderson twenty years afterwards, and to which the native name of corundum was attached. By this means Mr Greville was enabled to put the exertions of others in requisition; and after various fruitless attempts, through the assistance of Mr Edward Garrow, then (1792) residing at Trichinopoly, he at length obtained a minute account of the stone, as known in that part of Hindustan. It seems that the searching for and working with this substance is consigned, like most other branches of trade, to one particular caste; hence all others are wholly ignorant of it, and those who belong to it are communicative or otherwise, just as they may consider their interest affected. By dint of perseverance he at last discovered that the corundum was found in the neighbourhood of Condrasta, a village about fourteen miles from Permetty, which, according to Rennell's map, is situated on the south side of the Cauvery, not far from Caranel. Hither Mr Garrow repaired; and being, as he says, the first European whom the natives had seen, was as great a curiosity among them as Landers proved to the Ashantees. Condrasta he found to be a very small hamlet, occupied by five families, whose race had obtained a prescriptive right as miners to work in the pits. The implements by which their operations were carried on were of a very rude nature; a broad pointed heavy iron crow with a wooden handle being the only one mentioned. With this they formed their excavation in a soil composed of gritty granite, masses of which, several pounds weight, on being brought to the surface were crushed, and the crystals collected.

The receipt of this collection afforded Mr Greville the means of writing the interesting account of the corundum stone which we find in the *Transactions of the Royal Society of London*, read 7th June 1798, in which its identity with the sapphire, previously pointed out by Pelletier and De Lametherie in 1787, was finally confirmed. It is singular, that during that year other philosophers were occupied with the investigation of this mineral, namely, Werner in Germany, and Romé de Lisle in France; the former having sent to the latter two wooden models, which he pronounced to be the shape of the oriental ruby, and similar in form to the crystal of adamantine stone dissected by Pelletier and his collaborateur, and confirming the hint originally thrown out by Romé de Lisle, of a connection between the adamantine stone and the gems distinguished by the appellation of oriental.

Thus the name of corundum was given to the genus, and was generally adopted by mineralogists.

Bournon, in his paper on this stone, read before the Royal Society in 1802, divides it simply into perfect and imperfect; and had he added a third sub-species, under the name of granular or compact, his division would have been sufficiently comprehensive.

Mohs has described this mineral as the third species of his genus corundum, under the name of rhombohedral corundum, which comprehends the sapphire and ruby, with the other different-coloured telesies of Haüy, included in Bournon's perfect corundum. The brown and greenish-gray coloured varieties, and the emery stone from Madras,

Corunna. Naxos, &c., are also comprehended under the same head by Mohs.

The first of these, the perfect corundum, presents an infinite variety of colours. Red and blue are the most common; and the former, when perfect in transparency and colour, and of considerable size, vies with the diamond itself in value; but it is seldom known to exceed half an inch in length, with a proportionate breadth. The very perfect crystals of dark blue are next in value, and then the yellow; but the resemblance of the last to topaz when cut depreciates it considerably. These varieties are principally the produce of Pegu and Ceylon, but are found in several other localities in Europe, especially in Auvergne and St Gothard, but in small or foul stones.

Of the imperfect corundum we have abundance of the greenish-gray colour from the Mysore and the Malabar coast, whilst the Carnatic and China afford the brown coloured variety in rude imperfect crystals. In the Mysore it was originally found among the vegetable soil, evidently derived from the decomposition of the granite on which the soil rests, as noticed in the account by Mr Garrow.

The corundum occurs always imbedded in its matrix, not in drusy cavities. It is very hard, and difficultly frangible; but the natural joints are so perfect in the specimens of the greenish-gray coloured variety, that it is very easily cleavable into the primitive rhomb. In the granular variety from Naxos the sapphire occurs in distinct concretions of considerable size, and of a good colour. The compact variety is used by the natives of India for grinding and polishing all the different coloured gems, which is done by friction in the simplest manner. Use soon indents grooves on the surface of the stone; and it is from these grooves that the polished stones from India obtain such a constantly similar form, convex, oval, or circular. Pounded corundum, moistened with a little water, expedites the operation of grinding and polishing, and is also used in cutting and slicing stones. A bit of twisted wire stretched on a bow of bamboo of about three feet long, forms, with the grinding-stone, the whole necessary implements of an Indian lapidary. At Gellivara, in Sweden, this mineral occurs in greenish-gray particles, dispersed in iron ore. For other particulars, see MINERALOGY.

CORUNNA (Spanish *Coruña*), a city and seaport of Spain, capital of a province of the same name, in the ancient province of Galicia, 43 miles N. of Santiago. Lat. 43. 23. 36. N.; Long. 8. 20. 13. W. Pop. (1845) 18,840. It is divided into an upper and lower town, the former situated on the east side of a small peninsula, and the latter on the isthmus connecting the peninsula with the mainland. The upper town is the more ancient, and is surrounded by walls and bastions, and defended by a citadel. The lower town, which is separated from the mainland by ramparts and a ditch, is comparatively well built, and contains the theatre, custom-house, palace of the captain-general, court-house, arsenal, and barracks. The harbour is safe, and defended on the E. by Fort San Diego, and on the W. by Fort San Antonio. North of the city is the Tower of Hercules, 92 feet in height, a Roman structure now used as a lighthouse. Coruña is well defended on the side of the sea, but its defences on the land side are commanded by a hill which overlooks the city. The inhabitants are chiefly occupied in the herring and pilchard fisheries on the coast. The principal manufactures are linens, hats, cordage, canvas, and cigars. Shipbuilding is also carried on. Coruña is famous in history for the repulse of a very superior French force by the English under Sir John Moore on 16th January 1809, in which that gallant general received his death-wound. He was interred in his martial cloak on a bastion near the sea. A monument raised by the British government now marks his resting-place. The name Coruña is derived from the Latin *Columna*. By British sailors it is called the *Groyne*—a corruption of the French name *La Corogne*.

Corus ‖ Corvus.

CORUS, OMER, HOMER, or CHOMER, in *Jewish Antiquities*, a measure containing 10 baths, or 75 gallons and 5 pints, as a measure of liquids; and 32 pecks and 1 pint as a dry measure. The *corus* or *omer* was most commonly employed as a dry measure, and was the largest in use among the Jews. It contained, according to the rabbin, 10 ephahs or 30 sata or seahs. *Corus* is the most usual term in the historical writers, and *omer* or *chomer* among the prophets.

CORUS is used by some of our old writers for 8 bushels, or a quarter: thus, *decem coros tritici, sive decem quarteria.*

CORUSCATION, a glittering or sudden gleam of light, as that produced by electricity in the higher regions of the atmosphere during night, or by the aurora borealis. It is also applied to any vivid glittering light, whether natural or artificial.

CORVETTE, a sloop of war; an advice-boat with fewer than twenty guns.

CORVO. See AZORES.

CORVORANT, or CORMORANT. See ORNITHOLOGY.

CORVUS, the RAVEN or CROW kind. See index to ORNITHOLOGY.

CORVUS (*Raven*), in *Astronomy*, a constellation of the southern hemisphere, containing in Ptolemy's catalogue seven stars, in Tycho's the same number, and in the British catalogue nine.

CORVUS, the name given to several kinds of military engines used by the ancients both in sieges and in naval engagements, and so called from their supposed resemblance to the beak of a raven. Of the first kind was the *corvus demolitor*, for pulling down walls piecemeal (Vitruvius, x. 19). Another was the terrible engine spoken of by Tacitus (*Hist.* iv. 30), which appears to have been a kind of revolving crane, set upon the wall of a fortified place, and so contrived that its grappling-hooks could be made to descend suddenly among the besiegers, carry a man up into the air, and set him down within the walls. But the most famous of these machines was the corvus invented by the Romans for the purpose of enabling them to cope with the Carthaginian fleet, and by means of which they obtained a signal victory off Mylæ in Sicily, B.C. 260. A very minute but obscure account of this machine is given by Polybius (i. 22). Its construction and mode of application appear to have been as follows:—Upon the prow of each vessel was erected a round wooden pillar 24 feet in height, and about nine inches in diameter, upon the top of which was fixed a block or pulley. To this piece of timber was fitted a kind of wooden stage or platform, four feet in breadth, and about 36 feet in length, which was well framed and cramped together with iron. This platform was moveable about the upright pillar, as on a spindle, and provided with cords by which it could be hoisted up. On either side of the stage lengthwise was a parapet about the height of the knee, which was armed with a sharp iron spike having a ring at the top; so that the whole machine bore some resemblance to a baker's kneading-mill. To this ring was attached a rope, which, passing through the block, hoisted up the corvus, and then allowed it to descend with violence upon the deck of the enemy's ship—sometimes upon the prow and sometimes upon the stern, as occasion served. When they had grappled the enemy with these iron spikes, if the vessels happened to swing broadside to broadside they entered from all parts; but when they attacked them by the bow, they entered two and two by means of this machine as on a bridge, those who went first defending their front with their shields, while those who followed planted their shields upon the parapet, and thus defended the flanks.

CORVUS, *M. Valerius*, one of the most illustrious generals of the early Roman republic, was born B.C. 371. The era during which he lived was one of the most memorable in

Corwen || Corygaum.

the annals of Roman history, and he himself played the most conspicuous part in it. He was twice dictator, six times consul, and occupied the curule chair twenty-one times. In his various campaigns he defeated successively the Gauls, the Volsci, the Samnites, the Etruscans, and the Marsi. See ROMAN HISTORY.

CORWEN, a market-town of Merionethshire, North Wales, 12 miles E.N.E. of Bala. It is a neatly built town, standing on the south bank of the Dee, and sheltered by a rock at the foot of the Berwyn mountains, which rise abruptly behind it. It is a favourite resort of anglers. On the opposite side of the river are remains of the ancient British fort Caer Drewyn. Pop. of parish (1851) 2069.

CORYBANTES, in *Antiquity*, the priests of Rhea or Cybele, who celebrated the worship of the great mother of the gods by arraying themselves in full armour, and performing orgiastic dances in the forests and on the mountains of Phrygia, to the sound of flutes, horns, drums, and cymbals. By Strabo they are associated with the Cabiri, the Idæan Dactyli, the Telchines, and the Curetes. In the *Atys* of Catullus there is a picturesque description of the Corybantes, who are represented as transported to a pitch of the most extravagant enthusiasm. Accordingly, it is observed by Maximus Tyrius, that persons possessed with the Corybantic spirit became demented whenever they heard the sound of a flute; and hence the word *κορυβαντιάω, to corybantize*, was used in reference to a person's being transported, or possessed with a devil. The feminine epithets applied to the Corybantes by Catullus indicate that these priests were eunuchs.

Diodorus Siculus relates, that Corybas, the son of Jason and Cybele, instituted the worship of the mother of the gods in Phrygia, and gave his own name to the priests, as he passed through that country with his uncle Dardanus. But Strabo states it as the opinion of some, that the Corybantes were children of Jupiter and Calliope, and the same with the Cabiri. Others, however, think that the word had its origin from the circumstance, that the Corybantes always went along dancing, or tossing the head.

When the worship of Cybele was introduced at Rome (B.C. 204), her priests were called *Galli*. The etymology of this name is uncertain. Festus, Ovid, and others, would derive it from the river Gallus (now *Gatipo*), in Phrygia, regarding which it was fabled, that those who drank of its waters became mad and emasculated themselves. (Ovid, *Fast.* iv.) See CABIRI.

CORYBANTICA, a festival and mysteries celebrated at Cnossus in Crete, in memory of the Corybantes, who educated Jupiter and concealed him in that island from his father Saturn.

CORYCOMACHIA, in *Antiquity*, a kind of exercise in the gymnasium, in which a large leathern bag, filled with sand, and suspended by a rope, was swung to and fro between two or more players.

CORYGAUM, in Hindustan, a village within the limits of the presidency of Bombay, situate 16 miles N.E. of the city of Poona. The village, insignificant in itself, has been rendered memorable from its gallant defence, on the 1st January 1818, by a British force under the command of Captain Staunton, against a formidable detachment of the troops of the Peishwa. The British force consisted of only 500 native infantry, 26 European artillerymen, and a small number of auxiliary horse; that of the Peishwa was composed of three divisions of infantry, amounting in the aggregate to 3000 men, while in the valley below the village, the main army of the Mahrattas lay encamped, consisting of 20,000 horse and 8000 foot. The Peishwa ascended an eminence in the vicinity to watch the result, and to encourage his men by his presence. On both sides the loss was terrible, but the event of the battle left the British in possession of the place. A grant of L.500 per annum was conferred by the East India Company on Captain Staunton, in testimony of their admiration of the gallantry displayed by him upon the occasion. Lat. 18. 39. Long. 74. 8. (E. T.)

Corymbium || Cosenza.

CORYMBIUM, in *Antiquity*, a style of female headdress, in which the hair was arranged in the form of a *corymbus* or knot resembling the clusters of ivy-berries.

CORYPHÆUS (from *κορυφή*, the top of the head), in the ancient tragedy, was the chief or leader of the company who composed the chorus. (See DRAMA.) Hence coryphæus passed into a general name for the chief or principal of any company, corporation, or sect. Thus Eustatius of Antioch is called the coryphæus of the council of Nice; and Cicero calls Zeno the coryphæus of the Stoics.

CORYVRECKAN, WHIRLPOOL OF, a dangerous passage, about a mile in breadth, off the west coast of Argyllshire, lying between the south end of Scarba and the north point of Jura. It is named from a young Danish prince who perished there. Towards the Scarba side the sea is in almost perpetual tumult, arising from the narrowness of the passage through which the tide flows into and out of the sound of Jura. The turbulence of the water is also in part to be ascribed to the presence of a pyramidal rock rising with a rapid acclivity from the bottom about 100 fathoms down, to within 15 feet of the surface. By this interference the current is forced to assume various intricate directions; and, on the other hand, a counter current is produced, chiefly on the Scarba side, and its return into the main stream produces those gyrations, resembling the swells of Swinna and Stroma, which have been magnified into a whirlpool capable of engulfing ships. It is only when high tides and violent winds prevail that the place assumes the frightful character so opposed to the security of vessels. The place is generally avoided, however, by boats and small craft.

CORYZA. See CATARRH.

COS, a small island in the Archipelago, near the coast of Caria in Asia Minor, celebrated for the spirit of its inhabitants in resisting the Persian monarchs, and as the birthplace of Hippocrates, of Apelles, and of Ptolemy Philadelphus. Its chief city, of the same name, stood opposite to Halicarnassus, but was destroyed by an earthquake during the Peloponnesian war. The island is fruitful and salubrious, and celebrated for its wine, silks, and cotton of a beautiful texture. Its modern name is *Stanco* or *Stanchio*. Pop. about 8000.

COSCINOMANCY (*κόσκινον* a sieve, and *μαντεία* divination), the art or practice of divination by suspending a sieve and taking it between two fingers, or by fixing it to a pair of shears, then repeating a formula of words and naming the persons suspected of some offence. If the sieve trembled, shook, or turned when any name was repeated, that person was deemed guilty of the evil in question.

This species of divination is mentioned in the third idyl of Theocritus, and was in use within a recent period in some parts of England.

COSECANT, in *Geometry*, the secant of an arc which is the complement of another to 90°.

COSENZA, a city of Naples, the seat of an archbishopric, and the capital of the province of Calabria Citra, is situated in a deep glen at the junction of the Busento with the Crati, 12 miles E. of the Mediterranean. It is intersected by the Busento, which is here crossed by two bridges. The streets are generally narrow and crooked, and the lower part of the town is said to be unhealthy. The *tribunale*, or palace of justice, one of the finest edifices in that kingdom, is on the eastern bank; and an old castle, now used as a barrack, crowns the summit of an eminence on the opposite side of the river. It has also a diocesan seminary, royal college, theatre, foundling hospital, academies of science and literature; manufactures of earthenware and cutlery; and a considerable trade in silk, rice, wine, fruits, manna, flax, &c. Pop. 9000. It is a place of great antiquity, having, under the name

Cösfeld || Cosmology.

of *Consentia*, been the chief city of the Bruttii. Alaric, king of the Goths, died while besieging this city A.D. 410, and was buried in the bed of the Busento, which was turned from its course for that purpose.

CÖSFELD. See KOSFELD.

COSHERING, in the feudal customs, a kind of right of the lords to lie and to feast themselves and their followers at their tenants' houses. The word may perhaps be derived from the old English *coshe*, a cot or cottage.

COSINE, in *Trigonometry*, the sine of an arc which is the complement of another to 90°.

COSLIN, a town of Prussia. See KOSLIN.

COSMAS, a distinguished saint and martyr of the early Christian church, was a native of Arabia, where, along with his brother Damianus, he practised medicine gratuitously. The two brothers adopted this profession from the idea that by means of it they might most efficiently benefit their fellow-creatures. After a short but eminently useful career, they both perished in the persecution organized by Diocletian against the Christians, A.D. 303-311.

COSMAS, bishop of Maiuma in Palestine during the first half of the eighth century, was originally a monk of Jerusalem, and gained a great reputation by the sacred hymns which he composed for the service of the Greek church. These hymns—some of which are acrostics—are still for the most part in MS., though a few of them were at one time issued from the Aldine press.

COSMAS, surnamed *Indicopleustes* from the fact of his having sailed over the eastern seas, was a native of Egypt, and lived during the first half of the sixth century of the Christian era. In early life he travelled as a merchant through the East as far as India, visiting Arabia and Persia, and navigating the adjoining seas. In the course of his wanderings he amassed much information concerning the topography, history, and antiquities of the countries which he visited, and the mode of life, manners, and customs of the inhabitants. The result of his researches he embodied in his *Topographia Christiana, sive Christianorum opinio de Mundo*. Besides this work, Cosmas compiled a series of astronomical tables, a universal cosmography, an exposition of the Psalms, and a commentary on Canticles,—which treatises have perished.

COSMETIC (*κοσμέω, to adorn*), any preparation to render the skin soft and white, or to beautify and improve the complexion. The word *cosmetæ* among the Romans was used to denote a class of slaves whose business it was to dress and adorn their mistresses.

COSMICAL (*κόσμος, order, the world*), relating to the world, or to the whole system of visible bodies, including the earth and stars.

In the ancient astronomy a star is said to rise or to set cosmically when it rises or sets at the same instant with the sun. Cosmical is opposed to *achronycal*, which signifies that a star rises at the instant the sun sets, or *vice versâ*.

COSMOGONY, the generation, origin, or creation of the world or universe.

COSMOGRAPHY, the science which treats of the construction, figure, disposition, and relation of all the parts of the world. It consequently comprehends astronomy, geography, and geology.

COSMOLABE (from *κοσμος, world*, and *λαμβάνω, to take*), an ancient mathematical instrument for measuring distances both in the heavens and on the earth. The *cosmolabe* is in a great measure the same with the astrolabe. It is also called *pantacosm*, or the *universal instrument*, by Morgard, in a treatise written expressly on this instrument, and printed in 1612.

COSMOLOGY, the science of the world or universe. This is called general or transcendental cosmology by Wolfius, who has written a treatise on the subject; in which he endeavours to explain how the world arose from simple substances, and treats of the general principles of the modifications of material things, of the elements of bodies, of the laws of motion, of the perfection of the world, and of the order and course of nature.

Cosmopolite || Cossacks.

COSMOPOLITE, or COSMOPOLITAN, a person who has no fixed place of abode, or a man who is a stranger nowhere; a citizen of the world.

COSNE, a town of France, department of Nièvre, capital of an arrondissement of the same name, on the right bank of the Loire, 35 miles N.N.W. of Nevers. Pop. (1851) 6245. It has a tribunal of primary instance, a communal college, an agricultural society; and in the vicinity are extensive forges for the making of anchors and other heavy iron articles.

COSSACKS, certain Russian tribes who inhabit the southern and eastern parts of the empire. They are a species of military democracy, being independent of the imperial government in their internal administration, and paying no taxes into its treasury, but performing the duty of soldiers instead, in which capacity they guard the frontiers upon which they reside. Their religion, with few exceptions, is that of the Græco-Russian church. Both on account of their descent and present condition, they have been divided into two principal classes, the Cossacks of Little Russia (Malo-Russia), and those of the Don. Both classes, but especially the latter, have collateral branches. From those of the Don, who are the most civilized, are descended the Volgaic, the Terek, the Gresbeskoi, the Uralian, and the Siberian Cossacks. To the other race belong the Zaporogians or Haydamaks, who are the wildest and most barbarous of all. As to the origin of the people or their name, writers are by no means agreed. Some derive both races from the province of Cosachia. In the Turkish language *cazak* signifies a robber; but in the Tartar tongue it simply means a soldier lightly armed for rapid motion. Their origin is very probably Russian, and their language is fundamentally so, although mixed with Turkish and Polish words. The Cossacks of Little Russia first appear in history in the fourteenth century, when the invasion of Russia on the part of Poland forced numbers of the inhabitants to migrate to the banks of the Dnieper, where they gradually established themselves, and spread in the direction of the Bog and Dniester. The Polish king, Stephen Bathori, consolidated the constitution of these warlike tribes, and formed them into regiments under a commander-in-chief, entitled a Hetman or Headman. Some attempts to abridge their liberties, and introduce the Catholic religion, drove them in 1654 under the protection of Russia, from which they revolted in 1708, a considerable body of them joining the standard of Charles XII. under their hetman Mazeppa, whom Lord Byron has immortalized. This act drew down upon the whole people the vengeance of the Czar Peter I., who, after the battle of Pultowa, ordered them to be extirpated. With this branch of Cossacks were formerly united the Haydamaks, who, instead of propagating their race by marriage, perpetuated themselves as a nation principally by kidnapping children. They are still a rude uncivilized race. The Cossacks of the Don have been in the service of Russia since the sixteenth century. They occupy an extensive territory on both sides of the Don, living in villages, and supporting themselves while at home by fishing and the breeding of cattle, in preference to agricultural pursuits, for which they have little inclination. Their capital, Tscherkask, is a sort of Tartar Venice. It is situated on some islands in the Don: the houses are built on high wooden piles, and connected with one another by small bridges. It contains about 15,000 inhabitants; and, besides numerous churches richly adorned with the precious metals and gems, it possesses a regular theatre, and a school where several languages and sciences are taught. As this city is very unhealthy from the overflowing of the river,

Cosse ‖ Cossyah.

another called New Tscherkask was founded in 1805, about 14 miles north of the former, and it now contains about 18,000 inhabitants. For further particulars respecting the Cossacks, see RUSSIAN EMPIRE.

COSSE DE GENISTE, an order of knighthood instituted in 1234, by Louis IX. (St Louis), on the occasion of his marriage with Margaret of Provence. The motto on the collar of this order was *Exaltat humiles.*

COSSIMBAZAR, a town of Hindustan, in the province of Bengal, nearly adjoining the southern suburbs of Moorshedabad, of which it may be considered as the port. It is situated on the south-east bank of the Bhagarutty river, and is one of the largest trading towns in Bengal. It was long celebrated for its silk manufactures, and for the manufacture of stockings, which were all knitted by the women and children in the vicinity, and were held in the highest repute, until supplanted by the irresistible competition of the cheaper fabrics of Great Britain. The neighbourhood abounds with mulberry trees, on which silkworms are fed; and the quantity of silk produced not only supplies all that is consumed in the manufacture of carpets, satins, and other stuffs, but also leaves a surplus for exportation. The peninsula here formed by the windings of the Bhagarutty, at one time insulated, and thence denominated the island of Cossimbazar, is a perfectly flat bed of sand; but the annual overflow of the river leaves a rich deposit, and fertilizes this otherwise unproductive tract. It abounds with all descriptions of game, from the tiger and the boar to the inferior sorts, such as hare, deer, partridge, &c., and with all sorts of aquatic birds. The Cossimbazar river is named the Bhagarutty or Bhagirathi, and is reckoned a sacred branch of the Ganges. During the rainy season Cossimbazar has a most extensive water communication, which affords great facilities for its trade. The East India Company stationed agents here at a very early period for the purchase of goods, but their factory was not built till 1706. In 1756 it was taken and plundered by the nabob of Bengal. The latest census gives the number of houses at 1300, and that of the inhabitants at 3538. Long. 88. 18. E.; Lat. 24. 10. N. (E. T.)

COSSIPORE, in Hindustan, one of the suburbs of Calcutta, situate on the left bank of the Hooghly, five or six miles north of Fort-William. This place contains the government foundry, established for the casting of brass ordnance required for the military service of India. It was erected many years since by Colonel Hutchinson of the engineers, upon the best European model, and the establishment is represented as one of the most complete and perfect to be found in any part of the world. Specimens of the ordnance cast at Cossipore were sent home during the administration of Marquis Hastings, and being submitted to the examination of a committee of royal artillery officers at Woolwich, were pronounced superior in respect of workmanship and finish to those of the royal arsenal, the particular pattern of the gun being alone objected to. Instruction in the casting of guns is here afforded to the company's artillery officers upon their first arrival at Calcutta. Lat. 22. 38; Long. 88. 26. (E. T.)

COSSYAH HILLS, in Hindustan, extend over the tract of country lying between Assam on the north, and the district of Sylhet on the south, from Lat. 25. to 26. 27., and from Long. 90. 52. to 92. 11. The area of the country embraced within these limits is estimated at 2808 square miles, of which a superficies of 729 square miles belongs to the British, and the remainder to a number of protected native chiefs. The British portion supports a population of 10,935; that of the native chiefs maintains somewhat more than 30,000. The Cossyah tribes, though Pagans, are not Hindus; they eat beef, and have neither idols nor temples, but offer sacrifices to rocks, streams, and groves. Huge monuments of stone with doorways (reminding the English traveller of Stonehenge), are scattered over the hills, and are conjectured to have been constructed in memory of departed chiefs and warriors. Though the people are wild, the general tranquillity of the country has been secured by means of a liberal and conciliatory policy on the part of the British government. (E. T.)

Costa Rica.

COSTA RICA, REPUBLIC OF, the most southern, and one of the smallest, of the five states of Central America, lies chiefly between Lat. 8. and 11. N., and Long. 82. and 86. W.; and is bounded on the north by Nicaragua, south by New Granada, east by the Caribbean Sea, and west by the Pacific Ocean. It has an estimated area of 16,300 square miles, and a population of 215,000, of whom about 25,000 are Indians. The surface of the country is much diversified, but is chiefly occupied with mountains, some of which are volcanoes. Among these may be mentioned Irasu or Carthage, Turrialva, Chirripo, Barba, Votos, Erradura, and Miravalles. It contains two principal forests: that of Aguacate is remarkable for its rich gold mines, which were begun to be worked about 1821, and have been the means of attracting many colonists to settle there; and that of Dota which is of great extent, and through which passes the road from San José to the towns of Terrava and Borruca, leading thence into the republic of New Granada. At a point called Alto-de-Ochomogo, near Carthage, the streams which run through the principal part of the state diverge and discharge themselves respectively into the Pacific Ocean and the Caribbean Sea; so that Costa Rica may be considered as divided into two parts, a north-eastern and a south-western. This division is farther borne out by the different characters of the two parts. The south-western slope is easily accessible, and its climate, throughout nearly its whole extent, varies from insupportable heat and aridity to a mild and genial temperature. On the north-eastern side the aspect is more rugged,—the number, complication, and height of the mountains, and the impetuous currents of the rivers, both large and small, attract the attention of the traveller. Among the rivers of Costa Rica are the Tempisque and Grande, falling into the bay of Nicoya; the Ucus or Macho, which afterwards takes the name of Reventason, and falls into the Caribbean Sea; the Matina, formed by the rivers Chirripo and Barbilla; the Escudo de Veragua, dividing Central from South America; the Banana, Tiribee and Culabra, all falling into the Caribbean Sea; the Chrico Mola or Chrickam Aula, falling into the bay of Cheriqui; the Costa Rica or San Carlos, and the Sarapiqui, into the San Juan. The Baya is a canal, believed by some to be natural, and by others to have been cut by the aborigines, commencing at the port of Moin or Salt Creek, and running parallel to the coast as far as Pearl Kay Lagoon, a distance of 180 miles, being, however, stopped up in a few places. It is crossed by the river Matina and several others. Boats and canoes can come up from the port of Moin to the Matina, and up that river to the Chirripo and Barbilla, which are also navigable; so that the valuable wood on the banks of these rivers can be sent to Moin on rafts. The chief lakes are Locorra, at the head of the brook; Reventado, which supplies the city of Carthage with water; the twin lakes at Laguna, on the road from San José to the Matina; Ermosa, near the road from Barba to the Sarapiqui; and Surtidor, at the source of the latter river.

Agricultural and pastoral pursuits constitute the principal occupation of the inhabitants. Some parts of the state afford excellent pasturage, and great numbers of cattle, hogs, goats, and sheep are reared. In the forests are the tapir, mountain cow, wild goat, wild striped boar, zahino, &c. Among its vegetable productions are coffee, sugar, maize, tobacco, cocoa, indigo, peas, beans, &c. It is also rich in various kinds of timber, as mahogany, beech, cedar, oak, chestnut, and dyewoods. The climate varies much in the different parts. In the principal inhabited places it is said

Costal ‖ Costard.

to be remarkably mild and salubrious, and to have no extreme either of heat or cold, the thermometer varying between 50° and 76°; but including all places cultivated or in pasture it ranges through every degree, from the freezing point to 100°, according to the elevation of the land. Costa Rica is divided into six departments, San José, Cartago, Heredia, Alajuela, Guanaceute, and Punta de Arenas. Its principal towns are San José the capital, and Cartago or Carthage the former capital. The government is vested in a president and vice-president, elected for 6 years, and a legislative chamber composed of 12 deputies elected for 3 years. The chief court of justice is the tribunal of San José, which is presided over by 7 judges. The state has no debt; and the revenue, derived from duties on tobacco and spirits amounts to about 120,000 dollars. The militia consists of 5000 men, of whom 200 are called upon periodically for active duty. The Roman Catholic is the established religion, but complete toleration is established by law. After the declaration of independence by the Spanish American colonies in 1821, Costa Rica formed for a short time a province of Mexico. In 1823 it became one of the states of the Central American Confederacy, but on the dissolution of that short-lived union it became an independent republic. It has, unlike the other states, been in the enjoyment of internal and external peace for several years; and the efforts of its government have been exclusively directed to the development of its internal resources.

COSTAL (Lat. *costa*, a rib), pertaining to the side of the body or the ribs; as costal muscles, vertebræ, &c.

COSTANZO, Angelo di, Lord of Cantalupo, a celebrated Italian historian and poet of the sixteenth century, descended of a noble Neapolitan family, was born at Naples about the year 1507. Connected by ties of friendship with Sannazaro, and several other eminent men who then lived in the capital, he was encouraged by them in the design of writing a history of the kingdom of Naples, to remedy the incompleteness and partiality of the work of Collenuaccio. Having employed more than forty years in researches, he published the first part of his work at Naples in 1572; but being dissatisfied with his performance, he immediately after resolved to reconstruct it from the foundation. At length, in 1582, the work came forth in the shape in which it now appears, under the title of *Le Istorie del Regno di Napoli dal* 1250 *fino al* 1489, *divise in xx. libri*, Aquila, folio, an edition which has now become very scarce even in Italy. In it the author treats of the period from the death of the Emperor Frederick II. to the war of Milan under King Ferdinand I.; and though not immaculate, his history of the kingdom of Naples is still regarded as one of the best extant. It was reprinted at Naples, but very incorrectly, in 1710, 4to; and again, but with more care, in 1733, 4to. Lastly, it has been embodied in the great Milan *Collection of Classic Authors*, 1805, 3 vols. 8vo. Costanzo also occupies a distinguished rank among the poets of his age. His master in poetry was Berardino Rota, whom he greatly surpassed; and although he made no change in the form of the sonnet, he gave it a turn which the best poets have since taken as their model. His poetry in general is distinguished for the union of gravity with sensibility, which, in truth, constitutes its peculiar characteristic. His *Rime*, originally scattered throughout different collections, appeared for the first time together at Bologna, in 1709, 12mo. They have since been several times reprinted; but of all the editions, the best are those of Comino, Padua, 1723, 1728, and 1738, 8vo. Costanzo died at Naples about 1591.

COSTARD, George, a learned divine of the Church of England, and the author of several critical and historical works, was born at Shrewsbury about 1710, and educated at Wadham College, Oxford. In 1747 he published, in 8vo, some observations tending to illustrate the Book of Job. In 1750 he published two dissertations; one on the meaning of the word *Kesita* (Job xlii. 11); and another on the signification of the word *Hermes*. These were followed in 1752 by *Dissertationes duæ Critico-sacræ, quarum primâ explicatur, Ezek. xii.* 18, *alterâ vero* 2 *Reg. x.* 22. In 1775 he wrote a letter to Dr Birch, which is preserved in the British Museum, respecting the meaning of the phrase *sphæra barbarica*. Some time after this he published a second edition of Dr Hyde's *Historia Religionis veterum Persarum, eorumque Magorum*. In 1764, through the influence of Lord Chancellor Northington, he obtained the vicarage of Twickenham, which he continued to hold till his death. In 1767 he published *The History of Astronomy*, with its application to Geography, History, and Chronology (1 vol. 4to). This work was chiefly intended for the use of students, and contains a distinct view of the several improvements made in geography and astronomy. The last of his publications appeared in 1778, and consisted of A Letter to Nathaniel Brassey Halhed, Esq., containing some Remarks on his preface to the Code of Gentoo Laws. In this work he criticises the current opinion in regard to the great antiquity of the Gentoo laws; and adduces arguments in favour of the truth of the Hebrew chronology. Costard died Jan. 10, 1782.

Cosway ‖ Cote d'Or.

COSWAY, Richard (1740-1821), an eminent painter of the last century, was born in Devonshire. He was elected a Royal Academician in 1771, and gained considerable reputation by his pictures of "Rinaldo and Armida," "Psyche," "Madonna and Child," and "St John;" but his forte lay in miniature painting, in which he was very successful. His wife Maria, who was born at Leghorn of English parents, also painted portraits and historical subjects with great ability, as may be seen from the prints after her by Bartolozzi and others. After her husband's death she retired to Lodi.

COTA, Rodriguez, a Spanish poet, born at Toledo in the fifteenth century, and surnamed *El Tio*, or the Uncle. No details of his life are found in any of the biographies. He is believed to have flourished under the reign of Don Juan II., king of Castile; and the celebrated tragi-comedy of *Calista y Melibea*, as well as a satire against Juan and his court, entitled *Mingo Rebulgo*, are attributed to him. The *tragi-comedia*, which is also known under the name of *Celestina*, had been several times printed before the dates of the Seville and Madrid editions, which appeared respectively in 1539 and 1601. *Celestina* has been ascribed by some to Juan de Mena; but the slightest attention to the style of this poet, which is altogether different from that of Cota, shows that there is not the least foundation for such an opinion. The tragi-comedy, which was originally written in prose, was rendered into Castilian verse by Juan de Sedeno, Salamanca, 1540, 4to. It has also been translated into French, Paris, 1527, 1542, and Lyons, 1529, 8vo; into Italian, Venice, 1519, 1533, 8vo; and English, under the title of *The Spanish Rogue*, but without a date.

COTANGENT, the tangent of an arc which is the complement of another to 90°.

COTE D'Or, a department of France, formed of the northern part of Burgundy, of which it includes the countries of Montagne and Dijonnais, and the greater part of Auxois. It is bounded N. by the department of Aube, E. by those of Haute-Marne, Haute-Saône, and Jura, S. by that of Saône-et-Loire, and W. by those of Nièvre and Yonne. Area 3345 square miles. The surface is mostly hilly. A chain of hills runs from N.E. to S.W. through the centre of the department, separating the basin of the Seine from that of the Saône, and forming the connecting-link between the Cévennes and the Vosges mountains. A part of this range gives name to the department, and is so called from the number and excellence of its vineyards. The rivers are numerous but small, the only

one navigable being the Saône. The Burgundy canal, connecting the rivers Saône and Yonne, traverses this department from S.E. to N.W. The soil is generally good, producing wheat, maize, rye, barley, oats, hemp, flax, &c. The most important production, however, is wine, of which it yields several varieties. Honey is also produced in considerable quantities. The forests of this department are very extensive, and consist of oak, beech, elm, &c. The mineral productions are numerous and valuable, including iron, coal, marble, limestone, gypsum, potter's clay, &c. There are numerous iron works, breweries, distilleries, tanneries, potteries, &c. This department is divided into 4 arrondissements, as follows:—

Arrondissements.	Cantons.	Communes.	Pop. in 1851.
Dijon	14	267	151,331
Beaune	10	202	124,206
Châtillon-sur-Seine	6	116	54,075
Semur	6	143	70,685
	36	728	400,297

The capital is Dijon.

COTE-ST-ANDRE, La, a town of France, department of Isere, arrondissement of and 21 miles E.S.E. from Vienne. Pop. 3000. In its vicinity is produced the celebrated liqueur to which it gives name.

COTELERIUS, John Baptist (1627–1686), fellow of the Sorbonne, and regius professor of Greek, was born at Nismes. He collected the works of the apostolic fathers, and published them at Paris with a Latin translation and notes. He also published a work entitled *Monumenta Ecclesiæ Græcæ*, in three vols., being a collection of Greek tracts from the king's and M. Colbert's libraries, which had never before been published; and to these he added a Latin translation and notes.

COTERELLUS and *Cotarius*, terms used, according to Spelman and Du Fresne, to designate servile tenants; but in Doomsday-book and other ancient manuscripts they seem to be distinguished as well in tenure and quality as in name; for the cotarius had a free soccage tenure, and paid a stated firm or rent in provisions or money, with some occasional customary services; whereas the coterellus seems to have held in mere villenage, and his person, issue, and goods, were disposable at the pleasure of the lord.

COTERIE (French), a company, society, or association of people; used in English to denote a little assembly or meeting of friends for social enjoyment.

COTES, Roger, a celebrated English mathematician and philosopher, born at Burbach, Leicestershire, of which place his father was rector. Before his twelfth year he showed a decided predilection for mathematical study; and afterwards made such rapid progress in that science, that when only twenty-four years of age he was appointed Plumian professor of astronomy and experimental philosophy. He took orders in 1713; and that same year, at the request of Dr Bentley, he published the second edition of Newton's *Principia Mathematica*, enriched with an original preface. This, with an analytical memoir entitled *Logometria*, and a description of the great meteor which appeared in England on the 6th March 1716, inserted in the *Philosophical Transactions*, is all that Cotes lived to publish. He died June 5, 1716, at the age of thirty-three, and was buried in Trinity chapel, where a monument was raised to his memory, bearing a Latin inscription from the pen of Dr Bentley. He left unfinished a series of elaborate researches on optics, in reference to which Newton observed, "If Mr Cotes had lived, we should have known something." With regard to the pure mathematics, the principal discovery of Cotes consists in a theorem, which still bears his name, and which furnishes the means of integrating by logarithms and arcs of the circle the rational fractions whose denominator is a binomial. These expressions had already exercised the ingenuity of Leibnitz, and of John Bernouilli, and by their labours, in conjunction with those of Euler, this branch of the integral calculus soon assumed a more convenient and simple form. His papers were collected by his successor, Dr Robert Smith, and published under the title of *Harmonia Mensurarum, sive Analysis et Synthesis per Rationum et Angularum mensuras promotæ; accedunt alia Opuscula Mathematica.* Cambridge, 1722, 4to. Of this work, the "Analyse des Mésures, des Rapports, et des Angles, ou Réduction des Intégrations aux Logarithmes et aux Arcs de Cercle," published (Paris, 1747) by the English Benedictin Walmsley, is rather a paraphrase than a translation. Cotes left a valuable treatise on hydrostatics and pneumatics, which was also published by Smith, and afterwards appeared in a French translation, under the title of "Leçons de Physique Expérimentale sur l'Equilibre des Liqueurs," Paris, 1740, 4to.

Côtes-du-Nord, a maritime department in the N.W. of France, containing part of the old province of Brittany. It is bounded N. by the English Channel, W. by Finistère, S. by Morbihan, and E. by Ille-et-Vilaine. Area 2595 square miles. A chain of granitic mountains, of which the culminating point, Mount Menez, attains a height of about 1200 feet, runs through the department from E. to W., dividing it into two unequal parts, of which the southern is the smaller. Towards its western extremity this chain sends out two branches, the one extending westward and the other south-westward to the department of Finistère. Various smaller ramifications are sent off northward and southward from the main chain. The rivers are short and unimportant, the principal being the Rance, Arguenon, Guer, Trieux, Gouessant, and Gouet. The coast is generally steep and rocky. It is much indented by the mouths of numerous small rivers, and fringed, particularly towards its west end, by many small islands. The soil is mostly stony, primitive formations being everywhere found near the surface; and the plains on both sides of the mountain chain are often sandy and sterile. Agriculture is in a very backward state. Rye, oats, and wheat are the principal crops grown. Cattle, goats, and sheep are reared, but they are of inferior breeds. The draught horses, however, are much esteemed. The fisheries employ a great portion of its inhabitants, and constitute one of the most important resources of the department, which is thus an admirable nursery for the French navy. The forests are extensive, and abound with wolves, foxes, badgers, roe-bucks, and wild boars. Iron and lead-mines are worked, but otherwise this department is not rich in minerals. The linen manufacture, though still the staple of the department, has of late years much declined.

Côtes-du-Nord is divided into 5 arrondissements, which with their populations are as follows:—

Arrondissements.	Cantons.	Communes.	Pop. in 1851.
St Brieuc	11	97	180,275
Dinan	10	91	118,328
Loudéac	9	55	92,590
Lannion	7	63	114,737
Guingamp	10	73	126,683
Total	47	379	632,613

COTESWOLD (Saxon *cote*, a cot, and *wold*, a hill), several sheep-cotes, with sheep feeding on hills.

COTHEN, a town of Germany. See Köthen

COTHURNUS, a kind of buskin, raised on soles of cork, and worn by actors in the ancient tragedy, in order to increase their stature and thereby to give an appearance of greater dignity to the character of the hero personated. It covered the greater part of the leg, and was tied beneath the knee. Æschylus is said to have invented the cothurnus See Buskin.

COTIGNAC, a town of France, department of Var, arrondissement of and 9 miles N.N.E. from Brignoles. Pop. 3400. It has some trade in wine, silk, dried fruits, and confectionary.

COTILLON (French, *a petticoat*), a brisk dance, in

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which eight persons take part. It has been superseded by the more modern *quadrille*.

COTIOTE, a small district of Hindustan, province of Malabar. See MALABAR.

COTOPAXI, the most remarkable volcanic mountain of the Andes, in Ecuador, 35 miles S.S.E. of Quito. It rises 18,878 feet above the level of the sea, and is considered as the most lofty of the colossal volcanoes of the Andes. Its eruptions have been numerous and very destructive: those which took place in 1742, 1744, 1768, and 1803, are the most remarkable. With respect to the explosion of 1803, Humboldt observes—"At the port of Guayaquil, fifty-two leagues distant in a straight line from the crater, we heard day and night the noise of this volcano, like continued discharges of a battery; and we distinguished these tremendous sounds even on the Pacific Ocean." In 1744 the thunderings of the volcano were heard at Honda, a town on the Rio Magdalena, at the distance of 200 common leagues. In 1768 the quantity of ashes ejected by its crater was so enormous, that in the towns of Hambato and Tacunga day broke only at three o'clock in the afternoon, and the inhabitants were obliged to use lanterns in walking the streets. For twenty years before 1803, no perceptible smoke or vapour had issued from the crater, when in a single night its cone became so hot that its vast snowy covering had disappeared, and the scorified rock, naked, and of a dusky red, met the astonished eye in the morning; while the sudden melting of the snow gave rise to alarming torrents of water. The appearance of this volcano is in the highest degree majestic and sublime. It is a perfect cone, and, being covered with a thick layer of snow, shines at sunset with dazzling splendour, standing forth in bold relief upon the azure heavens. The upper 440 feet are covered with snow, except the summit, which appears to be surrounded by a circular wall, and which, owing probably to the heat, is never covered with snow. Humboldt found it difficult to ascend the mountain as far as the line of perpetual snow, and he pronounces it impossible ever to reach the summit.

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COTRONE, a city of Italy. See CROTONA.

COTT, or COT, a particular sort of bed-frame, suspended from the beams of a ship, between decks, for the officers to sleep in. It consists of a large piece of canvas sewed into the form of a chest, about six feet long, one foot deep, and three feet wide, and is extended by a square wooden frame with a canvas bottom.

COTTA, C. AURELIUS, a distinguished Roman general, who, during his consulate in B.C. 252, defeated the united forces of the Carthaginians and Sicilians in Sicily. He was celebrated for the severity of his discipline, and on one occasion scourged and degraded into the ranks a near relative of his own, through whose carelessness a part of the camp had been set on fire. On his return to Rome he was honoured with a triumph for his victory over the Carthaginians. In B.C. 248, he was a second time appointed consul. The time and manner of his death are unknown.

Many other members of this family held high offices in the Roman republic; the most remarkable of whom were C. Aurelius, who held the consulship B.C. 75, and enjoyed a high reputation as an orator; and his brother Lucius, who in his prætorship, B.C. 70, carried the celebrated *lex Aurelia judiciaria*, by which the senators were deprived of their exclusive right of acting as judices, and were only allowed to exercise it along with the *equites* and the *tribuni ærarii*.

COTTABUS, in *Grecian Antiquity*, a kind of social game, of Sicilian origin. It consisted in a display of dexterity, by throwing a quantity of wine or other liquid into a brazen basin without spilling it. This favourite diversion was variously modified, as described by Athenæus, Suidas, and Julius Pollux.

COTTAGE SYSTEM.

AMONG the various schemes devised for checking the progress of pauperism in England, and for augmenting the comfort and happiness of the lower classes, few seem to have obtained a greater degree of popularity, or to be more generally patronised, than the COTTAGE SYSTEM;—that system which proposes, under certain restrictions, to furnish the industrious poor with cottages and small pieces of land, to be used for the purpose of keeping kine, raising potatoes, or for some other species of husbandry.

It is not our intention to detail the various peculiarities of the plans of different authors by whom the efficacy of the cottage system has been maintained. We shall content ourselves with examining the fundamental principles on which the whole scheme is founded; and, in so doing, we shall endeavour to resolve the important question, whether the more minute division of landed property, and the letting of small farms and patches of ground, to any considerable portion of the lower classes, would tend to improve their condition and character, and to reduce the sum total of human misery.

As the effects of the cottage or small farming system on the condition of the poor must, in a great measure, depend on the fact of its tending to increase or diminish the exchangeable value of raw produce, it will be necessary, first of all, to inquire into its probable operation in this respect. If it should tend to reduce the price of corn, cattle, &c. or to render their acquisition less difficult, that would be a strong presumption in its favour. But, on the other hand, if it should tend to raise the price of these articles of provision, or to make them exchange for a greater quantity of labour, its introduction would obviously be prejudicial to the community, and especially to the labouring classes.

Effects of a subdivision of landed property on the price of raw produce.

We have already endeavoured to show that the price of raw produce has a natural tendency to rise as society advances, and as a country becomes more populous. (*Principles of the Corn Laws.*) The best lands being first brought under cultivation, recourse is afterwards had to those which are inferior, and require a greater quantity of labour to make them yield the same produce. The *real* price of this produce, which is always regulated by the quantity of labour necessary to its production, is therefore increased; and it exchanges for a greater portion of those commodities the production of which has not also become more difficult.

Had the inventive genius of man been limited in its powers; had the ploughs, harrows, and other machines and implements used in agriculture, at once attained their utmost degree of perfection, and remained ever after in the same state; the rise in the price of raw produce consequent to the increase of population would have been much more obvious. When in such a state of things it became necessary to resort to poorer soils in order to raise additional quantities of food, a corresponding increase of *manual labour* would have been required. On this hypothesis no improvement could have taken place in the powers of the labourer himself. Having already reached the perfection of his art, a greater degree of animal exertion could alone have overcome fresh obstacles. More labour would have been necessary to the production of a greater quantity of food; and it would have been necessary in the precise proportion according to which the quantity

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was increased. Thus, supposing the labour of *ten* men to have been required, during a given number of days, to produce *ten* quarters of wheat, from land of a certain quality,—when *fifteen* quarters were produced in the same time and from the same land, *fifteen* hands must have been employed in its production. The effects of improved machinery, and of a better system of manuring and cropping, are here supposed to be entirely out of the question. Had the arts continued in this stationary state, the price of raw produce must obviously have varied directly with every variation in the quality of the soils successively brought under cultivation.

But in an improving society, the circumstances which regulate the real and exchangeable values of raw produce are extremely different. Here, too, it has doubtless a constant tendency to rise; for notwithstanding that every successive improvement in agriculture, and every new device by which labour may be saved, and the energies and powers of machinery augmented, operate to lower prices,—still the rise of profits, and the consequent stimulus given to population, by every fall in the price of raw produce, increase the demand, and again raise prices, by forcing the cultivation of poorer soils. But this rise is rendered much less perceptible than it would be in a stationary state of society. After inferior soils have been brought under cultivation, more labourers may be required to raise the same quantities of food; but as the powers of the labourers are augmented, a smaller number is required, in proportion to the work to be performed, than if no such improvement had taken place. It is in this way that the tendency to an increase in the price of raw produce is counteracted in the progress of society. The productive energies of the earth itself gradually diminish, and we are compelled to resort to soils of a constantly-decreasing degree of fertility; but the productive energy of the labour employed to extract produce from these soils is as constantly improved. Two directly opposite and continually-acting principles are thus set in motion. From the operation of the causes to which we have alluded, the increasing sterility of the soil is sure, in the long run, to overmatch the increasing power of machinery and the improvements of agriculture, so that prices experience a corresponding rise. Occasionally, however, meliorations in the latter more than compensate, during lengthened periods, for any deterioration in the quality of the former, and a fall of prices is the consequence. Should an equilibrium take place, and the opposite principles exactly counterpoise each other, prices would remain stationary.

Had the whole surface of the earth been originally of the same degree of fertility, and had *the same outlay of capital and labour always continued to yield the same amount of raw produce*, the effects of improved machinery and agriculture in reducing prices would have been quite obvious. If such had been the case, raw produce must have invariably *fallen* in value as society advanced. There would have been nothing to counteract the effects of improvements. The quantity of labour required for the production of all sorts of commodities would, by reason of improvements in machinery and the arts, have been almost always diminishing; and of course their real price would have been as constantly on the decline.

It results, as a consequence of these principles, that any constitution of society, or any method of dividing landed property, which should operate to counteract the spirit of improvement, or which should prevent agriculturists from adopting the most efficacious methods for saving labour and expense in carrying on their business, would be materially injurious.

The rate of profit, and consequently the power to accumulate capital and population, is ultimately regulated by the price of farm produce. If its price be relatively low, that is, if it be easily produced, a comparatively small outlay of labour will suffice to obtain a large quantity of produce. If, in a country thus situated, property be protected, and full scope be given to accumulation, wealth will rapidly increase. Where labour is more than ordinarily productive, the labourer receives a large share of the produce of his exertions, at the same time that a large net profit remains to his employer. In America, labour is extremely well rewarded, but the profits of stock are, notwithstanding, much higher than in Europe. The choice of immense tracts of fertile and unoccupied land relieves the farmers of the United States from the necessity of cultivating any but the richest soils. The wants of the country can be supplied without having recourse to lands of an inferior quality; and although the wages of workmen are comparatively high, yet, as their labour is proportionally productive, capitalists realize a corresponding and ample profit.

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The difficulty of raising sufficient supplies of corn is the principal cause why old-settled and densely-peopled countries advance slowly in the accumulation of capital and riches, and why the profits of stock in them are comparatively low. Were it not, however, for the improvements which are constantly making in agriculture, this difficulty would be greatly increased. These, by enabling the increasing sterility of the soil to be partially overcome, reduce the cost of production, or the real price of food; and by this means the rate of profit, and consequently the power to accumulate wealth and population, is prevented from falling so low as it would do in a society where no improvements were made.

Now this, we apprehend, must be the situation of every country in which a minute division of landed property, or an extended cottage system, has been introduced. The produce of a small farm of five, ten, or even twenty acres, may perhaps enable its occupier to preserve his family from downright starvation, but it will never enable him to accumulate stock to any extent. "Where," asks Mr Young, "is the little farmer to be found who will cover his whole farm with marl at the rate of 100 or 150 tons per acre? who will drain all his land at the expense of two or three pounds an acre? who will pay a heavy price for the manure of towns, and convey it thirty miles by land carriage? who will float his meadows at the expense of L.5 per acre? who, to improve the breed of his sheep, will give 1000 guineas for the use of a single ram for a single season? who will send across the kingdom to distant provinces for new implements, and for men to use them? who employ and pay men for residing in provinces where practices are found which they want to introduce into their farms? At the very mention of such exertions, common in England, what mind can be so perversely framed as to imagine, for a single moment, that SUCH THINGS are to be effected by *little farmers? Deduct from agriculture* ALL *the practices that have made it flourishing in this island, and you have precisely the management of small farms.*" (*Travels in France*, 2d edition, vol. i. p. 410.) Besides, though it were admitted that small farmers might accumulate capital, they could not apply it in the most efficient manner. "The division of labour which, in every pursuit of industry, gives skill and dispatch, cannot take place on the greatest farms in the degree in which it is found in manufactures; but upon small farms it does not take place at all. The same man by turns applies to every work of the farm; upon the larger occupation there are ploughmen, thrashers, hedgers, shepherds, cow-herds, ox-herds, limeburners, drainers, &c. This circumstance is of considerable importance, and decides that every work will be better performed on a large

than on a small farm. One of the greatest engines of good farming, a sheep-fold, is either to be found on a large farm only, or at an expense of labour which destroys the profit." (*Travels in France*, vol. I. p. 409.)

Small farms increase the price of raw produce.

Neither could a small farmer use any but the simplest machines, and he must, in a great measure, be prevented from availing himself of the powers of the lower animals. An Irish cottager cannot employ either a thrashing-machine or a horse. Manual labour is his only engine for extracting produce from the earth. He cannot avail himself of natural agents, nor render them subservient to the great work of production. Those improvements which, in countries where capital is accumulating in masses, are every day rendered more efficient, and tend materially to reduce the price of raw produce, and to render the necessaries of life attainable by less labour, are altogether incompatible with a minute division of landed property. The additional supplies of food required in a kingdom divided into small occupancies cannot be produced without a proportional increase of manual labour; so that raw produce rises in price with every increase of population, or as soon as it becomes necessary to cultivate inferior soils. There is, in this case, nothing left to counteract increasing sterility. It is neither checked by improved machinery, nor by any expedients for saving labour. But, being allowed to exert its full effect, society very soon becomes clogged in its progress; and its future advancement is rendered extremely problematical.

This, we conceive, constitutes a fundamental objection to every attempt to introduce a plan for dividing landed property into minute portions; for surely nothing can be more preposterously absurd than to think of relieving the hardships and distresses of the poor by recommending the adoption of a scheme which would infallibly tend to raise the price of the principal necessaries of life.

But a minute division of landed property is not merely disadvantageous from its having a tendency to raise the price of raw produce, by preventing the most advantageous distribution of capital and labour; it must also exercise a powerful effect on manufactured commodities, and, by increasing the cost of their production, contribute to enhance their real price.

Effects of a subdivision of landed property on manufacturing industry.

In a country like England, where an improved system of husbandry is generally introduced, where farms are extensive, and where improved machinery is employed in agricultural operations, a comparatively small proportion of the inhabitants are engaged in the cultivation of the soil. The rest are employed in manufacturing, in carrying the products of the different districts of the kingdom to where they are in the greatest demand, and in exchanging them for the products of other countries. Farmers do not spend their time in clumsy attempts to manufacture their own produce; and manufacturers cease to interest themselves about the raising of corn and the fattening of cattle. Every class bestows its undivided attention on some particular department of industry. Labour is economized, and it is also perseveringly and judiciously applied. Agriculturists raise the largest crops, because they can readily exchange them for other commodities conducive to their comforts and enjoyments; whilst manufacturers and merchants are stimulated to increase the quantity and to improve the quality of their articles, that they may thereby command a greater quantity of raw produce. As valuable or desirable objects are multiplied, greater efforts are made to procure them. A spirit of industry, and a desire to rise in the world, are universally diffused, and the apathy and languor which are natural to a stationary state of society are scarcely known.

"It is," says Dr Smith, "the great multiplication of the productions of the different arts, in consequence of the division of labour, which occasions, in a well-governed society, that universal opulence which extends itself to the lowest ranks of the people. Every workman has a great quantity of his own work to dispose of, beyond what he himself has occasion for; and every other workman being exactly in the same situation, he is enabled to exchange a great quantity of his own goods for a great quantity, or, what comes to the same thing, for the price of a great quantity of theirs. He supplies them abundantly with what they have occasion for; and they accommodate him as amply with what he has occasion for, and a general plenty diffuses itself through all the different ranks of society."

But if a country were generally divided into small farms, these effects could only take place in a very limited extent. Where a great proportion of the inhabitants is directly supported by the produce of the soil, it is obvious that there must be less of it to support others. Small farmers have it not in their power to purchase any considerable quantity of manufactured goods; nor, where these abound, are manufacturers able to purchase a large share of the produce of the soil. Neither capital nor labour can, in such circumstances, be employed in the most advantageous manner; and that division of labour, to the influence of which the greater part of the improvement of society may be justly ascribed, can only be partially introduced. A considerable portion of the coarser sorts of manufactured commodities would, in a country so occupied, be prepared at home, though at a much greater expense; for the small surplus of agricultural produce that would remain, after satisfying the wants of the cultivators, would be barely sufficient to procure such necessaries as could not be procured by the rude efforts of agricultural labourers. Being obliged to engage by turns in every different employment, workmen would be prevented from acquiring a proper degree of dexterity in any.[1] But as it is by the *quantity* of labour expended on a commodity that its exchangeable value is regulated, it is obvious that, where there is a minute division of landed property, not only the price of corn, but also that of all sorts of manufactured commodities, would be increased. Labour would become less powerful in producing or in procuring them; and the situation of the great body of the people, who have only labour to barter for commodities, would be rendered comparatively wretched. No one would have any, or but very little surplus produce to dispose of; and instead of general opulence, we should meet with nothing but universal poverty. "The tendency of such a system," says an intelligent writer who had carefully observed its effects, "*is to approximate man to the state of the savage, where the insulated being is obliged to*

[1] "In Ireland, the minute division of land, and the manner in which the inhabitants are scattered over the country, render it necessary for labour of various kinds to be combined in the same individual; and thus each family becomes the manufacturers of their own clothing, and of every thing else which they use. Most of the raw materials being supplied either by their flocks, or the produce of their land, they are better able to continue this system, and to dispense with the use of articles imported or made by regular workmen. In arts carried on in this manner, *improvement is impossible;* and while the same system exists, no taste can be excited for a superior mode of life, nor will much encouragement be given to the establishment of manufactories. Except in the cotton branches, and in the curing of provisions, this pernicious system is everywhere observed; it pervades all ranks, from the nobleman, who makes his own candles, cultivates his own patch of flax, and has it spun by his servants, to the cotter, whose wife and daughters spin and manufacture the frieze and woollen stuffs which serve them as clothing." (Wakefield's *Account of Ireland*, vol. i. p. 760.)

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supply himself by his own labour with every thing that his situation may require."

A subdivision of landed property renders the occupiers dependent on the landlords.

It deserves to be mentioned, that a minute division of landed property, by preventing the extension and improvement of manufacturing industry, renders the occupiers of land almost entirely dependent on its proprietors. Those farmers who incur the displeasure of their landlords are unable to betake themselves to another employment, and are obliged to submit to every species of indignity. The state of society during the middle ages approached, in some respects, very nearly to this; and it should be remembered, that the division of labour, and the extension of commerce and manufactures, has been even more beneficial, from its having effected the abolition of villenage, and removed the grinding oppression of feudal tyranny, than from its having multiplied the comforts and conveniencies of life. Nor is it less certain that every discovery of a new channel in which industry may be advantageously employed, affords an additional guarantee for the enjoyment of personal freedom and independence. By enlarging the field of exertion, and adding to the means of acquiring an independent livelihood, whilst it increases the comforts of every individual, it also renders them less liable to be affected by derangements in any particular branch of business, or by the partialities and caprices of those in authority.

It is impossible that the prizes in the lottery of human life can be too much multiplied. The greater the variety of ways by which men may rise to eminence, the more vigorous will be the efforts to rise. Where full scope is given to the accumulation of property, all individuals, even those in the humblest walks of life, are cheered with the idea that, by industry and economy, they may better their situation, emerge from obscurity, and acquire opulence. But in an essentially agricultural society, where the greater part of the population is directly engaged in the culture of the soil, there is but little variety of condition. In such countries capital cannot be accumulated; great cities cannot exist; and the liberal arts and professions, which chiefly depend on them for protection and support, and to which they owe their birth, are neither patronised nor indulged in. It is not to be imagined that cultivators, engrossed, as small farmers must constantly be, with the thoughts of providing for their present wants, can pay any attention to schemes of general or prospective improvement. Such men have no sufficient motive to stimulate them to exertion; and a perpetual sameness, like that of China, or at most a nearly imperceptible progress, is all that can be expected amongst them, and it is all that ever will take place. It is only in countries like America or England that the energies of man, as well as the powers of the soil, are developed to their full extent. There, while the diversity of the objects of pursuit gives ample room for gratifying the diversity of dispositions, the applause consequent on any invention that either extends the power of man over the physical world, or enlarges his intellectual faculties, perpetuates the discoveries made and the spirit which makes them.

Effects of the cottage system.

Most of the misconceptions and erroneous opinions to be met with respecting the cottage system appear to have originated in hasty and premature attempts at generalization, founded on a few limited observations of its local effects. But first appearances are, in this case especially, the most fallacious. The effects observed to result from the partial granting of cottages, furnish no clue by which to trace the ultimate consequences of the system. On the contrary, they are eminently calculated to mislead.

Advantageous at first.

Were cottages, with small pieces of ground attached to each, let at a moderate rent to a few of the most industrious labourers in the best cultivated districts of Great Britain, there can be no doubt that the situation of those individuals would, in the first instance, be ameliorated. They would acquire these possessions with previously-formed habits of industry and economy. When their own little farm did not require their exertions, they would be able to find employment in the more extensive farms in their vicinity; and might in this way procure the ploughs, harrows, and carts of their neighbours to assist them in their operations. Such men would be employed with nearly as much effect as they would have been had they continued as farm servants on estates managed in the first style. It is even probable that their exertions would, in the first instance, be rather increased, inasmuch as a part of the labour necessary for the cultivation of the small farm would be executed at extra hours, after the ordinary day's labour was performed.

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But the truth of this statement is nowise inconsistent with the principles which we have been endeavouring to establish. The *ultimate* and necessary consequences of a minute division of landed property deserve to be as much attended to as those which are immediate and transitory only.

But ultimately prejudicial.

In the *first* place, it is extremely probable that the small farmers would, at no distant period, become disgusted with the life of laborious exertion which they had formerly led. It is natural to suppose, that, having become comparatively independent, and not being under the necessity of constantly employing themselves, occasional intervals of relaxation would take place. A cottager, however small his possession, has some species of produce to dispose of. This leads to a habit of going to market, where much precious time is lost in the adjustment of trifling bargains. "Nothing," as Mr Young has justly remarked, "can be more absurd than a strong hearty man walking some miles, and losing a day's work, in order to sell a dozen of eggs or a chicken, the value of which would not be equal to the labour of conveying it if he were properly employed." Such habits, too, are almost sure to lead to dissipation. The small farmer must have his porter and his gin as well as the extensive farmer. It is the want of time and opportunity, still more than the want of money, that prevents a hired labourer from apeing the conduct of his employers. The circumstances, too, which distinguish a farm-servant from a farmer, are much better defined, and more easily appreciated, than those which distinguish a small farmer from an extensive one. The latter are both placed, if we may use the expression, in the same caste; and hence the extravagances of the small farmer, though equally hurtful to himself and his family with those of a labourer, are less an object of animadversion in the neighbourhood. They clash less with popular prejudices and received opinions; and there is, therefore, a greater probability of their being more indulged in.

If these consequences of the introduction of small farms should not become obvious in the lifetime of the first occupiers, they would certainly discover themselves in that of their successors. Not having undergone the same rigid training as their fathers, the views and habits of the two races would be essentially different. And the character of the industrious labourer, which had predominated in the first, would, in the second, give place to that of the half-employed, petty farmer.

But, in the *second* place, it is obvious that the beneficial effects observed to follow the first introduction of small farms depend almost entirely on their occupiers having it in their power to employ themselves at other work when their labour is not required at home. Now, with a generally extended cottage system, this could not be the case. Where *all* farms are small, none would require the labour of extra hands, nor would they afford their own

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possessors constant employment, except, perhaps, during seed-time and harvest. Nor is it to be imagined that the leisure of a poor cottager has any thing in common with that of an extensive farmer or capitalist. The cottager is inactive, not because he has realized funds adequate for his support, but because no exertions can better his condition, and because there is no demand for his labour. No man, it should be recollected, loves exertion or industry for its own sake. All have some end or object in view, the accomplishment of which is to compensate for the toils and privations to which they at present submit. But a small farmer is almost entirely cut off from the expectation of rising in society. No person possessed of capital would ever think of embarking in such a hopeless concern; and after supporting a family, no small farmer, originally without capital, is ever able to accumulate any. As it is impossible for him to escape from poverty, the cottager naturally becomes indolent and careless. His opinions of what is necessary to his comfortable subsistence are degraded, and he ultimately sinks into a state of sluggish or stupid indifference.

Effects of the cottage system in Ireland.

That this is a fair picture of the state of society in every country in which landed property is divided into minute portions, is abundantly certain. But we have no occasion to go from home to seek for an exemplification of its effects. We have only to turn to Ireland. There the cottage system has been submitted to the test of experiment, and it is proper that the result should be generally known.

In our inquiry into the principles of the corn laws, we endeavoured to show that the granting of high bounties on the exportation of corn from Ireland, in 1780 and 1784, contributed to the extension of tillage, and to the breaking up of the pasture grounds in that kingdom. But the want of capital, and the consequent impossibility of procuring tenants capable of taking large farms, obliged the proprietors to divide their lands into small portions. Large tracts of old grass land were ploughed up, and let in farms of from ten to twenty acres; and in this way the stimulus, intended to act as an incitement to agricultural improvement, has had a much more powerful effect in causing the subdivision of farms, and in increasing the agricultural population of the country.

Mr Newenham's authority is decisive as to this fact. "Large farms," he informs us, "of from 500 to 1500 and 2000 acres, once so common in Ireland, hold actually no sort of proportion to farms of from ten to thirty or forty acres. In the county of Down, Mr Dubordieu says that farms run from twenty to forty, fifty, and in some instances as far as a hundred acres. Such is the case in most other parts of Ireland. For several years past the landlords of that county have been much in the habit of letting their lands in small divisions. Besides this, the cottier system, or the giving a certain quantity of land as an equivalent for wages, prevails throughout most parts of Ireland. In fact, upwards of four fifths of the Irish people are subsisted chiefly on the produce of the land which they hold." (*Inquiry into the Population of Ireland*, p. 270.)

Every part of Mr Wakefield's work on Ireland abounds with interesting information respecting the effects of this minute division of landed property. Our limits, however, will only permit our extracting the following passages.

When noticing the state of landed property in Kerry, Mr Wakefield observes: "Few persons here occupy such a quantity of land as to oblige them to employ a labourer; it is not, therefore, customary for people to go from their own homes to work, and, indeed, none but those who have taken very dear farms, and experience the necessity of procuring a little ready money, ever think of it. This system, considered in a public point of view, strikes me as being exceedingly injurious. A country occupied by inhabitants whose ambition is so limited that they have no desire to push their industry beyond that indolent exertion which procures them the bare necessaries of life, must remain without improvement. Such people cannot be said to *live*, but to *exist*; to supply their animal wants is the chief object of their labour, and if they can raise money enough, by the sale of butter and pigs, to pay their rent, all their care and anxiety is ended. The existence, however, of these wretched beings depends entirely on the season; for if their potato crop fails, they are in danger of being starved. This mode of life, instead of elevating the moral faculties in the slightest degree, tends only to depress and degrade them. It becomes the parent of idleness, the worst evil that can afflict human nature; and that habit, if it spreads or becomes general, must lead to national poverty, and even want, with its concomitants, vice and misery." (*Account of Ireland*, vol. i. p. 262.)

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"In Fermanagh," says he, "whether it arises from habit, or a natural propensity to indolence, the people do not rise until a late hour in the morning, and the cows are not milked till noon. There being but a poor market for the produce of the earth, little encouragement is afforded to industry; they therefore seldom think of turning their time to the best advantage." (*Account of Ireland*, vol. ii. p. 745.)

In his chapter on rural economy, Mr Wakefield makes the following observations: "The Irish cottier's only anxiety is, that the butter and the pig sold, and the labour given to his landlord, may be equal in value to the payment which he has to make. When satisfied on this head, his mind is at rest; he has no further wants, and neither he nor his family consider labour as of any importance to their happiness. His potatoes are left in the ground till the commencement of frost makes him apprehend that his food may be locked up in the earth; and though very great inconvenience has been occasioned by this negligence, the repeated experiment of the bad result arising from it has not yet been able to induce the peasantry of Ireland to adopt a better method. It is very common to hear persons of higher rank observe, when a very early frost takes place, that 'it is a fortunate event, as it will oblige the *poor* to dig up their potatoes' (*for the POOR and the CULTIVATOR OF THE SOIL are here synonymous expressions*); and of course they will be saved before a severer one sets in." (*Account of Ireland*, vol. i. p. 517 and 583.)

It is not necessary to quote authorities to prove the miserable state of the hovels in which the cottagers reside. Notwithstanding his prejudices in their favour, Mr Newenham admits "that a *bedstead* is a luxury which a great majority of the Irish labouring poor are strangers to. And as for clocks, warming-pans, frying-pans, tea-kettles, cups and saucers, &c. which we find in every cottage here, I believe it is unnecessary to say that they *never* constitute a part of the poor Irishman's furniture." (*Inquiry respecting the Population of Ireland*, p. 280.)

We shall close these statements with an extract from Mr Curwen's work on Ireland. That experienced agriculturist travelled through the greater part of it in 1813, and, after having carefully inquired into the condition of the small farmers and cottagers, gave the result of his investigation in the following terms: "The size of farms, from fifteen to thirty acres, would give an average of about twenty-two or twenty-three acres to each. Portions of these are again sublet to cottiers, whose rents are paid by labour done for the tenants, from whom they sometimes receive milk and some other necessaries. These running accounts are an endless source of dissatisfaction, of dispute, and of contention, at the quarter-sessions. In some

of the more populous parts of Ireland there is supposed to be an inhabitant for every acre, while the cultivation of the soil, as now practised, does not afford employment for a third of that population. In the north, where the linen trade has been established, the lower classes are weavers, which gives them a great superiority over the southern districts. The labour on the highways and great roads, for which such large assessments are made on the counties, afford, for a portion of the year, a great source of employment.

"The minute subdivision of lands among these occupants is attended with many serious evils. The rents of these sublet parcels become so high to the actual cultivators as to preclude all profitable returns from their labour. It affords too great a facility to marriage. The population becomes increased beyond the capital of the country employed in husbandry; and the supernumerary individuals are compelled to subsist on the produce of others' labour, to which they have no power of contributing. The aggregate number of horses is greater than would be required if the estates were distributed into moderately sized farms; while the want of farming buildings, besides other disadvantages, prevents the accumulation of manure.

"The labourers, with few exceptions, are all married. The farmers have no hired servants of either sex residing in their dwellings; this is another serious evil arising out of small farms. Ireland, which in extent is nearly equal to one half of Great Britain, does not probably employ one tenth of the agricultural servants.

"The buildings on every farm being erected at the expense of the tenant, are necessarily on the most limited scale, seldom more than a cabin, and this insufficient for the children of the family beyond their earliest days. As the children grow up, they are compelled to seek another establishment for themselves, and to hazard every consequence that may ensue. Alternative they have none. The interests of all parties suffer, and it would be for the advantage of the whole community to promote a radical reform of the present disreputable system."

Effects of the division into small freehold properties.

Such are the ruinous effects produced by the small farming system. And such, too, with some few exceptions, would be the effects of having a country parcelled out into small FREEHOLD PROPERTIES. A few words will be sufficient to show the similarity of the cases.

First, It is obvious that the division of labour would be quite as inapplicable in a country divided into small properties as in one occupied by small farmers. The proprietor of ten, twenty, or fifty acres, can as little afford to keep ploughmen, hedgers, thrashers, &c. as the person who holds them on lease. But whatever may be the capital of the occupier of a small farm, its *size* will not admit of its being farmed so as to yield the largest quantity of produce with the least possible expenditure of labour.

It may be supposed, perhaps, that, in countries occupied entirely by proprietors, raw produce may be sold at a cheaper rate than in those occupied by farmers, who, in addition to the expense of labour, are burdened with the payment of rent. This, however, is really not the case. The price of raw produce, as well as of manufactured commodities, is determined by the quantity of labour necessary to its production. Rent, it has been demonstrated, does not enter into price. Corn is not high because rent is paid, but rent is paid because corn is high; and no reduction would take place in the price of corn although landlords should relinquish the whole of their rent. Such a measure would turn some farmers into landlords, and some landlords into beggars; but it would not diminish the quantity of labour necessary to raise corn on the least productive land in cultivation; and it is this quantity which determines its price, and consequently the price of the whole crop.

Although, therefore, it cannot be doubted that the condition of the greater part of the occupiers of land, in a country held by small proprietors, must, upon the whole, be preferable to their condition in a country held by small farmers, the condition of every other class would be unaffected. The price of corn is the same whether it is raised by a small farmer or a small proprietor. Neither of them is able to bring his produce to market upon the same reasonable terms as an extensive farmer. The profits of stock would, therefore, be less than in countries where agriculturists are in a situation to adopt every expedient by which labour may be saved or rendered more efficient; and the power of the society to accumulate wealth would be proportionally diminished.

In the *second* place, small properties, as well as small farms, have a strong tendency to increase the agricultural population of a country in a ratio far exceeding the demand. A property of forty or fifty acres of good land might support a single family in tolerably easy circumstances; but what is to become of the children? No country, it will be remembered, which is divided into small occupancies, can ever furnish surplus produce sufficient, after satisfying the wants of the cultivators, to feed a numerous body of merchants, handicraftsmen, &c.; nor would small occupiers have any demand for the products or services of such persons. There could therefore be no demand for that surplus population which an agricultural society is always producing; and the division of the paternal property would be the only way in which families could be provided for. This, however, is only calculated to make bad worse. Farms of forty or fifty acres are not incapable of pretty good cultivation; but those of twenty or twenty-five, and still more of ten or twelve acres, must be ill cultivated. But in essentially agricultural countries, such, for example, as France, where the right of primogeniture is almost unknown, and where property must be divided in nearly equal portions amongst all the children of a family, properties can hardly fail to be reduced even below *ten* acres. They must, in fact, be perpetually lessening, until, to use the words of Mr Young, when pointing out the pernicious effects of this system in France, "you arrive at the limit beyond which the earth, cultivate it as you please, will feed no more mouths; yet those simple manners, which instigate to marriage, still continue. What then is the consequence, but the most dreadful imaginable. By persevering in this system, you soon would exceed the populousness of China, where the putrid carcasses of dogs, cats, rats, and every species of filth and vermin, are sought with avidity, to sustain the life of wretches who were born only to be starved. Small properties much divided prove the greatest source of misery that can possibly be conceived; and this has operated to such an extent and degree in France, that a law undoubtedly ought to be passed, to render all division, below a certain number of arpents, illegal." (*Travels in France*, vol. i. pp. 413, 414.)

The condition of the agricultural classes in France has been materially ameliorated since Mr Young visited that kingdom. The abolition of the feudal privileges of the nobility and clergy, and of the gabelle, corvée, and other grievously oppressive and partial burdens, would of itself have sufficed to make the farmers and small proprietors more respectable and comfortable. A great part too of the property of the church, and of the emigrants, came into their hands at extremely low prices. By this means small properties were augmented, and fresh energy was given to the agriculturists. Still, however, the extreme division of landed property, which, in consequence

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of the law of equal partition, is every day becoming more minute, and the consequent excess of the rural population, form the prime evils in the social condition of the people of France. "The population of that country," says Mr Birkbeck, "seems to be arranged thus:—A town depends for subsistence on the lands immediately around it. The cultivators individually have not much to spare; because, as their husbandry is a sort of *gardening*, it requires a large country population, and has, in proportion, less superfluity of produce. Thus is formed a numerous but poor population. The cultivator receives payment of his surplus produce in sous, and he expends only sous. The tradesman is on a par with the farmer; as they receive so they expend; and thus 50,000 persons may inhabit a district, with a town of 10,000 inhabitants in the centre of it, bartering the superfluity of the country for the arts and manufactures of the town: poor from generation to generation, and growing continually poorer as they increase in numbers, in the country by the division and subdivision of property, in the town by the division and subdivision of trades and professions. Such a people, instead of proceeding from the necessaries to the comforts of life, and then to the luxuries, as is the order of things in England, are rather retrograde than progressive. There is no advancement in French society; no improvement, nor hope of it." (*Tour in France*, 4th edit. p. 34.)[1]

Whether property in land be the most efficient instigator to labour

It has been said, that property in land is of all others the most active instigator to severe and incessant labour. This, however, is a very doubtful proposition. It is true, that the exertions of a little proprietor are not paralyzed by the apprehension of being turned out of his farm before he has reaped the reward of his labours. But, on the other hand, his certainty of a resource, his dependence on a small piece of ground from which he cannot be ejected, and which will preserve him from absolute want, joined to the impossibility of his rising in the world, foster indolent habits. A farmer can never calculate with certainty on getting a renewal of his lease. Unless he has accumulated some capital, he is always exposed to the risk of being thrown destitute upon the world; but it is not so with the small proprietor. He relies for support, not upon capital, but upon land. He is exempted from all chance of being turned out of his possession; and he has not therefore the same powerful motive to save and accumulate as the other. The small proprietors and farmers of France, Mr Birkbeck informs us, "having absolutely no means of improving their situation, submit to necessity, and pass their lives contentedly." The same is the case in Great Britain. "Throughout England there is no comparison between the case of a day-labourer and of a little farmer: we have no people that work so hard and fare so ill as the latter." (Young's *Travels in France*, vol. i. p. 415.) And those counties of Scotland, Kinross for example, in which property is very much divided, are uniformly behind in their agriculture, and are farmed in a very inferior style to those where estates are more extensive.

It is foreign to the object of this article to compare the moral and political effects produced by the division of landed property into large and small portions. We shall merely observe, that a needy population, but scantily supplied with the necessaries, and enjoying very few of the comforts of life, is not very likely to be imbued with a just sense, either of the dignity of man or of his rights. An agricultural population, spread over a wide extent of country, has no point of re-union. Men only feel their consequence; they only act in a collective capacity, and with vigour and effect, after they have been condensed into masses and collected in cities. It is comparatively easy to animate the inhabitants of a large town with the same spirit; there is a sympathy in their joys and in their sufferings; and the redress of an injury done to a single individual becomes, in some measure, the business of the whole. But with agriculturists the case is different; they may be trampled down piecemeal; they cannot act collectively, and must, therefore, submit with less resistance to the yoke of the oppressor. Of all the arguments in favour of a minute division of landed property, that which supposes it should powerfully contribute to keep alive a feeling of manly independence, seems the most futile and preposterous.

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Effects of the cottage system for relieving the distresses of the poor.

As a plan for relieving the distresses of the poor, the cottage system is perhaps the very worst that can be devised. It should always be borne in mind, that except in the case of maimed and impotent persons, there cannot, generally speaking, be any poor in a country, that deserve to be relieved, unless the population be redundant. As long as the supply of labour does not exceed the demand, the whole industrious part of the community may be employed; none but the idle and profligate can be without work, and the means of subsistence; and it will not, we presume, be contended that cottages ought to be built for their reception. In all cases, however, where the poverty and distress of the people proceed from a redundancy of population,—and that is the case wherever industrious persons are unable to procure wages sufficient to purchase the ordinary necessaries and comforts of life—it would surely be most absurd to attempt to improve their condition by introducing a system, which, whatever might be its immediate effects, would lead to a still greater redundancy of population. Now, this would most unquestionably be the consequence of the introduction of the cottage system. A person who gets possession of a cottage and a small piece of ground, finds himself in a situation to marry. Being no longer dependent for mere subsistence on the good will of his employers, but feeling, if not an increase of wealth, at least an increase of security against want, the cottager is naturally stimulated to contract that engagement, into which men are otherwise sufficiently prone to enter. A cottage could not indeed be of any use to a single man. Either a wife or a female servant would be required to superintend its domestic economy; and as a cottager could not afford to pay wages, it is easy to perceive which of the two he would prefer.

No person would think of attempting to relieve the distress occasioned by a bad harvest, or by any sudden derangement of the affairs of the commercial world, by proposing the adoption of a cottage system. The plan of granting cottages has only been recommended in cases where a permanent difficulty has been experienced in procuring employment. But in every such case the cure is worse than the disease. Where the population is redundant,—and an industrious man can never be long without employment from any other cause,—it should be our object not to accelerate, but to retard the rate of its increase—not to increase, but to diminish the number of cottages.

Influence of the cottage system in England.

Unluckily, we are not left to argue speculatively on these points, or to refer for illustrations to France and Ireland. England furnishes examples both of the advantage of throwing obstacles in the way of the erection of cottages, and of the evils attending their too great multi-

[1] For further information as to the effects of the present French law of succession, see the note on the "Disposal of Property by Will," in the fourth volume of M'Culloch's edition of the *Wealth of Nations*.

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plication. Some of the latter had manifested themselves at a very early period; and in the 31st of Elizabeth an act was passed "for the avoiding of the great inconveniences which are found by experience to grow, by the erecting and building of great numbers and multitudes of cottages, which are daily more and more increased in many parts of this realm." To counteract the evil, it was enacted that in future no cottage should be built, to which *four* acres of land were not attached. This statute contributed to check the increase of cottages; but we are clearly of opinion that the poor-laws have opposed by far the most formidable obstacle to their multiplication, and consequently to that of the agricultural population. As soon as they were enacted, landlords and occupiers saw, that if, by the erection of cottages, the splitting of farms, or otherwise, the population upon their estates or occupancies was unduly augmented, they would be burdened with the support of all who, from old age, sickness, want of employment, or any other cause, might become at any future period unable to provide for themselves. The wish to avoid incurring any such indefinite responsibility not only rendered landlords and farmers exceedingly cautious about admitting new settlers upon their estates and farms, but stimulated them, whenever the demand for labour was not pretty brisk and constant, to take measures for diminishing the population, and for hindering its increase beyond its proper level, by pulling down cottages, and preventing their being rebuilt. The influence of this principle has been most powerful. In proof of this we might refer to a host of authorities; but the following extract from a work of Arthur Young, published in 1771, will probably be deemed sufficient: "One great inducement to marriage is the finding without difficulty a comfortable habitation; and another, nearly as material, when such requisite is found, to be able to exercise in it whatever business a man has been educated to, or brought up in. The first of these points is no easy matter to be accomplished; for it is too much the interest of a parish, both landlords and tenants, to decrease the cottages in it, and, above all, to prevent their increase, so that, in process of time, habitations are extremely difficult to be procured. There is no parish but had much rather that its young labourers would continue single; in that case they are not in danger of becoming chargeable; but, when married, the case alters: all obstructions are, therefore, thrown in the way of their marrying; and none more immediately than rendering it as difficult as possible for the men, when married, to procure a house to live in; and this conduct is found so conducive to easing the rates, that it universally gives rise to an *open war against cottages*. How often do gentlemen who have possessions in a parish, when cottages come to sale, purchase them, and immediately raze them to the foundation, that they may never become the *nests*, as they are called, of *beggars' brats*, by which means their tenants are not so burdened in their rates, and their farms let better; for the rates are considered as much by tenants as the rent. In this manner cottages are the perpetual objects of jealousy, the young inhabitants are prevented from marrying, and population is obstructed." (*Farmer's Letters*, 3d edit. vol. i. pp. 300–302.)

We are inclined to think that the comparatively slow increase of the agricultural population of England, down to the beginning of last war, and the high wages received by the labourers, are mainly attributable to the circumstances now stated. But since the alteration of the poor-laws in 1795, the obstacles to the increase of cottages have been to a considerable extent removed, at least in some considerable districts in the south, and the inconveniences thence resulting have been most striking. In several instances the parochial overseers have agreed to pay the rents of the cottages occupied by paupers; and as the assessment for the poor is not imposed on houses, but on the land according to its value, the owners of small patches have, in many instances, been tempted to cover them with cottages, to the great injury of the more extensive landowners of the parish, who are in fact obliged to pay their rents. This system has had the most pernicious operation. It has acted as an incentive to premature marriages, and, in many districts, has increased the supply of labour much beyond the demand. Some very interesting evidence upon this subject was given before the Committee of the House of Commons on Emigration in 1826. A most intelligent witness, Mr Hodges, M. P. for Kent, expressed himself as follows: "I am quite satisfied that the erection of cottages has been a most serious evil throughout the country; and I have been induced, acting on that conviction, to concur with other cottage proprietors, who are going to take down from twenty-six to thirty cottages as soon as the present occupants are out of them, if they emigrate, as we think they will do; for if we leave the buildings standing, *young persons of seventeen and eighteen years of age, and even younger, would marry immediately, and thus the evil would continue.*" (*Report*, p. 136.) And in another place, Mr Hodges says, "Perhaps I am taking a liberty in adverting to what I stated the other day; but without an attention to the fact then disclosed, of the prodigious increase of cottages of late years, all other regulations will be nugatory; and I cannot forbear urging again, that this, or any similar measure, having for its object the relief of parishes from their overpopulation, must of necessity become perfectly useless, unless the act contain some regulations with respect to the erecting and maintaining of cottages." (*Report*, p. 185.) The evidence of other witnesses is precisely similar to this.

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In Yorkshire, and all the north of England, where the pernicious practice of mixing up poor-rates and wages has not been introduced, cottages have not been unduly increased, and the poor are comparatively prosperous. We do therefore think that no time should be lost in bringing forward some legislative measure, capable of checking the progress of the evil pointed out by Mr Hodges; and this might be done either by making the owners of all cottages responsible for their occupants, or by making the assessments to the poor proportional to the population on the land as well as to its value. It is not to be endured, that the proprietor of a few acres should be allowed, by covering them with cottages, and letting them to occupants for whom there is no demand, to reduce the whole labouring population of a parish to a state of pauperism, and to bring a heavy burden on the owners of the land and other property, that he may put a few pounds into his pocket. The longer we delay grappling with the evil, it will become the more formidable, and the more difficult to put down. But either of the measures now suggested would arrest its progress; and were they combined with a judiciously devised system of emigration, the surplus labourers by which some districts are now oppressed might be easily got rid of, and the labouring population restored to its former sound and healthy state.

Neither the circumstance of the cottage system increasing the price of food by preventing the accumulation of capital and the improvement of machinery, nor its tendency to diffuse idleness and dissipation, is half so injurious to the labouring classes, as its influence in factitiously stimulating population. Although it were possible, and certainly it is not, immediately to provide for all the paupers in England, by granting them cottages and small pieces of land at a moderate rent, in the course of a few years

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we should be in a much worse situation than at present. What would become of the pauper families? If the cottage system be once fairly introduced, where shall it stop? If it was proper to relieve the distresses of the sires in this way, why not apply it to those of the sons? The call for relief in the latter case would be more pressing than in the former, inasmuch as the population would be more superabundant. It would then be impossible to retrace our steps. A fresh allotment of cottages would become necessary, and a fresh stimulus would be applied to population. In this way the cottage system would at length overspread the whole country. "The principle of gravitation," to borrow the language of Mr Ricardo, "is not more certain than the tendency of such a system to change wealth and power into misery and weakness; to call away the exertion of labour from every object except that of providing mere subsistence; to confound all intellectual distinction; to busy the mind continually in supplying the body's wants; until at last all classes should be infected with the plague of universal poverty."

The fact that the cottage system tends to give a factitious stimulus to population, and hence to cause a reduction of the real wages of labour, is of itself sufficient to satisfy every unprejudiced inquirer of its pernicious influence on the lower classes. But its bad effects would not stop there. After landed property had been divided into minute portions, and population had begun to press against the limits of subsistence, cottagers, in order to preserve their families from want, would resort to such crops as supply the greatest quantity of food on the smallest extent of ground. An extensive farmer cultivates those only which yield the largest net profit. But the small farmer must look to other considerations; the necessities of those depending on him for support must first be provided for. He must have food before he begins to think of profit. A cottager with five, ten, or fifteen acres of land, could not support himself and a family on wheaten bread and butcher-meat. He would be forced to resort to some less expensive food, —to relinquish first one enjoyment and then another; and, descending step by step, according as the increase of population increased the competition for cottages, POTATOES would at length constitute his only fare.

Although the price of labour fluctuates with every fluctuation of the demand and supply, it is, like every other thing, possessed of exchangeable value, ultimately regulated by the expense of production. Where labourers consider neat cottages, comfortable clothes, bread, beef, tea, and the like, necessary to their comfortable and decent subsistence—and where, unless they have a prospect of being able to command these enjoyments, they are less inclined to marry—wages are necessarily high. But, under the cottage system, wages would not merely experience a temporary depression from an excessive supply, but would be permanently reduced. It would supply workmen at a comparatively small expense. And wages, being no longer regulated by the price of wheat, beef, and other such articles, but by that of potatoes, a species of food raised at the least possible cost, they would sink to the very lowest point. Cotton

From the fact of manufactured commodities generally falling, and of raw produce generally rising (See *Principles of Corn Laws*), in the progress of society, such a disproportion in their values is at length created, that, in those countries where labourers are chiefly supported on corn, beef, &c., and where wages must of course be mainly regulated by their price, they are able, by sacrificing a small portion of their food, to provide liberally for all their other wants. But where the potato forms the ordinary food of the lower classes, the operation of this principle is scarcely perceptible. Potatoes, it is true, as well as corn, rise in real value as society advances, or as it becomes necessary to raise them on poorer soils; but, under any circumstances, the labour required to produce as many potatoes as will feed a workman, bears but a small proportion to that which is required to produce corn or butcher-meat for the same purpose. In a comparative point of view, therefore, very little additional command over manufactured commodities would be gained by the labourer who diminished his consumption of potatoes; and hence the actual condition of a population chiefly dependent on that root is not only much worse than it would be were they dependent on some more expensive food, but their future prospects are rendered still more gloomy and discouraging.

It would not be an easy task to enumerate all the evils to which a country is exposed, where the real wages of labour are reduced extremely low, or where they are regulated by the price of the cheapest species of food; but they are unquestionably of an appaling description. Where wealth is accumulated, the more opulent and middle classes, and even the lower orders, consume considerably more than the mere necessaries of life. In a season of scarcity, this consumption being diminished, has the same effect as the importation of an additional supply of provisions from abroad. But where the mass of the population is reduced to a dependence on mere necessaries, they cannot diminish their consumption. In a nation in this situation, consumption remains nearly the same, and a deficient crop is sure to entail disease, famine, and death, on a considerable portion of the community. This is no very alluring prospect held out by the cottage system, but it would be fully realized. When a bad harvest happens in a country abounding in capital and manufactures, these are exported, and corn is brought home from every quarter of the world. But what superfluous produce would a nation of cottagers, or rather, we should say, of paupers, have to dispose of? Millions die in China and Hindustan whenever there is any serious deficit in the rice crop. The extremity of want is felt in Ireland when the potato is not ordinarily productive; and the sole reason why famines are not so frequent as in China is, that the cottage system is not yet universally introduced, and that some capitalists are still to be found in that country. (J. R. M.)

COTTAPATAM, a town of Hindustan, on the sea-coast of the Southern Carnatic, 65 miles south from Tanjore. E. Long. 79. 15.; N. Lat. 9. 58.

COTTBUS, a town of Prussia. See KOTTBUS.

COTTIWAR, a town of India. See KATTYWAR.

COTTON (*Gossypium*) is a vegetable down of exquisite softness, with beautifully fine fibres, and is an indigenous product of all intertropical regions. Linnæus subdivided the cotton plant into five species:—1, *Gossypium herbaceum;* 2, *G. arboreum;* 3, *G. hirsutum;* 4, *G. religiosum;* 5, *G. barbadense.*

Other authorities have enumerated as many as ten species, but for all practical purposes the division into three classes will be sufficiently minute. The varieties are exceedingly numerous; yet of those most widely diffused, *herbaceous* cotton, *shrub* cotton, and *tree* cotton, need only be especially referred to. The most useful cotton is the herbaceous, which is an annual plant chiefly cultivated in the United States and in the East Indies. It grows from two to five feet in height, is rich in foliage, and its fibrous fruit is preceded by flowers, of white or pale yellow colour, like those of the convolvulus. As the flowers fade, a pod, or capsule,

Cotton. is formed of the size of a small walnut, containing the fibres of cotton, and as the pod ripens it expands, and the snow-white fibres burst forth ready to be gathered.

In the United States the seed of the herbaceous cotton is sown generally in the months of March and April, and its marketable fruit is usually gathered in the period commencing with August and terminating with the year. Boweds and Orleans cottons constitute the great productions of the United States, and are recognised in the English and European markets as "American cotton." These cottons are chiefly cultivated in the great valley of the Mississippi, the fields of its growth now extending to the Texas. The cultivation of cotton in the United States is most scientifically and industriously pursued, and is attended with highly profitable results, the value of the crop being little less than thirty millions of pounds sterling. It is expected that in 1854 the entire crop will amount to three and a-half millions of bags, of more than 400 lb. each. But the skill of the American planter has been most conspicuous in the production of fine sea islands cotton. The seed of this cotton, which is also an annual and herbaceous plant, was obtained in 1786, in the Bahama Islands, where it had been introduced from the West Indies, and was first cultivated in Georgia. The small islands which extend along the American coast from Charleston to Savannah were found, from their sandy soil and contiguity to the sea, to be admirably adapted to the production of exquisitely fine, long, and strong stapled cotton. This cotton soon acquired great and deserved celebrity. A great demand arose for it; but from the limited extent of the islands upon which it can be grown, and the expense attending its cultivation, it can only be supplied at a comparatively high price. Hence the production of this cotton was not susceptible of indefinite extension like the shorter stapled cottons of the United States; and from the beginning to the middle of the present century the total yearly amount of the crop has not greatly varied, the annual yield averaging about ten millions of pounds weight. From the circumstance of the seed of this cotton having been first introduced into Georgia, it was consequently called Georgia cotton, though its cultivation had only been successful upon the sea-coast of that state. Its celebrity, however, caused it to be planted upon the high lands of Georgia, where it was found to degenerate; but still the quality, though shortened in staple, was found to be of a desirable class, and it acquired the name of uplands, or bowed Georgia cotton, whilst the same seed yielded the famed sea islands cotton. Here it may be observed that a humid atmosphere and a sandy soil seem most conducive to the production of good useful cotton; but for the growth of very fine and long stapled cotton an impregnation of salt both in the soil and in the air appears to be indispensable.

Without the energy of the American planter, it is difficult to conceive the possibility of the cotton trade of England and of the world attaining the extent and importance which it now possesses. As the colonies of Great Britain—the West Indies in particular—possessed all the natural advantages of soil and climate for producing cotton to an extent much beyond the probable consumption of the United Kingdom, it might reasonably have been inferred that the colonial interests alone would have stimulated the cultivation and production of cotton to supply the certain and increasing home demands of the constantly enlarging manufactories. Whether the fatality of protection to the English colonies, maladministration of colonial affairs, or supineness on the part of the colonists themselves, produced the indifference which caused an article of increasing importance like cotton to be neglected when remunerative markets were opening for indefinite supplies of it—may be wisely inquired into, not to remedy the past, but for the purpose of ascertaining how far a new and profitable direction may be given for the future to colonial labours and efforts; for the stigma will remain, that whilst arts and inventions were being developed at home which became the sources of great national wealth, the cultivation of the material on which to exercise the skill and labour of the mother country had to be sought and obtained from a foreign source. Cotton

In the British East Indies the cultivation and the manufacture of cotton have certainly existed longer than in any other country. For five centuries before the Christian era, cotton was largely used in the domestic manufactures of India, and the clothing of the Hindus then consisted chiefly of garments made from that vegetable product. Earliest in possession of the herbaceous cotton plant, the natives of India were enabled to manipulate its fibres, and to establish a cotton-manufacturing industry which has remained almost unchanged to the present time. More than two thousand years before Europe or England conceived the idea of applying modern industry to the manufacture of cotton, India had matured a system of hand-spinning, weaving, and dyeing, which during that vast period of time received no recorded improvement. With a plant indigenous to the soil, and a people remarkable for intelligence, when Europe was in a state of barbarism, it is wonderful that no approximation was made to the mechanical manufacturing operations of modern times, and still more strange that the agricultural production of cotton should not within that period have been improved and considerably enlarged. The cotton of India during its known existence can only be regarded as a material for manufacture greatly inferior to the like productions of other countries. India unquestionably possesses soil, climate, and all the requisite elements from nature for the cultivation of cotton to an almost boundless extent, and of a quality which might be most useful and acceptable in the manufactures of Europe, and even of America. During a series of years the weight of cotton grown in the East Indies and consumed in Great Britain may have been one-tenth of the whole, whilst the value cannot be estimated at more than one-twentieth of the total cost of home-consumed raw cotton. The British West Indies supply only small portions of the cotton required by the manufacturers of the United Kingdom, though the quality of the cotton there produced is excellent; and would be very largely bought and consumed if it were largely supplied. For a considerable time the British colonies have not supplied more than one-twentieth part of the British consumption of cotton, and yet in the possession of Great Britain there exists a greater extent of land suited to the growth of cotton than in any other dominion. At Port Natal cotton of excellent quality might be grown to any reasonable extent; and in Australia, cotton equal to the finest of the fine might be produced to an almost indefinite amount.

Brazil is an extensive cotton-growing country, and sends steady supplies of it to the European markets. The quality of its cotton is everywhere highly esteemed.

Persia, Spain, Italy, Malta, and the adjacent countries, are all capable of producing excellent cotton; but in Africa there are probably greater undeveloped resources for the cultivation of cotton than can be found in any other portion of the globe.

The example of Egypt is a great lesson for the governors of those countries whose agricultural resources remain undeveloped. In 1821 Mehemet Ali conceived the possibility of effectually cultivating cotton, and succeeded. From that year to the present time large supplies of that useful and now indispensable raw material have been obtained from Egypt, to the great convenience of the British manufacturer, who has found the quality second only to the sea islands cotton of the United States.

The herbaceous cotton plant unquestionably exhibits all the desirable qualities of cotton applicable to manufactures, as proved by the productions of the United States and of the East Indies. The cottons produced in the West

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Indies, in Brazil, and in Egypt, are from the shrub; and it is observed that the older the plant the coarser become the fibres. Tree cotton, as a marketable product, is almost unknown; but in Borneo, and in many other tropical regions, the plant on which it grows is found flourishing in a wild state. To ensure economy of culture, and of gathering the cotton as it opens and ripens, it is evident that the plant and the shrub are most accessible, and that the tree cannot always be either safely or conveniently climbed to obtain its downy fruit.

In modern times, no material on which the industry of mankind is exerted can be compared with the vast importance of that beneficent gift of providence, cotton. Millions of our fellow-creatures depend upon its cultivation and manipulation for support. Capitalists embark in its production and manufacture; as also in its trading and mercantile distribution. National resources are enlarged and benefited by it; and to Great Britain it has proved a fountain of wealth, from which streams of prosperity have flowed from the time of its first introduction as an agent of labour and traffic to the present moment. (T. B—Y.)

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THE manufacture of cotton had its origin in the East, where the cotton plant is indigenous, and where the climate renders a light and absorbent fabric a suitable clothing for the people. It has in consequence been long established over every part of Asia, although it was only in India that the fabric was manufactured extensively, with a view to foreign exchange.

Cotton manufacture in India

Arrian mentions cotton cloth among the commodities which the Romans brought from India; but the quantity imported by them was inconsiderable, arising from the preference which they gave to woollen clothing. Dr Robertson remarks, that the difference between the cargoes imported from India in ancient and in modern times appears to have arisen, not from any diversity in the nature of the goods prepared for sale in that country, but from variety in the tastes or in the wants of the nations with which they have successively traded.

The implements used by the Indians in the different processes of the cotton manufacture, from the cleaning of the wool to its conversion into the finest muslin, may be purchased for the value of a few shillings, and are of so rude and simple a construction as to be evidently the invention of a very early period. With the exception of the loom, none of them deserves the name of a machine, or displays the slightest mechanical ingenuity. They spin the yarn upon the distaff; and yet, with all the advantages which we in this country derive from machinery, we have only recently been able to equal, either in fineness or quality, the yarn which is produced by means of this primitive instrument. The well managed use of the finger and thumb of the Indian spinner, patiently and carefully applied in the formation of the thread, and the moisture at the same time communicated to it, are found to have the effect of incorporating the fibres of the cotton more perfectly than can be accomplished by our most improved machines.

The loom is composed of a few sticks or reeds, which the Indian carries about with him, and puts up in the fields under the shade of a tree, or at the side of his cottage. He digs a hole large enough to contain his legs and the lower part of the "geer," and fastens the balances to some convenient branch over head. Two loops underneath the geer, in which he inserts his great toes, serve as treadles; and he employs the shuttle, formed like a large netting needle, but of a length somewhat exceeding the breadth of the cloth, as "battoon," using it alternately to draw through the weft and strike it up. The reed is the only part of the weaving apparatus which approaches, in the perfection of its construction, to the instruments we use. The loom has no beam, and the warp is laid out upon the ground the whole length of the piece of cloth. The weavers live entirely in villages, as they could not, if shut up in towns, work in this manner. Upon this rude machine, worked in the way we have mentioned, the Indians produce those muslins which have long been such objects of curiosity, from the exquisite beauty and fineness of their texture.

It is probable that the whole of the implements which we have just described existed as we now find them before the people of India were divided into castes. The transmission of the same employment from father to son (which, although not specially enjoined by the Hindu code, is the invariable practice in India), while it has the effect of conveying unimpaired the knowledge acquired in any art, tends to check its farther advancement. It is the opinion of Mr Rickards, who so ably advocated the interests of the natives of India in the discussion in parliament on the renewal of the Company's charter (1814), that latterly this form of society, with all its dependencies, habits, and restraints, has been held together chiefly by the oppression of the fiscal exactions, the want of a free trade, and the consequent universal poverty of the people. In support of this opinion, he refers to what the Hindu population of Calcutta and Bombay have achieved in the pursuits of commerce. We trust, however, that we may now look forward to the speedy abolition of this system, so much opposed to all development of talent, and which, by reducing man to the condition of a machine, has paralyzed the exertions and arrested the improvement of the people of India.

Abolition of the East India Company's commercial monopoly.

Such was the commercial and social condition of the British territories in the East Indies till 1834, when the Company's charter was renewed only as a governing power; the trading monopoly previously possessed being then totally abolished. In that year a new era began for the East Indies. Thence may be dated a charter emancipating the industry of that vast dependency, thereby securing individual exertion, and laying the foundation of social, as well as of national progress. Free intercourse with the intelligent classes of the Western World has begun to enlighten the minds of the old Hindu population; superstition is decreasing; European arts and civilization are appreciated; the great agents of national advancement, canals, roads, and railways, are desired; a knowledge of the English language is increasing; and the constant discovery of new wants continually incites to new exertions. Many wealthy natives of India now visit Europe, and return to their homes with diminished prejudices and increased stores of useful and practical knowledge The pure administration of justice, as conducted in the courts of Great Britain, is warmly admired and longed for; and all the indications of this enlarged intercourse point to the tendencies which are inherent in intelligent man to adopt customs, manners, laws, and institutions which promote his welfare and happiness. India possesses undeveloped resources of immeasurable magnitude. Immense tracts of uncultivated ground, rich in jungle and in wild produce, wait for approaches or roads, and for human labour to convert useless vegetation into products of home consumption or of export. Materials for dyeing may be grown to the extent of any reasonable demand. Sugar, tea, and coffee, may become never-failing sources of profit. Cotton, so much required in Europe, may be so greatly improved in quality and enlarged in quantity, that, as an agent of exchange for the manufactures of Great Britain, it may increasingly minister to the comfort and convenience of the cultivator and consumer. That the production of cotton

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is slowly increasing there can be no doubt, and that its quality seems to be improving is a gratifying fact. But to render the East Indies a beneficially producing and consuming country, public works are indispensable. Rivers must be made safely navigable, and bridges built over them. The formation of roads in every direction must be commenced. Canals for communication, and tanks, or great reservoirs for water, to irrigate the land under cultivation, must be constructed; and railways must be made, intersecting and traversing the country, wherever industry shall require them. Probably the solid advancement of the East Indies during the last twenty years, with an open trade, exceeds the progress made in the previous century. During the commercial monopoly of the East India Company, the exports from Great Britain never attained an average of three millions sterling per annum, but in 1853 they exceeded eight millions; still, with one hundred and fifty millions of British subjects in India, even this value of exports can only be regarded as insignificant.

To the same cause, however, which thus prevented improvement in India, is to be attributed that dexterity in his particular employment which the Indian artisan possesses. From the earliest age he learns to spin and weave under the direction of his father; and having no hope or desire of advancement in any other line, he gains, through constant practice, that wonderful skill, which may thus be considered almost as a family inheritance. To be able to manage his ill-constructed loom, even in the production of ordinary fabrics, he is obliged to acquire such a sleight of hand, that it is not surprising if, out of the multitude trained in this manner, a few should be found capable of producing those muslins which are said, when spread upon the grass, to appear like the gossamer web. From the superiority of these goods, and from their retaining the beauty of their appearance longer than European muslins, it has been supposed that the cotton of which they are made is of better quality than any known to the European manufacturers. This, however, is a mistake; there is no cotton in India of a quality superior to the best sea islands. The excellence which these muslins possess is to be ascribed wholly to the skilful tact of the workman in the processes of spinning and weaving.

But how dearly is this excellence of art purchased by the sacrifice of the better faculties of man! How different is the effect produced by this branch of industry upon the people and circumstances of India, from that produced by it upon the people and circumstances of England! In the East the cotton manufacture has probably been carried on as extensively as at present for some thousand years; yet it has given birth to no inventions, to no increase of national riches, to no improvement in the condition of the labouring class. The scanty pittance which the poor artisan gains from his labour is spent by him in his sustenance almost as soon as it is received. In England, the same manufacture has existed little more than a century, yet in that short time it has given rise to some of the happiest efforts of ingenuity; it has been of incalculable use in promoting mechanical skill; and the demand for additional power created by the extension of its processes has led to the perfecting of the steam-engine, the most successful attempt which man has ever made to bend the properties of matter to his will. How many canals, bridges, and railroads have been formed for the circulation of its products; how many new cities, and what an increase of population, has it called into existence; how many new agricultural markets has it been the cause of establishing; and how mightily has it thus increased the comforts and the means of enjoyment of the community!

In India, this manufacture has not only failed to improve the condition of the people—it does not appear even to have afforded to those engaged in it the means of accumulating the capital necessary to carry it on; for both the price of the material and the wages of the workmen, in place of being supplied by the master manufacturer, are advanced by the purchaser of the goods.

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Thus, the East India Company, which until lately was in the habit of making a great part of its remittances in manufactures, actually advanced, through its resident, the funds required to enable the workmen to produce the goods. To assist this officer, the Company placed under him a number of European servants, and an establishment of native clerks and of persons termed Peons, whose duty it was to watch and control the weavers. The resident, when he had to provide an investment, entered into a contract for the goods, either with the native merchants acting as brokers, or with the master manufacturer or headsman, and these parties made subsidiary agreements with the weavers. The resident then advanced money for carrying on the work to the chief contractors, who distributed it to the different classes of workmen, and were responsible for the delivery of the manufactured goods at the Company's warehouse, in the state stipulated in the contract. The commercial resident never interfered with the arrangements or operations of the contractors, except when complaints were made of delay or fraud, arising from the interference of other brokers, or contractors acting for other parties than the Company; and then a host of Peons were sent forth by him to intimidate, and, if necessary to coerce the weaver. The resident, when not engaged in providing goods for the Company's investment, was authorized to employ the weavers on his own account. This greatly increased his influence over those people, who having him constantly among them, as head of the little colony, and being unable at any time to move a step without his advances, felt themselves in a state of entire dependence upon him. Thus, although the brokers, who made contracts for the Portuguese and others, were generally willing to give higher prices than those which the resident arbitrarily fixed, the weavers, however they might be disposed to elude his orders, or to outwit him in his operations, never ventured openly to dispute his will. Various laws and regulations were enacted to protect the workmen in their transactions with the Company's agents; but where the sovereign was the chief trader, and a party in the cause, the impartial administration of justice was not to be looked for.

For some years past, the East India Company has ceased to remit so large a part of its revenue as formerly in manufactured produce. So far, however, as it still does so, the goods are provided in the manner we have pointed out; and the same mode is followed by private merchants, trading on their own account, for the purpose of obtaining goods for export; but now British manufactured cottons are largely imported into India.

Common muslins were made in every village throughout the peninsula. Orme says, "When not near the high road or a principal town, it is difficult to find a village in which every man, woman, and child, is not employed in making a piece of cloth."

The very fine muslins to which we have alluded, of such exquisite texture as to have been poetically designated "webs of woven wind," are made at Dacca. They were intended chiefly for the use of the potentates of the country, who kept agents to superintend the workmen employed in the manufacture; but since the assumption by the Company of the territories of these Indian princes, the demand has fallen off, and a considerable part of the population have betaken themselves to the cultivation of indigo. The cotton from which the muslins of Dacca are woven, grows in a district of not more than 40 miles in length by 3 in breadth, and in such limited quantity as never to have become an article of commerce.[1]

[1] Since this article was sent to the press, we have received a communication from Moorshedabad on the present state of the Dacca

Cotton Manufacture.

The long cloths and fine pullicats are made chiefly within the presidency of Madras, the coarse piece goods and pullicats in Surat, the finest calicoes at Masulipatam, and tablecloths of a superior quality at Patna. Each district varies from the others in the nature of its productions, as may be seen from the different denominations of cotton goods to be found in every consignment coming from India.

An apprehension has sometimes been expressed that the inhabitants of India, in possession of the raw material, may obtain a knowledge of our machinery, and, by combining with its peculiar advantages their cheaper labour and superior manual dexterity, may be enabled to undersell us to such a degree as to ruin and put an end to our manufacture; but in the state of the people of India there are circumstances which render this impossible, without a change being first produced upon their moral condition, their institutions, and their habits. The training which makes the Indian, with such imperfect tools, able to perform his work so well, disqualifies him from doing it in any other way, or with any other implements than those to which he has been familiarized from his infancy. The attempt to introduce our machinery into India is, however, now being made. A spinning mill has been built at Calcutta; and although the private company which commenced the undertaking has failed, the work continues to be carried on. There are at present nearly 700 persons employed in the mill, engaged at the rate of about seven shillings each per month; but these people, it is found, cannot continue to work beyond a few hours at a time, and a succession of hands to carry on the operations through the day is required. To train them, in such circumstances, to dexterity and skill, is impossible; and, accordingly, the yarn spun is not only of inferior quality, but, even with the low nominal wages, costs so much as to disqualify it for competition with the yarn of this country. An attempt is now being made to establish a cotton-spinning mill at Bombay.

Cotton Manufacture.

The extensive introduction of machinery into Great Britain has meanwhile, by reducing the price of our manufactures, enabled us to maintain a successful competition with the Indian goods at home, by sending cotton manufactures to a large amount to India itself. A complete revolution has in consequence taken place in the nature of the exports from that country to Europe, and indeed to all the markets on this side of the Cape of Good Hope. When we first got possession of India, our investments at home were principally (in point of value almost entirely) composed of manufactured produce. They are now in a great measure made up of the produce of the soil, indigo, cotton wool, raw silk, saltpetre, &c. &c.

It might have been expected that this change would have produced most distressing effects upon the crowded population of a country such as India, which in all ages has been a great manufacturing and exporting community; but no materially unfavourable consequences have resulted from it. In India every manufacturer is at the same time a husbandman. When not employed in making a web, he supports his family by agricultural labour. It thus happened, that in proportion as the demand for goods for export declined, the natives, without difficulty, and without that distress which generally attends a change of employment in other countries, were able to direct their attention more and more to agriculture; and the result has hitherto been rather an improvement in their condition than otherwise.

The following tables show the difference of the cost of cotton yarn produced in India and in Great Britain, and indicates the changeless nature of unaided human labour in the former, whilst by mechanical appliances in the latter, cheapness and plenty result.

Comparative Statement of the Cost of English and Indian Cotton Yarn in the Years 1812 *and* 1830, *furnished by Mr Kennedy of Manchester to the Committee of Parliament on East India Affairs, and continued to* 1854.

	English Cotton Yarn.												Indian Cotton Yarn.		
	Hanks per day per spindle.			Price of Cotton and Waste per lb.			Labour per lb.			Cost per lb.			Price of Cotton and Waste per lb.	Labour per lb.	Cost per lb.
	1812.	1830.	1854.	1812.	1830.	1854.	1812.	1830.	1854.	1812.	1830.	1854.	1812, 1830, and 1854.	1812, 1830, and 1854.	1812, 1830, and 1854
No.				s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
40	2·	2·75	2·75	1 6	0 7	0 6	1 0	0 7½	0 5	2 6	1 2½	0 11	0 3	3 4	3 7
60	1·75	2·5	2·5	2 0	0 10	0 7½	1 6	1 0½	0 8	3 6	1 10½	1 3½	0 3½	5 8½	6 0
80	1·5	2·	2·	2 2	0 11¼	0 9	2 2	1 7½	1 3	4 4	2 6½	2 0	0 4½	8 10½	9 3
100	1·4	1·8	1·8	2 4	1 1¾	0 11	2 10	2 2½	1 8	5 2	3 4¼	2 5	0 5	11 11	12 4
120	1·25	1·65	1·65	2 6	1 4	1 3	3 6	2 8	2 0	6 0	4 0	3 3	0 5	16 0	16 5
150	1·	1·33	1 33	2 10	1 8	1 9	6 6	4 11	3 6	9 4	6 7	5 3	0 6	25 0	25 6
200	·75	·9	·9	3 4	3 0	2 6	16 8	11 6	6 0	20 0	14 6	8 6	0 6	44 7	45 1
250	·05	·6	·6	4 0	3 8	3 6	31 0	24 6	18 0	35 0	28 2	21 6	0 8	83 4	84 0

Cotton manufacture of China.

The cotton manufacture of China is of immense amount, and is carried on almost entirely for home consumption; but its origin is not of the same remote date as that of India. Indeed the lateness of its rise, and the slowness of its progress, in a situation so favourable, appear extraordinary. In the accounts of the revenues and of the arts of China during the period of the celebrated dynasty which commenced about 1100 years before the Christian era, and lasted for some centuries, no mention is made of the cotton plant; nor indeed is there any notice of cotton in these records until about 200 years before the Christian era; from which period to the sixth century, the cotton

muslin manufacture, accompanied by a sample of the Dacca cotton wool, and some skeins of the yarn spun from it. The wool is equal in fineness to the very best sea islands, of still stronger staple, but so short as to preclude the possibility of its being spun by our machinery. The district in which the cotton is grown is stated to be periodically overflowed. The yarn is of different grists, the coarsest *greatly* finer than the highest number spun in this country (No. 250), while the finest has been rated by an experienced spinner to whom we have shown it, to be of a fineness not under 350. It is beyond our conception how this yarn can be spun by the distaff and spindle, or woven afterwards by *any* machinery. Machine spun cotton yarn has, however, more recently been produced in Manchester which very greatly exceeds in fineness any yarn ever known to have been produced by the hand labour of India.

Cotton Manufacture.

cloth, which was either paid in tribute, or offered in presents to the emperors, is always mentioned as a thing rare and precious.

The annals record as a singular circumstance that the Emperor Ou-ti, who ascended the throne in 502, had a robe of cotton. In the seventh century we find the cotton plant mentioned, but its cultivation appears to have been then confined to gardens; and the poems and romances of that period are occupied in celebrating the beauty of its flowers. From these circumstances we may venture to say that there could have been no manufacture of the article in the country at that time. It was in the eleventh century that the cotton plant was first removed from the gardens to the fields, and became an object of common culture; and it is not until this period that we can date the commencement of the manufacture. So slow and backward sometimes are nations, far advanced in other respects, in prosecuting objects afterwards considered by them as indispensable to their comforts. This is the more remarkable in the case of the Chinese, a people possessed of much ingenuity, and alive to everything connected with self-interest.

The cotton tree was introduced into China at the time of the conquest of that country by the Mogul Tartars, in the year 1280; after which period every encouragement was given by government to the culture and manufacture of cotton. But there were considerable difficulties to be encountered, in the prejudices of the people, and in the opposition of those engaged in the manufacture of woollen and linen; and it was not until the year 1368 that these obstacles were altogether surmounted. After that date the progress of the cotton manufacture was rapid, and now nine-tenths of the population are clothed in its fabrics.

Almost the only cotton goods exported from China are nankeens. Barrow states the production of all the fabrics of the Chinese manufacture at the time he visited the country (in 1792) to be stationary, attributing this to the want of proper encouragement from the government, and to the rigid adherence of the people to ancient usages. To keep a manufacture in a progressive state there must be a progressive demand for its products; and the Chinese manufacturers having no means of disposing of any surplus quantity must accommodate the supply to the wants of their own consumption. It is said by travellers who have obtained access to that country, that the people show a great desire for articles of British manufacture. How valuable then to both countries must be the establishment of a free intercourse, and how conducive probably to the increase of the productions of both!

The Chinese, over and above the cotton wool which they raise at home, import largely from British India, and from the Burmese territories. This intercourse commenced towards the close of the eighteenth century. A famine, which happened in China about that period, induced the government to direct, by an imperial edict, that a greater proportion of the land should be thrown into the cultivation of grain. Since then, the importation of cotton from India has been considerable, although constituting but a small part of what is consumed in their manufacture. The amount of the importations is stated at 40,000 bales.

Introduction into Europe.

The manufacture of cotton goods in Europe is said to have been first attempted by the commercial states of Italy, before the discovery of the passage to India by the Cape of Good Hope. These enterprising communities were the entrepôts through which the cotton fabrics of India passed to the different markets of the West; and being situated in the neighbourhood of countries where the cotton wool was grown, and familiar with manufacturing processes, it is supposed that they were led to attempt the imitation of articles so much valued, and bringing so high a price. Another account assigns the introduction of the cotton manufacture into Europe to a later date, and gives to the people of the Low Countries the honour of having been the first manufacturers of these articles, in imitation of the cotton fabrics which the Dutch, about the beginning of the seventeenth century, began to import from India. But this last account cannot be correct; for Guicciardini, in 1560, in a very full list which he gives of the different articles annually imported into and exported from Antwerp,[1] then the greatest commercial mart in Europe, specifies fustians and dimities of many fine sorts among the manufactured articles imported from Milan, and mentions cottons generally among those brought from Venice. But in the articles exported from Antwerp, although we find linens sent to almost every country, cotton cloth is not once mentioned. Italy, therefore, at that time had a cotton manufacture, which, it is probable, soon after made its way to the Netherlands; for we know it was brought from the latter country to Britain by Protestant refugees about the close of the sixteenth or early in the seventeenth century.

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Introduction into England.

That this manufacture was carried on in England at a pretty early period of the seventeenth century, we know from good authority. Lewis Roberts, in his *Treasure of Traffic*, published in the year 1641, says—"The town of Manchester buys linen yarn from the Irish in great quantity, and weaving it, returns the same again in linen into Ireland to sell. Neither does her industry rest here; for they buy cotton wool in London that comes from Cyprus and Smyrna, and work the same into fustians, vermilions, and dimities, which they return to London, where they are sold, and from thence not seldom are sent into such foreign parts, where the first material may be more easily had for that manufacture." These goods were woven chiefly about Bolton, and were purchased there at the weekly market by the Manchester dealers, who afterwards finished them, and either sent them to London for export, or sold them to their customers over the country.

Early state of the manufacture in England.

At this period, and for a long time after, the weaver provided his own warp, which was of linen yarn, and the cotton wool for his weft, buying them wherever he could best supply himself. But as the trouble of looking about for these materials was found to be an unprofitable application of his time, the Manchester purchasers established agents in the different villages for the sale of those articles. In this way of conducting the business, each weaver's cottage formed a separate and independent little factory. The yarn for his warp was bought by him in a prepared state, the wool for his weft was carded and spun by the female part of his family, and the cloth was woven by himself and his sons.

This is the situation in which we generally find a manufacture before the introduction of machinery, and particularly before it has been carried to such an extent as to allow of a division of labour, and a separation of the different processes into distinct employments. At this stage, the workman has usually his residence in the country, where he can be accommodated with a little garden ground, and perhaps with grass for a cow; and there, in the bosom of his family, aided by the industry of its different members, he prosecutes his employment. How much more of the comforts of life and of the means of natural enjoyment belong to this state of the manufacture than to the more advanced one, in which combined systems of machinery, and a more perfect division of labour, collect the workmen into factories and towns!

It would be impossible to enumerate all the descriptions of cotton goods which, in succession, were brought forward from the commencement of the manufacture.[2] The pat-

[1] See Macpherson's *Annals of Commerce*.

[2] The fustians that were made at this early period of the manufacture were those denominated herring-bone, pillows for pockets and

Cotton Manufacture.

tern cards of the principal houses in the trade, which were circulated from time to time through the kingdom and over the continents of Europe and America, exhibited specimens of nearly two thousand kinds, comprehending in the assortment every variety of taste and fancy.

For the introduction and after improvement of many of these articles, the country is indebted to the late Mr John Wilson of Ainsworth. This gentleman was originally a manufacturer of fustians at Manchester, but had early engaged in the manufacture of cotton velvets, which by persevering efforts he succeeded in bringing to the utmost degree of perfection. His improvement of the mode of dressing, of finishing, and particularly of dyeing these goods, acquired for them so high a character, that both in the home and foreign market his articles sold in preference to those of every other manufacturer. His plan for cleaning off the loose and uneven fibres was by the use of razors. He afterwards successively employed for this end, singeing by spirits of wine and the application of a hot iron resembling a weaver's drying iron, which last instrument had been introduced for the same purpose in the manufacture carried on in the Manchester house of correction by Mr Whitlow, governor of that institution. At a later period Mr Wilson effected his object by drawing the goods rapidly over a cylinder of cast-iron heated to redness, by which they were in a superior manner cleared of the down or pile which had been raised upon them in the various operations of weaving, washing, bleaching, or dyeing. These successive inventions of Mr Wilson, for performing this process, give us some idea of the manner in which improvements are introduced into our manufactures, when fortunately the efforts of self-interest are directed by intelligence and talent. Mr Wilson, having a turn for chemical inquiries, investigated the different known processes of dyeing; and, by the improvements he introduced in the application of them to his own manufacture, materially advanced that art. Having succeeded to his satisfaction in dyeing the other rich colours, he procured from the Greeks of Smyrna the secret of dyeing Turkey red. An account of this process was given by him in two essays, read to the Philosophical and Literary Society of Manchester, and which, on his retiring from business, he printed and distributed among his friends. The many valuable improvements introduced by Mr Wilson into the different processes connected with the cotton manufacture had the effect not only to establish it more firmly, but rapidly to enlarge its extent.

A considerable share of the calico printing business was transferred, about the year 1760, from London to Lancashire, in consequence of the cheaper accommodation for carrying on the work, and the lower wages of the workmen. A fall in prices thereupon took place, and this cheapness produced an increased demand for calicoes. These goods were at that time made of linen warp and cotton weft, it having been found impracticable, before Sir Richard Arkwright's discovery, to spin cotton warp of sufficient strength.

At this period the dealers from Manchester, in place of buying fustians and calicoes from the weaver, as had been the practice before, began to furnish him with materials for the cloth, and to pay him a fixed price per piece for the work when executed. Along with a portion of linen warp, they gave him out a portion of cotton wool, which he was obliged to get spun into the weft he was to use. But so fast was the manufacture by this time outstripping the process of spinning, that it frequently happened that the sum which the master weaver was allowed by his employer was less than what he found himself obliged to pay to those whom he employed to spin it. He durst not, however, complain, much less abate the spinner's price, lest his looms should be unemployed. In this state of things, the further progress of the manufacture must have been stopped, if a more productive mode of spinning had not been discovered.

Cotton Manufacture.

It has been said that the yarn produced at this time in England, by the one-thread wheel, the only spinning machine known, did not exceed in quantity what 50,000 spindles of our present machinery can yield. To have reared and trained hands sufficient to have doubled this quantity, had it been possible, must have been the work of a length of time, and the amount of the manufacture would still have been insignificant. A change in the system, therefore, had become indispensable; and we find that different ingenious individuals had already begun to employ themselves in contriving a better mode of spinning.

When we contrast the splendid inventions connected with the cotton manufacture, which from this period burst forth in rapid succession, with the passive acquiescence in the use of imperfect machinery during the long period which preceded, we are apt to ascribe these improvements to the circumstance alone of a number of men of genius having at that moment arisen, and to forget that the ultimate cause exists in the times which called their energies into action.

Already, about the year 1750, the fly-shuttle had been invented by Kaye of Bury—one of the most important steps in the progress of the art of weaving; and in the year 1760 improvements had begun to be made in the carding process.

Fly-shuttle.

James Hargreaves, a weaver at Stanhill, near Church, in Lancashire, an illiterate man, possessed of no great mechanical knowledge, had adapted the stock cards used in the woollen manufacture to the carding of cotton, and had besides greatly improved them. By his invention a person was able to do double the work, and with more ease than by hand-carding. In the stock cards, one of the cards is fixed, whilst the other, being suspended by a cord over a pulley, is worked by the carder; and in this way two or three cards can be applied to the same stock.

Progress of improvement in the carding process.

This contrivance was soon succeeded by the cylinder cards, or carding engine. It is not ascertained who was the inventor of this valuable machine, but it is known that the father of the late Sir Robert Peel was among the persons who first used it; and that, so early as 1762, he, with the assistance of Hargreaves, erected a carding engine with cylinders at Blackburn. This machine did not differ materially from that now in use, except that it had no contrivance for detaching the cotton from the cards, an operation which was performed by women with hand cards.

These successful advances show that the minds of the manufacturing class had been awakened to discovery, and must have encouraged and stimulated the efforts that were then making to effect corresponding improvements in spinning.

There had been several unsuccessful attempts to improve the mode of spinning before the year 1767, when James Hargreaves, whom we have already mentioned, invented the "*Spinning Jenny.*" The idea of this machine is said to have been suggested to him by seeing a common spinning wheel which had been accidentally overturned, continue its motion while it lay on the ground. If such was the cause, it marks a mind of no common description which from so casual an occurrence could elicit an invention of so much importance.

James Hargreaves invents the spinning jenny.

After several unsuccessful attempts to carry into execution the conception he had formed, he succeeded in pro-

outside wear, strong cotton ribs and barragon, broad-raced linen thickset and tufts, with whitened diaper, striped dimities, and jeans. At some distance of time there were added to these, cotton thicksets, goods figured in the loom; and at a still later date, cotton velvets, velveteens, and strong and fancy cords. (Aitken's *History of Manchester.*)

Cotton Manufacture. Description.

ducing a rudely constructed *jenny* of eight spindles, turned by bands from a horizontal wheel. In it the eight rovings were passed between two pieces of wood laid horizontally the breadth of the machine: and these being grasped in the spinner's hand, and drawn out by him, formed the rovings into threads. The structure of this "jenny" was soon afterwards greatly improved, and it was at last brought to work as many as eighty spindles. This machine, although of limited powers when compared with the beautiful inventions which succeeded it, must be considered as the first and leading step in that progress of discovery which carried improvement into every branch of the manufacture —which, as it proceeded, changed the nature and character of the means of production, by substituting mechanical operations for human labour—which caused the manufactured article to become more and more a product of capital. The progress of invention after this was rapid; for when it was seen that, with the aid of the few mechanical combinations we have mentioned, the spinner had been enabled to increase his power of production eighty-fold, the attention of those engaged in other branches of manufacture was awakened to the possibility of introducing changes equally beneficial into their peculiar employments.

Hargreaves' invention occasioned great alarm among those who earned their subsistence by the old mode of spinning, and even produced popular commotion. A mob broke into his house and destroyed his machine; and some time after, when a better knowledge of the advantage of his invention had begun to bring his "spinning jenny" into general use, the people rose a second time, and scouring the country, broke to pieces every carding and spinning machine they could find. Hargreaves himself had by this time removed to Nottingham, where he was engaged in erecting a small spinning work, about the same period that Mr Arkwright came to settle there, who had also been driven from Lancashire by the fear of similar violence.

The "jenny" in a short time put an end to the spinning of cotton by the common wheel; and the whole wefts used in the manufacture continued to be spun upon that machine, until the invention of the "mule jenny," by which it was in its turn superseded. Hargreaves died in great poverty a few years after his removal to Nottingham.

Sir Richard Arkwright's spinning frame.

While Hargreaves was producing the common jenny, Mr Arkwright (afterwards Sir Richard Arkwright) was employed in contriving that wonderful piece of mechanism, the spinning frame, called first the water-frame, and afterwards the throstle, which, when put into motion, performs of itself the whole process of spinning, leaving to the workman only the office of supplying the roving or prepared material, and of joining or piecing the thread when it happens to break.

The extraordinary person to whom we owe this invention was born in the year 1732, at Preston, in Lancashire, of parents in poor circumstances, and was the youngest of thirteen children. He was brought up to the humble occupation of a barber; and up to the time when he made his discovery he continued to derive his subsistence from the exercise of this employment. Living in a manufacturing district, it is probable that his attention was drawn to the mechanical contrivances around him; and that hearing from every one complaints of the deficient supply of cotton yarn, he was stimulated to contrive a plan for increasing the production, by changing the mode of spinning. Even after he had matured the conception of what he proposed to execute, he had great difficulty in giving his ideas a practical form, from his total want of mechanical skill and experience; and his discovery was likely to have been lost to the world, from his not being able to find any person willing to embark the capital that was necessary to give the undertaking a fair trial. None but a person of his ardour and perseverance could have overcome such obstacles.

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It has already been mentioned that Mr Arkwright had removed to Nottingham. Here he prevailed upon the Messrs Wrights, bankers, to advance him the sums of money necessary to enable him to go on with his experiments; it being understood that, if his plan succeeded, they were to share in the profits. These gentlemen, however, finding the amount of their advances swell to a larger sum than they had expected, while there seemed to them little prospect of the discovery being brought into practical operation, informed Mr Arkwright that the transaction being out of the ordinary course of their business, they would be glad if he could get some one else to take their place, and repay them their money; and they mentioned Mr Need of Nottingham as a person likely to do this, from his being already engaged in other patent discoveries, and acquainted with such undertakings. Mr Arkwright in consequence applied to Mr Need, who told him he had no objection to join in the scheme, if he could be satisfied that the discovery was such as he represented it, and desired him to carry the model of his machine to Mr Strutt of Derby, his partner in the stocking patent, by whose report he would be guided. Mr Strutt, a man of great mechanical knowledge, seeing at a glance the merit of the invention, and how little was required to render it complete, told Mr Need that he might with great safety close with Mr Arkwright; the only thing wanting to his model being an adaptation of some of the wheels to each other, which, from want of science, the inventor, with all his powers of contrivance, had not been able to accomplish.

In the year 1769, Mr Arkwright obtained his patent for spinning with rollers, and Mr Need and Mr Strutt became his partners in the concerns to be carried on under it. He erected a mill at Nottingham, which he worked by horse power. But this mode of giving motion to the machinery being expensive, he, in the year 1771, built another mill at Cromford, in Derbyshire, to which motion was given by water.

In 1772 his patent was contested, on the ground that he was not the original inventor of the process for which it was obtained; but a verdict was given in his favour, and his right to the exclusive use of the discovery remained afterwards undisturbed.

Obtains a second patent for machinery for preparing cotton.

Mr Arkwright, soon after his removal to Cromford, followed up his first great discovery with other inventions and combinations of machinery for preparing the cotton for spinning, by which perfection was gradually given to the process through all its successive operations. For these additional improvements he took out another patent in the year 1775. But in 1781, his right to this second patent was disputed, on the plea that he was not the inventor of some of the mechanical contrivances comprehended under it; and after different trials of the question before the courts of King's Bench and Common Pleas, judgment was finally given against him in November 1785, and the patent cancelled.

The originality of Mr Arkwright's mind, as well as the merit of his invention of the spinning frame, appear most striking when we consider the little resemblance between this machine and the common spinning wheel. His discovery did not consist in improving an instrument which already existed, but in the invention of an entirely new means for performing the same process in a better manner. When this is kept in view, it seems extraordinary that such a contrivance should have been the production of a person in his circumstances. His subsequent inventions for preparing the cotton, which are sometimes spoken of as the most wonderful parts of the process of cotton spinning, do not appear to us so striking as this first effort of his genius. Besides the advance in mechanical knowledge which he must have made before the time when they were produced, these inventions, although only to have been conceived by an ori-

Cotton Manufacture.

ginal and fertile mind, are still but improved arrangements of a machine previously in use, or applications of his own spinning machine altered and adapted to the accomplishment of this object. But the power of his mind was perhaps marked by nothing more strongly than the judgment with which, although new to business, he conducted the great concerns to which his discovery gave rise, and the systematic order and arrangement which he introduced into every department of his extensive works. His plans of management, which must have been entirely his own, as no establishment of a similar nature then existed, were universally adopted by others; and after long experience, they have not yet, in any material point, been altered or improved.

In 1786, Mr Arkwright, on presenting an address from the county of Derby, of which he was then high sheriff, had the honour of knighthood conferred upon him.

We shall now proceed to give an account of the different machines used in cotton spinning, invented by Sir Richard Arkwright, and of those afterwards invented by others, describing them in the order in which they are employed. In this manner we shall be able to exhibit a view of the present state of the art. The instruments used in the preparation and spinning of cotton wool are the following:—

The Opener; the Scutcher, and Spreading Machine; the Carding Engine; the Lap Machine; the Drawing Frame; the Slabbing Fly Frame; the Intermediate Fly Frame; the Finishing Fly Frame; the Throstle Frame for coarse warps; the Self-acting Jenny for numbers below 50; and the Hand-mule Jenny for higher numbers. The first three of these instruments are employed in the rude process of cleansing the raw cotton, and separating its matted flocks. In the Carding Machine it is carded and further purified; in the Lap Machine it is fashioned into flat folds; and in the Drawing Frame it is formed into a loose rope, the fibres of which have a parallel arrangement. In the Slabbing Frame it is slightly twisted; and in the intermediate and Finishing Frames it is still farther twisted, particularly in the higher numbers; but it is not yet yarn. The Throstle Frame is chiefly used for coarse warps; whilst upon the Self-acting and Hand Mule Jennies, both coarse and fine yarns are spun.

In the OPENER the raw cotton is spread uniformly on a feeding table, from which it is raised by a pair of rollers, and by them subjected to the action of a *Beater*. This beater consists of four pairs of arms issuing from a strong axle, each alternate blade being furnished with stout pins or teeth. It is 18 inches in diameter over the blades, by about 48 in width; and when in motion, makes 1300 revolutions in a minute. By an ingenious contrivance a strong draught of air is made to play through the newly-opened cotton, thus carrying away the dust and other foreign particles which adhere to it. This machine is capable of opening up about 20,000 lb. of cotton in 72 hours.

The SCUTCHER resembles the Opener in many respects, and the idea of the latter was obviously taken from it. It consists of two pairs of fluted rollers; a beater with three blunt knives or blades, 10 inches or more in diameter, moving at the rate of 1500 revolutions in the minute; and of two pairs of calender rollers, between which the cotton passes, and is formed into bundles or laps.

The SPREADING MACHINE is generally attached to the Scutcher, and consists of an iron frame, a feed table, two pairs of feed rollers, a beater, a grating, a perforated air cylinder made of cast iron, through which the loose cotton passes; a fanner below the cylinder for drawing off the dust, a pair of fluted rollers, and two pairs of calender rollers, which form the cotton into laps, as in the Scutcher.

The cotton wool, after it has been carefully picked, either by the hand or by a machine, is carried to the carding engine. This machine consists of two or more large cylinders covered with cards, with teeth like those of hand cards, which revolve in opposite directions, and nearly in contact with each other. These cylinders are either surmounted by other small ones, covered in like manner with cards, by whose revolutions in opposite directions to those of the larger cylinders, and with different velocities, the cotton is carded, and put on the last or finishing cylinder; or, as is now more generally practised, the first cylinder, that is, the one nearest the feeder, is surrounded by a fixed concave framing lined with cards, which, coming nearly in contact with the cylinder cards, produce the same effect in the process as the top cylinders, and in a more simple manner. (See Plate CXC. figs. 1, 2, 3, 4.)

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This description of the carding machine is still (1854) applicable for numbers of yarn above 100, which are made from sea island cotton. For numbers above 50, a system of twice carding is still employed. The engines are generally 36 inches wide. The cotton is partially carded in the breaker or first card; it is then re-formed into a lap; and is lastly passed through the finisher or second card; for the finest yarns, however, combing is substituted.

We have noticed, in speaking of the carding engine, which Mr Peel erected in 1762, that at that time the cotton was taken off the finishing cylinder by means of hand cards. But by the time Mr Arkwright began his spinning, this operation was performed by the application of a roller with tin plates upon it like the floats of a water wheel, which, revolving with a quick motion, scraped off the cotton from the card. This was a rude contrivance, and in its operation injured both the cotton and the cards. Mr Arkwright substituted for it a plate of metal, toothed at the edge like a comb, which, in place of being made to revolve like the other, was moved rapidly in a perpendicular direction by a crank, and, with slight but reiterated strokes on the teeth of the cards, detached the cotton from them in a uniform fleece. He employed narrow fillet cards, wound round the doffing cylinder in a spiral form, by which contrivance a continuity of fleece was produced, which, as it left the card, was gradually contracted in its size by being passed through a kind of funnel, and then flattened or compressed between two rollers; after which it was received into a tin can in the state of a uniform continued carding.

The taking off the cotton from the cards in this manner is one of the most beautiful and curious operations in the process of cotton spinning; and although the crank, which forms a part of the apparatus, had perhaps been used in some way or other prior to the date of Mr Arkwright's second patent (as was urged in the action for having it set aside), the comb for taking off the fleece, and the spiral card which produces its continuity, were inventions indisputably his own.

The LAP MACHINE is only occasionally used, and that in the case of double carding, where the object is to re-form the cotton into a lap after it has passed through the breaker or first card. It consists of a frame, two pairs of calender rollers 4 inches in diameter, and a lap-drawer 18 inches in diameter. It is supplied with cotton from cans placed behind the machine; and what passes through the first pair of rollers is consolidated into a uniform sheet, which is afterwards rolled up into a lap or bundle. What is called a DOUBLER is merely a pair of short rollers attached to one side of the machine, through which two ends (or slivers, as they are technically called) are made to pass rapidly from two cans behind to one in front. This arrangement is useful when there is not room at the back of the machine for a sufficient number of cans with single ends. From this short description it will be seen that the lap machine is subsidiary to the carding machine.

For the preparation of cotton to spin fine yarns there has been recently introduced into the leading fine spinning concerns of Manchester, a combing machine, the patented invention of Heilman, formerly of Gwebwiller in France. This curious and beautiful machine has the property of removing all the particles of dirt and short fibres from fine long-stapled cottons, thereby leaving only the cleanest and most perfect wool to be attenuated into the finest as well as the most perfect cotton yarn which can be produced. So beautifully clean, even, and perfect is the yarn made by the aid of the comber, that fine muslin and laces can be manufactured of qualities so excellent that an increased consumption of these products of elegant luxury may be reasonably anticipated.

Drawing frame.

The next step in the process after the carding or combing is what is called drawing the cotton. The machine employed for this purpose, called the drawing frame, depends simply on the principle of elongation by rollers. To imitate the operation performed by the finger and thumb in hand spinning, two pairs of rollers are employed; the first pair, slowly revolving in contact with each other, are placed at a little distance from the second pair, which revolve with greater velocity. The lower roller of each pair is furrowed or fluted longitudinally, and the upper one

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is neatly covered with leather, to give the two a proper hold of the cotton. If we suppose a carding to be passed between the first pair of rollers, it will be drawn forward as they move, but without any change in its form and texture further than a slight compression received from the incumbent roller. But if from the first pair it be passed through the second, moving with twice or thrice the velocity of the first, it will be drawn twice or thrice smaller than it was when it entered the first rollers. In the succeeding operation, two, three, or more of these drawings are passed together through the rollers in the same manner, coalescing as they pass, and forming a single new drawing This doubling and drawing is several times repeated, and has the effect of arranging all the fibres of the cotton longitudinally in a uniform and parallel direction, and does away with all inequalities of thickness. In these operations the cotton receives no twist. (See Plate CXC. figs. 5, 6.)

Roving frame.

Roving the cotton, which is the next part of the process of preparation, is an operation similar to that employed for drawing it, only that, to give the rove, in its now reduced thickness, such a degree of tenacity as will make it hold together, a slight twist is given to it, converting it into a soft and loose thread. This is effected by passing it, as it leaves the rollers, into a conical can, which, while receiving it, revolves with considerable velocity. (See Plate CXC. figs. 7, 8, 9.) After this the rove is wound by the hand upon a bobbin by the younger children of the mill, and carried to the spinning frame. The roving frame, as here described, is never used now (1854), having been entirely superseded by the fly frame; but the principle remains unchanged.

Fly frame.

About the year 1817, the fly frame was introduced for preparing rovings for the middle and coarser numbers of both warp and weft; and this machine having received considerable improvements since, has superseded the use of the roving frame. Instead of the revolving cans of the roving frame, the fly frame has spindles placed at equal distances from each other, with a fly on the top of each, one of the legs of which is made in the form of a tube, for the purpose of receiving the roving and conveying it to the bobbin. The rollers deliver the roving to the top of the fly, where it passes through a small hole immediately above the centre of the spindle, called the eye of the fly, and from which it descends through the tube to the bobbin, which is fitted loosely on the spindle. The fly revolves rapidly round the bobbin, and winds the roving on it as fast as it is delivered by the rollers. (See Plate CXCII. figs. 1, 2.) The motion of the rollers and spindles are equal and uniform at all times; hence the twist is equally diffused over all parts of the roving. But to adapt the taking up of the roving to the uniform delivery of the rollers, the speed of the bobbin must be variable and unequal; for, while it increases in diameter, the velocity of its acting circumference will remain the same. The ratio of its accelerating motion, therefore, must be equal to the ratio of its increasing diameter; that is, supposing the bobbin to follow the fly; but sometimes the fly follows the bobbin, in which case the speed of the bobbin must decrease in the same ratio as above The matured bobbin and fly frame is the most scientific machine now used in cotton-spinning factories. It can be constructed to produce rovings for either coarse or fine spinning, and which can be relied upon for perfect accuracy, whether of one hank or of fifty hanks in the pound.

Tube frame.

An improvement in the process of preparation for cotton spinning is the tube frame. It is employed as a finishing frame for coarse numbers. The construction of this machine differs from that of the roving frame in having, instead of cans, revolving horizontal cylinders, parallel with the beam rollers, placed about twelve inches in front of the beam. Its chief advantage lies in the great quantity of roving it can produce in a given time, its excess of production to the fly frame being as 84 to 17; but the rove it produces is inferior in quality, and, having no twist, is extremely soft and tender, and causes a greater quantity of waste than the roves prepared by the fly frame. This frame has also fallen into disuse, in consequence of the great improvements which have been made in the fly frame of late years, which is now (1854) driven with much greater speed than formerly, and produces *rovings* of a quality so superior that, except for coarse yarns, or where the work is very carelessly performed, the tube frame is never employed.

Spinning frame.

The SPINNING FRAME or THROSTLE has the double set of rollers, which have been described in the account given of the drawing and roving frames, and which, operating in the same manner as in those machines, extend the rove, and reduce it to a thread of the required fineness. The twist is given to the thread by the application of the spindle and the fly of the common flax wheel, adopted in the machine for this purpose. (See Plate CXCI. fig. 10)

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The yarn produced by this mode of spinning is called water twist, from the circumstance of the machinery by which it is obtained having been, for a long time after its invention, put in motion by water.

Throstle.

The only attempt to extend the principle comprehended in Sir Richard Arkwright's first contrivance, the spinning frame, is to be found in the machine called the Throstle, introduced about the year 1810 In this machine the spinning apparatus is in every respect the same as in Sir Richard Arkwright's frame, but the movement of the parts is different.

In place of four or six spindles being coupled together, forming what is called a head, with a separate movement by a pulley and drum, as is the case in the frame, the whole rollers and spindles on both sides of the throstle are connected together, and turned by bands from a tin cylinder lying horizontally under the machine. The merit of the invention chiefly lies in the simplification of the moving apparatus just mentioned. The movement is not only rendered lighter, but greater facility is afforded for increasing the speed of the machine, and, consequently, when the nature of the spinning admits it, for obtaining a larger production. The throstle can also, with more ease, and at less expense, be altered to spin the different grists of yarn: only a few movements required to be changed in it to produce this end, while in the spinning frame there are a great many. (See Plate CXCI. fig. 11.)

Mr Danforth's throstle.

An improvement on the throstle, which was thought to be very promising, was lately made by Mr Danforth, an American spinner. His object was to obviate the vibration of the spindle (caused by the flyer being placed on the top of it, with nothing to keep it steady), whereby it is prevented from being driven with advantage beyond a certain limited speed. To remedy this, Mr Danforth introduced into his throstle a stationary spindle, on the top of which he fixed an inverted conical cup. In this improved throstle the bobbin revolves on the spindle with great rapidity, and by a transverse motion is raised and lowered so as to be, when at the highest point, entirely within the cup, and when at the lowest entirely below it. The edge of the cup, passing thus along the whole length of the bobbin, builds the yarn equally on every part while it is receiving the necessary twist.

To secure to himself the benefit of this invention, Mr Danforth took out patents in all the different European states. His improvement gives a great increase of quantity, but is accompanied by such an addition of waste as to form, in the opinion of many spinners, an insuperable objection to its use.

The throstle frame is now (1854) almost the only machine in use for the production of warps of low numbers, that is, which do not go higher than 32. In the most approved machines of this kind the spindles make 5000 revolutions in the minute, each spindle producing 27 hanks per week when spinning 32's. The Danforth frame is now entirely out of use.

Mr Crompton invents the mule jenny.

Probably no inventive contribution, more valuable and important to the cotton trade, has been offered to it than the mule. Mr Samuel Crompton of Bolton, in 1775, completed his invention of the "mule jenny," in contriving which he had been engaged for several years. But this machine, possessing great merit and advantages, did not come into general use, nor was its value known, until after the expiration of Arkwright's patent; because till then the spinner was confined to the rove prepared for common jenny spinning, which was unsuitable to the mule jenny.

After the spinner was allowed to make use of Mr Arkwright's fine process of preparation, by his patent being cancelled, the power of this machine became known; and its introduction forms another important era in the history of the cotton manufacture. Being fitted to supply those "grists" and qualities of yarn which the other machines could not produce, the manufacturer was enabled to enter upon fabrics which otherwise it would have been in vain to attempt. Warps of the finest quality are spun upon the mule; while on the throstle yarn of a finer *grist* than No. 36 cannot be spun to advantage. The reason is, that the fine thread has not strength to stand the pull of the rollers when winding itself on the bobbin of the throstle; a stress which is saved to it in the mule, where the draught takes place only in a slight degree faster than

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the rove is given out by the rollers. All wefts, from the lowest to the highest numbers, are now spun upon Crompton's machine, the use of Hargreaves' jenny having been almost entirely superseded by it. It was some time, indeed, after the mule came into use, before it was ascertained that the finest yarn required for the manufacture could be produced from it. But in the year 1792, Mr Jonathan Pollard of Manchester succeeded in spinning yarn upon the mule of the fineness of 278 hanks to the pound, from cotton wool grown by Mr Robley, in the island of Tobago. This yarn was sold at twenty guineas per pound to the muslin manufacturers of Glasgow.

Description of the mule jenny.

The MULE, in its structure and operation, is a compound of the spinning frame and of Hargreaves' jenny; from which circumstance it has probably received its name. It contains a system of rollers like that belonging to the twist frame; but in place of having every four or six of them in separate heads, as is the case in that machine, the whole are coupled together; and the rove being drawn through them, is, in its conversion into thread, received on spindles revolving like those of the jenny. The carriage on which these spindles are placed is moveable, and is made to recede from the rollers a degree faster than the thread is given out. After a certain quantity of the roving has been thus delivered by the rollers, they are stopped; but the carriage continues to recede somewhat farther; and the spindles continuing also to revolve, the thread is drawn out to the fineness required, and then receives its proper portion of twist. This last operation resembles that performed by the common jenny, and produces a similar effect. (See Plate CXCI. fig. 12.)

Mr Crompton took out no patent; but many years after he had given this important invention to his country, he received from parliament a grant of L.5000.

Mr Kelly's patent for giving motion to the mule by machinery.

The mule was originally worked by the spinner's hands; but in 1792, Mr William Kelly of Glasgow, at that time manager of the Lanark Mills, obtained a patent for moving it by machinery. Mr Kelly soon saw, however, that in the extended state of the cotton trade, the exclusive possession of this important improvement was not likely to be quietly acquiesced in; and, unwilling to involve himself in the litigation which would have been necessary to defend his privilege, although the undisputed inventor of the process, he allowed every one freely to avail himself of its advantages.

Mr Kelly's machinery was contrived so as to move every part of the mule, even to the returning of the carriage into its place, after the draught was finished. Had his invention come into full operation, the employment of men as spinners would have been thereby rendered unnecessary, and children would have been able to do all the duty required. But, after a short trial, it was discovered that a greater amount of produce could be obtained, and at a cheaper rate, by using the machinery merely to draw out the carriage, and employing the men to return it as formerly. In this way one spinner could serve two mules, the one carriage moving out during the time that he was engaged in returning the other.

Progress of improvement in mule spinning.

Proceeding in this train of discovery, it was next found unnecessary to confine the mule to a hundred and forty-four spindles, the largest number which it had till then contained; for, with the assistance of the above mechanical improvement, the spinner was able to manage two mules of three or four hundred spindles each, and thus to spin on six hundred or even 1000, instead of on only a hundred and forty-four spindles.

The process of mule spinning continued to be conducted upon this plan, till several proprietors of large cotton works restored the part of Mr Kelly's machinery which returns the carriage into its place after the draught is completed. By thus lessening the fatigue to the spinner, they were enabled to employ women in place of men. All that is to be done by the spinner in this case is, with a slight touch of the hand to shift the band, so as to allow the carriage to be moved back into its resting position, and, as this takes place, to manage the guide for building the cop, and regulate the motion of the carriage as it recedes.

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An extension of the size of the mule employed in spinning very fine numbers was accidentally suggested to a spinner of Manchester in 1830, and enabled him to reduce $2\frac{1}{2}$ per cent. the wages paid for spinning these numbers. Being desirous to fill a garret-room of his mill with jennies of five hundred spindles each, of the size of those worked in the rooms below, he found, from the contraction of the space, occasioned by the inclination of the roof, that there was not room for a mule of five hundred spindles to stand across the floor. It then occurred to him that, as in spinning those high numbers of yarn, the movement of the carriage in drawing out so slender a thread was of necessity very slow, it might be practicable to work a thousand spindles in one mule, without increasing the breakage of threads; and that, should this be the case, he would then be able to fill his garret by placing these mules lengthwise. The experiment was tried, and the mule of a thousand spindles found to work so well as to admit of the above reduction of the wages of the spinner.

Self-acting mule.

There was introduced in the year 1832 into different spinning works, a mule, the carriage of which, after having drawn out the thread, is returned by mechanical means, without the aid of the spinner, or the guidance of his hand to secure the uniform building of the cops. The apparatus for accomplishing this can be affixed to the mules now in use without any other alteration. Messrs Sharpe and Robarts took a patent in 1829 for this invention; but the right to the discovery having been disputed, its general adoption was retarded till some time afterwards, when a verdict in their favour was obtained. The machinery for effecting the object being rather complicated, fears have been entertained that it may be liable to get out of order, and cause frequent stoppages of the work, besides occasioning a considerable expense in keeping the machine in repair. The most judicious spinners, however, consider the discovery to be founded upon correct principles; and when such is the case, we may count upon mechanical science being able sooner or later to simplify the movement, and admit of the improvement being brought into general use. The mill proprietors in Lancashire have altered their mules to spin coarse yarns in this manner; and they are able to dispense with the mule spinners, retaining merely the elder piecers to manage them, and children to take up and join the broken ends.

The self-acting mule is now (1854) employed for spinning all sizes of yarns below 50's; and in the manufacture of these low numbers a great saving is effected by its use. Many patents for the improvement of this machine have been taken out of late years, and more or less success has attended these attempts. The hand-mule is still in use for all numbers of yarn, and has undergone no improvement, except in stability and constructive details.

The stretcher or fine roving frame.

In addition to the process of preparation already described as employed in frame and coarse mule spinning, the cotton intended for fine mule spinning goes through a further operation. It was found that extending the roves at once to a fine thread, was a reduction of texture too rapid to admit of the production of a good article, and that an intermediate operation was necessary. This gave rise to the process of stretching, which is performed on a mule fitted up for the purpose which draws the rove another degree finer, without communicating to it such an additional twist as might prevent its being extended afterwards into a thread upon the spinning mule; but the stretcher is now in the course of being abandoned, fine rovings of perfect quality, made upon fine bobbin and fly frames, having been substituted for those previously made upon stretchers.

We have now finished our account of the different machines employed in cotton spinning, and have endeavoured to describe the succession of improvements which have been made on them up to this time, so as to give some idea of the progress in their power of production. But it will not

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be possible, from the nature of the subject, to exhibit in a similar manner the not less important advances made from time to time in the construction of the minute parts of these machines, and in the skill and management of the spinner who works them. By these means a progressive acceleration of their movement was rendered practicable, and even after the machine had long been apparently in a very perfect state, the quantity of produce was more than doubled.

About the year 1790 the average product of the spinner of yarn No. 40 was little more than a hank per spindle per day; but by the year 1812, as appears by Mr Kennedy's table of the comparative cost of the cotton yarn of India and of this country, it had advanced to two hanks per day, and in 1830 to 2·75. The effect of this increase of production upon the cost of the article was very great, as will be seen by the following statement of the reduction of the wages of spinning, and of the fall in the sale price of yarn which rapidly succeeded.

We have already noticed that, until the cancelling of Sir Richard Arkwright's patent, by which the mule spinner became at liberty to use his improved mode of preparation, the few fine wefts required were spun on Hargreaves' jenny. In the year 1786 this yarn was sold in Glasgow and Paisley at 31s. per pound for No. 90; 7s. per pound being the price of spinning it. The warp was spun upon the water or throstle frame, and was sold at the same time at 47s. 6d. the pound for No. 90.

We are informed by Mr Crompton, that immediately upon his completing his invention of the mule, in the year 1775, he obtained 14s. per pound for the spinning and preparation of No. 40; that a short time after he got 25s. per pound for the spinning and preparation of No. 60; and that he then spun a small quantity of No. 80 to show that it was not impossible to spin yarn of so fine a grist; and for the spinning and preparation of this he got 42s. per pound. For some little time after the mule came into general use, in the year 1786, it was the practice in many places for the spinner to purchase the wool in a prepared state; and separate concerns for preparing cotton were established and carried on. At that time 10s. per pound were paid for spinning No. 100; but soon afterwards the wages for this number were reduced, first to 8s. and then to 6s. 8d. In 1790 the price of spinning No. 100 was 4s. per pound. In 1792 it was brought to 3s. 1d., and in 1793 to 2s. 6d., at which price it continued till 1795; when the mule coming to be worked by machinery, and an increase being made in the number of spindles, the spinner was enabled so to extend the quantity of his produce, as to admit of another considerable reduction in wages. The price of spinning No. 100 was in the course of a few years brought down to 8d. per pound, at which price it continued until 1826, when it was further reduced to 6½d. per pound. Notwithstanding this extraordinary diminution of the price of spinning, such have been the effects of the improvements in the plan and construction of the machinery, in the selection and preparation of the wool, and in the spinner's skill and tact in the execution of his work, that he is able to earn more money now than he did when the wages were at the highest.

The sale prices of the yarn during this period were as follows:—

In the year		In the year	
1786, for No. 100	38s.	1797	19s.
1788	35s.	1799	10s. 11d.
1791	29s. 9d.	1801	8s. 9d.
1793	15s. 1d.	1803	8s. 4d.
1795, spun from Bourbon cotton wool	19s.	1805	7s. 10d.
		1807	6s. 9d.

Since 1807 the price of yarn, after various fluctuations, fell in 1829 to 3s. 2d., and in 1831 to 2s. 11d., at which price it remained in 1832. Since 1832 the fluctuations have not been extreme, the price never rising above 5s. 6d., at which it stood in 1836, nor falling below 2s. 9d., as in 1842. In 1846 it was 3s. 2d. In 1854, warp 100's was 3s. 6d.; medium 100's, 2s. 5d.; and weft 100's only 1s. 9d.

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But the benefit of the improvements we have noticed has not been confined to the reduction of the cost of the yarn. Its quality has been rendered so much superior, that the weaver is enabled, with the same hours of labour, to produce a fourth more of cloth than he was able to do at the beginning of the present century.

Watt applies the power of the steam-engine to manufacturing machinery.

During the time that the machines for the different processes of cotton spinning were advancing towards perfection, Mr Watt had been employed in maturing and reducing to practice his conceptions for extending the powers of the steam-engine. His inventions for rendering these available to the movements of manufacturing machinery exhibit a beauty of contrivance peculiarly characteristic of his genius, and, to a greater extent than any of the other discoveries which mark this period, have influenced the circumstances of this country and of mankind.

If we had no other means of giving motion to our machinery than by placing it on a stream of water, or employing the power of horses, how comparatively expensive must our operations have been, and how limited their progress! By means of Watt's inventions we are enabled to carry the power at once to the situation where it can be most advantageously used; we can place it in the centre of a population trained to manufacturing habits, and thus bring together the different branches of manufacture, with their numerous subsidiary establishments, all dependent upon or intimately connected with each other, thereby giving facility and effect to their mutual operations.

Some account of the introduction of the steam-engine, therefore, naturally forms a part of the history of the cotton manufacture. In perusing the following detail, obtained from Mr Watt in 1818, the reader, aware of the present extensive employment of this powerful auxiliary to industry, will be surprised at the slowness with which it came into general use.

Mr Watt had early turned his thoughts to the application of the steam-engine to rotatory motion, and in the year 1781 had devised the means for accomplishing this end. But at the moment he was taking measures for legally securing to himself the exclusive advantages of his invention, a confidential workman betrayed a part of his plan to other persons, who took a patent for it. In the following year, having substituted a most ingenious contrivance to supply the part of the process which had been stolen from him, he obtained for Messrs Bolton and Watt a patent for his mode of applying this power. They erected their first *rotative* engine (for we are obliged to use that term to avoid circumlocution) in the year 1782, at Bradley ironworks, and another in the same year at their own manufactory. In 1783 they erected an engine for winding ores out of a mine in Cornwall. In 1784 they erected seven engines, one for an oil mill at Hull, one at Messrs Goodwin and Company's brewery in London; one at Mr Whitbread's, with four others,—including the first engine for that splendid establishment, the London Albion Mills. Among those erected by them in 1785 was one for Messrs Robinsons, at Papplewick, in Nottinghamshire, for spinning cotton,—the first instance of the application of steam to this manufacture. In the following year they erected a number of their engines for various purposes; and in 1787 one for Messrs Peels, at Warrington, for cotton spinning, and three others for the same purpose at Nottingham. No rotative engine had yet been erected at Manchester; and it was seven years after Bolton and Watt had received their patent that they constructed for Mr Drinkwater the first engine used there for spinning cotton. This engine is still (1854) working admirably. In 1790 they erected one for spinning cotton at Nottingham for Sir Richard Ark-

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wright, and another at Darlington for spinning flax; a cotton-spinning engine at Manchester for Mr Simpson, and a second at Papplewicke for Messrs Robinsons. Some time before this Sir Richard Arkwright and others, from an ill-judged economy in the first cost, had introduced into their spinning factory atmospherical or Newcomen's engines, with rotative motions applied to them. But quickly perceiving their error, they abandoned them;—and Bolton and Watt's engines soon came to be universally used among cotton spinners, and all other manufacturers.

Account of the progress made in the cultivation of cotton wool.

In an account of the means which contributed to that fall in the price of spinning which we have mentioned, we must not omit the progressive improvement in the cultivation of the raw material, and in the application of its different qualities to their most profitable uses. Previous to the year 1793, the cotton used in the coarser articles of the manufacture, with the exception of a small quantity imported from India and from the Levant for the fustian trade, was wholly the growth of our own and of the French West India Islands. That for the better kind of goods was raised in Demerara, Surinam, and Berbice. The wool for fine goods was grown in the Brazils; and that for the few very fine muslins then manufactured, in the Isle of Bourbon.

In 1787 the descriptions of cotton imported into Britain appear to have been as follows:—

From the British West Indies	6,800,000	lbs.
From the French and Spanish colonies	6,000,000	
From the Dutch	1,700,000	
From the Portuguese	2,500,000	
From the Isle of Bourbon, by Ostend	100,000	
Smyrna and Turkey	5,700,000	
	32,800,000	

Had we continued to derive our sole supply of cotton from these countries, the progress of the manufacture would have been greatly retarded, not only from the difficulty of making the production of the raw material keep pace with the increasing consumption, but from the impossibility of obtaining the qualities of wool suited to the finer descriptions of goods, which the improved machinery enabled us to undertake.

But fortunately, about the year 1770,[1] the planters in the southern states of the American Union began to turn their attention to raising cotton wool; and, besides carrying the cultivation of the article to a great extent, they produced qualities of cotton before unknown. In 1792 the quantity of cotton exported from the United States was only 138,328 lbs., no manufacture of cotton goods having been attempted in America for many years after that period. In 1831 they exported 619,000 bales to Great Britain, 127,000 to France, and 27,000 to other parts. In 1845 the quantity grown in the United States was 2,100,537 bales.

The American cotton wool first brought to this country was very ill cleaned, and in consequence was indiscriminately applied to the manufacture of the coarser species of goods. It was soon, however, perceived that the cotton raised upon the coast, termed *sea islands cotton*, had a finer and longer staple than that grown farther back in the country, and known by the name of *upland* cotton. But it was not for several years, and after a succession of trials, that this wool was ascertained to be of a quality in every respect superior to the cotton of the Isle of Bourbon. Indeed, it was only in the year 1796 that the finest description of it was applied to the purposes for which Bourbon wool had till then been used, and which it soon entirely supplanted. The second quality of it about the same time supplanted the Brazil wool in many kinds of goods.

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The upland cotton is a different species from the sea island, and is separated with such difficulty from the seed, that the expense of cleaning the wool must have put a stop to its further cultivation, had not a machine, by which the operation of cleaning is easily and successfully accomplished, been invented. This machine was invented in 1795 by Mr Eli Whitney of Massachusetts. There are two qualities of this cotton, the one termed Upland Georgia, grown in the states of Georgia and South Carolina; and the other, of superior quality, raised upon the banks of the Mississippi, and distinguished in the market by the name of New Orleans cotton. A strong prejudice existed for some time against the upland wool, which was thought to be of inferior quality, and not to take a good colour in dyeing; but being found suitable to different coarse fabrics, its cultivation was so rapidly extended, that in 1807 55,018,448 lbs. of upland cotton were exported from the United States.

The cotton of the finest quality ever brought to the English market, or probably ever grown, was that formerly mentioned as having been raised in the island of Tobago between the years 1789 and 1792, upon the estate of Mr Robley. That gentleman carried the cultivation of this article to some extent; but the price of cotton falling very low, and the cultivation of sugar becoming extremely profitable in consequence of the destruction of the sugar plantations in the French islands, he was induced to convert his cotton grounds into a sugar plantation. The production of cotton of this very fine description has hardly ever been attempted by any other person, although it is believed that the price it would yield would amply repay its expense.

Until about the year 1815, it was thought that the cotton wool of India, from the shortness of its staple, could not be spun with advantage upon our machinery; and in consequence, the greater part of the Indian cotton brought to this country was spun upon the common jenny, and used as weft for the coarsest calicoes. It was discovered, however, that by mixing it with the longer stapled wools of other countries, it might be brought into a state fit for the mule and spinning frames.

It was expected that the opening of the trade in 1814 would have led to more care in the cultivation of the article, and would have given rise to the production of cotton of superior quality to any that had previously been obtained from India. This, however, did not take place. It appears, from the evidence before the parliamentary committees in 1830-31, that up to that period there had been no improvement in the quality of the cotton raised in India; that the dependent state of the cultivator, and the constant fiscal interference to which he was subjected, are insurmountable obstacles to the attainment of this object; and that until European skill and capital come to be employed in the cultivation of the cotton, better qualities are not to be looked for. The influence of the impolitic regulations imposed under the Company's monopoly to secure the revenue are particularly felt in the presidency of Bombay. Up to a late period, this was the only part of India in which any considerable quantity of cotton was grown or exported. In the district of Guzerat alone 100,000 heavy bales are annually produced.

The part of the crop which goes to the Company for the rent of the land is delivered by the cultivator to the Company's collector, immediately after the cotton has been

[1] The year 1770 has always been stated as the period at which the planters of the southern states began to turn their attention to the raising of cotton wool. But we happen to know that in 1764, William Rathbone, an extensive American merchant in Liverpool, received from one of his correspondents in the southern states a consignment of eight bags of cotton. This cotton, on its arrival at Liverpool, was seized by the custom-house officers, on the allegation that it could not have been grown in the United States, and that it was liable to seizure under the shipping act, as not being imported in a vessel belonging to the country of its growth. When afterwards released, it lay for many months unsold, in consequence of the spinners doubting whether it could be profitably worked up.

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picked, but before it has been separated from the seed. This person fixes annually the rent which the cultivator is to pay, the amount of which is always imposed in a specified sum of money, but payable in cotton, rated at a price named by the collector. Its amount upon an average of years is about one-half of the crop. In the payment of this rent the collector refuses to receive any but the best and cleanest part of the cotton, and to this the farmers dare not object. What remains is purchased principally by the Company's commercial resident, who formerly fixed the price he was to pay for it; but in the bargains now made by the officer, he gives the average price received by the cultivators in the surrounding districts

If the culture of cotton in Guzerat has been able to exist under this oppressive system, what might not be expected were the rent of the lands (as is now the case in the presidency of Bengal) fixed and paid in money, and were the growers at liberty to sell the product to those who would give the best price for it! The rapid increase of cultivation in Bengal since the introduction of this more enlightened system of management, and the acquisition and diffusion of wealth which have been the consequences, present a striking contrast to the impoverished and wretched state of the cultivators in Bombay, and speak a language in political science not to be misunderstood.

Since 1814 attempts have been made to introduce the Bourbon seed into Guzerat. These attempts have failed, but it would be wrong to be discouraged by the ill success of an undertaking carried on under the management which usually belongs to monopoly. A very different result may be looked for when that system and its effects shall have been more completely done away, and improvements come to be conducted by those who are to reap the benefit of them. Were this better system once established throughout the peninsula, it appears not unreasonable to expect, in a country so extensive and of such various soils, not only that all the qualities of cotton wool known to our manufacturers would be produced, but that new varieties might be obtained, possibly of more useful application than any we yet possess.

Egyptian cotton wool and manufacture.

Egyptian cotton was introduced into this country for the first time in 1823. Among many schemes for calling into action the capabilities of Egypt, all of which were selected with admirable sagacity, Mehemet Ali, the ruler of that country, thought of cotton wool as a product suited to the soil and climate, and the culture of which, from the great and growing demand, was likely to prove a profitable speculation. His measures for prosecuting this object were carried into execution with the energy which characterized all his proceedings, and were upon a scale to enable him, so early as 1823, to export 5623 bales to England.

The following table shows the amount exported annually since that period.

Year.	Bales.	Year.	Bales	Year.	Bales.
1823	5,623	1834	7,277	1844	66,700
1824	38,022	1835	4,372	1845	82,000
1825	110,000	1836	34,953	1846	59,600
1826	136,000	1837	41,193	1847	20,700
1827	130,000	1838	29,700	1848	29,000
1828	50,000	1839	33,500	1849	72,600
1829	75,000	1840	3,800	1850	79,700
1830	120,000	1841	40,700	1851	67,400
1831	100,000	1842	19,600	1852	189,900
1832	41,183	1843	48,800	1853	105,400
1833	3,893				

The cotton-wool exported is all long-staple wool, but of two sorts,—one called in Egypt makko, and in England common Egyptian; the other the produce of sea islands seed, called in Egypt Senaar, and in England sea islands Egyptian. Besides these two descriptions of cotton, Egypt raises from 15,000 to 20,000 bales of short-staple cotton, similar in quality to that of Smyrna, and chiefly consumed in the country itself.

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The cotton received from Egypt is found to be among the most useful that is grown, and that raised from sea islands seed ranks in quality next to American sea islands.

Cotton manufacture of Egypt.

Having succeeded in the production of cotton, the pasha thought he might advance another step, and have it spun into yarn and woven into cloth. He accordingly formed establishments for spinning and weaving in Cairo, Bosaco, Rosetta, and other places; and so early as 1826 he had at work sixty-one mills moved by the power of buffaloes. The machinery was supplied from France and England, orders in council having been obtained in the latter country to authorize its export. Power-looms were also sent out, but did not succeed.

A few years later the pasha shipped a thousand bales of yarn to Calcutta for sale; but it was not of a quality to enter into competition with the English yarn, and it was found to be unsaleable, except at a most disadvantageous price. He ordered it therefore to be woven into cloth in Calcutta on his own account, and to be re-shipped to Egypt in a manufactured state.

Interior of Africa.

Clapperton and Landers, on their expeditions to trace the course of the Niger, found the inhabitants everywhere clothed in cotton. They mention that cotton wool is produced in the different districts in the interior, and is spun into cloth on the spot. There exists, therefore, in the heart of Africa an extensive manufacture of cotton cloth. It is to be regretted that they give no information of the way in which the yarn is spun, and no description of the loom employed to weave it. It would be interesting to know the nature of the instruments used by the natives in these processes, as such knowledge might enable us to trace whence the Africans derive their acquaintance with the art of weaving, and thus perhaps throw some light on African history.

It appears that the people of Eboe, and of the countries near the coast, are chiefly clothed in Manchester cotton goods; a circumstance which would lead us to expect, should we succeed in obtaining a commercial intercourse with the interior of Africa, that a valuable market for our manufactures may be found in that country.

Within the last twenty years (1854), the American settlers of Liberia have established a communication across the country to Timbuctoo, and have found there a considerable market for cotton cloths.

We shall now resume our account of the progress of the manufacture in Great Britain.

Stocking yarn.

From Sir Richard Arkwright having commenced his operations at Nottingham, the seat of the stocking manufacture, and from his connection with Mr Need, who was largely engaged in it, the whole produce of his spinning was at first devoted to that trade. The cotton yarn for this manufacture requires to be particularly smooth and equal; and to secure these qualities, it is spun by a process differing a little from that employed for ordinary twist. Being from two roves in place of one, it is called double spun twist. The introduction of this article produced a great change upon the stocking manufacture. Hand-spun cotton was entirely laid aside; and stockings made of twist were of so superior a quality, that in a short time they wholly supplanted thread stockings.

Stocking trade.

The manufacture of cotton stockings in Nottinghamshire, Derbyshire, and Leicestershire, is now of great extent.

Cotton warp spun.

About the year 1773, Mr Need and Mr Strutt made the important discovery, that the yarn produced by the spinning frame had sufficient strength to fit it for warp, although its firmness and hardness rendered it less suitable for weft. The weft, therefore, continued to be spun by Hargreaves' jenny; and from this time the calicoes, and other articles in imitation of India goods, which had hitherto been manufactured with linen warp, came to be made wholly of cotton;

and the progressive increase of these manufactures, particularly of calicoes, after this time, was unexampled.

Calicoes made entirely of cotton.

After having made a considerable quantity of those goods, Mr Need and Mr Strutt discovered, that, when printed, they were subject to double the duty charged upon calicoes woven with linen warp, and that their sale was even prohibited in the home market. After a long and expensive application to the legislature, they succeeded in procuring the repeal of those impolitic laws. Nearly about the same period, calicoes entirely of cotton were begun to be made at Blackburn, and also at Preston; which places soon became the seat of their manufacture, and for a long time the great market to which the printers from all parts of the kingdom resorted for their supplies. This branch went on increasing for many years in a most extraordinary degree. About the year 1805, it was calculated that the number of pieces sold annually in the Blackburn market was not less than a million; and by that time the manufacture of this article was not confined to the country around Blackburn, but had spread into the north-west district of Yorkshire, principally about Colne and Bradford, from which part of the country 20,000 pieces weekly are said to have been sent to Manchester.

The first attempts to manufacture muslins in Britain.

The first attempts to make muslins in this country commenced simultaneously in Lancashire and at Glasgow about the year 1780, but without success. There was no yarn fitted for the weft of these goods, except that spun upon Hargreaves' jenny; and when made of this, it was found they were not of a marketable quality. Recourse was then had to wefts brought from India; and although a better article than the former was by this means produced, it was still not of a quality to compete successfully with Indian muslin. As soon, however, as the invention of the mule jenny enabled the spinner to produce yarns suited to such fabrics, the manufacture of the finest cotton articles became an important branch of trade in this country. That machine, as has been mentioned, came into use at the end of the year 1785, upon Sir Richard Arkwright's patent being cancelled; and it is from that period we ought to date the commencement of this part of the manufacture. So rapid was its progress, that in 1787 it was computed that 500,000 pieces of muslin were in that year manufactured in Great Britain.

Muslin began to be made nearly at the same time at Bolton, at Glasgow and at Paisley, each place adopting the peculiar description of fabric which resembled most those goods it had been accustomed to manufacture; and in consequence of this judicious distribution at first, each place has continued to maintain a superiority in the production of its own article.

Jaconets both coarse and fine, but of a stout fabric, checked and striped muslins, and other articles of the heavier description of this branch, are manufactured in Bolton and in its neighbourhood.

Tambouring machine.

Book, mull, and lino muslins, and jaconets of a lighter fabric than those made in Lancashire, are manufactured in Glasgow. Sewed and tamboured muslins are almost exclusively made there and in Paisley. A machine of most ingenious contrivance for performing the operation of tambouring was in the year 1807 invented by Mr John Duncan of Glasgow, and a patent taken out for the discovery. Each machine contains about forty tambouring needles, and is superintended by a girl, who pieces the thread when it breaks. This beautiful, and, at first, promising piece of mechanism has never come into general use. At present there are only three or four machines kept at work by the Messrs Mitchells of Glasgow, who at an early period became proprietors of the patent.

What are called fancy goods, woven in the loom, were first made at Paisley, which had been the chief seat of the silk gauze manufacture of this country. In the silk trade, which was then beginning to fall into decay, a body of most ingenious workmen had been bred. By employing them, the taste and invention which had produced the varieties displayed in that beautiful article were immediately transferred to the production of similar fabrics of muslin. From this circumstance Paisley for a long time retained the exclusive possession of this branch; but being only seven miles distant from Glasgow, the general seat of the cotton manufacture of Scotland, and the mart to which most purchasers of muslin resort, many of its principal manufacturers have been induced to move their establishments to that city, although the weaving of these muslins continues to be executed in Paisley and its neighbourhood.

There is a curious circumstance to be noticed with regard to the manufacture of the very fine fabrics of muslin in Scotland,—that a great part of the yarn used for them is brought from Manchester, in consequence of the Scotch spinners not having yet been able to produce the very fine numbers of yarn of the best quality. This inferiority does not proceed from a less perfect construction of the machinery employed in Scotland, the mechanics and the machine-makers of Glasgow being admitted to be excellent workmen; neither does it arise from the want of skill in those who conduct the business, or from any difference in the processes employed in the two countries; but it is to be attributed to the same cause which produces the superior yarn of India, namely, an adroitness and mechanical sleight of hand in the operative spinners of Manchester, acquired by a few out of the great multitude bred there.

The manufacture of the thicker cotton fabrics was at the same time rapidly rising in importance. The manufacture of dimities has been exclusively confined to the north of England, all attempts to make them in Scotland having proved unsuccessful.

Balason handkerchiefs were first manufactured about Preston and Chorley, where they still continue to be made. The manufacture of ginghams was for a long time confined to Lancashire, but for many years it has been extensively introduced at Glasgow, although Lancashire continues to be the chief seat of this branch.

Pullicat handkerchiefs were first made about the year 1785 at Glasgow, where the manufacture of them has been carried on to a great extent. They were not made in Lancashire till some time afterwards, and the manufacture of them there has never been to the same amount; Glasgow, therefore, continues to be the principal mart for this article.

Blue and white checks and stripes for exportation were at first of a linen fabric, but were afterwards woven with linen warp and cotton weft; and when Sir Richard Arkwright's discovery enabled the spinner to produce cotton yarn of sufficient strength to be used for warps, a great proportion of these goods came to be made wholly of cotton. This manufacture is carried on in Lancashire and in the county of Fife, and to a small extent at Aberdeen; its chief seat, however, is Carlisle.

The manufacture of cotton cambric was begun about the same period, and was separated into two branches; into cambric to be used as garments in a white or printed state; and into cambric made in imitation of French linen cambric, to be used for the same purposes as that article. The first is made nearly altogether in Lancashire, where the manufacture of it is carried on to a great extent; and the second, of much less amount, wholly at Glasgow. The Scotch manufacturers have never been able to rival the Lancashire in the first, nor the Lancashire manufacturers to rival the Scotch in the last.

Bandana handkerchiefs, and Bandana cloths for garments, were first made by Mr Henry Monteith, at Glasgow, about the year 1802, and are now manufactured there to a considerable amount. The cloth is dyed a bright Turkey red, and the colour is discharged from those parts which form

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the pattern or figure, by passing a chemical mixture through them. Glasgow still continues to be the chief seat of this manufacture, and there are in that city several large works for carrying it on. The demand for Bandanas, however, has latterly fallen off, while, in consequence of the repeal of the impolitic duty on printed cloths, the consumption of these has greatly increased; and most of the proprietors of the Turkey-red dyeing establishments have therefore been induced to add calico-printing to their former business.

From the circumstance of Glasgow being the seat of a fine manufacture, it was found difficult, as long as hand-weaving continued, to introduce there the weaving of calicoes. The article was made to a limited amount at Perth, but the Scotch calico-printers were obliged to look for the principal part of their supply of cloth to Lancashire. So long as this was the case, it is evident that the Scotch were not on an equal footing with the English printers; and as a great deal of capital had been embarked in the trade by the former, a considerable anxiety was felt by them that this defect in their situation should be remedied. The object was at length attained by the introduction into Scotland, in 1801, of the art of weaving by the power of water or of steam; the machinery and subsidiary processes for which had about that time been so improved, that cloth woven in this way was found to be as cheap, if not cheaper, than if produced by manual labour.

Weaving by power.

Weaving by power, fifteen years before its introduction into Scotland, had been attempted by the Rev. E. Cartwright of Hollander House, Kent, who invented a loom to be worked by mechanical means. The circumstances of this discovery, which will be found fully detailed in the following letter from Mr Cartwright, are curious, and, in the history of inventions, we think interesting. Mr C. says—

"Happening to be at Matlock in the summer of 1784, I fell in company with some gentlemen of Manchester, when the conversation turned on Arkwright's spinning machinery. One of the company observed, that as soon as Arkwright's patent expired, so many mills would be erected, and so much cotton spun, that hands never could be found to weave it. To this observation I replied, that Arkwright must then set his wits to work and invent a weaving mill. This brought on a conversation on the subject, in which the Manchester gentlemen unanimously agreed that the thing was impracticable; and, in defence of their opinion, they adduced arguments which I certainly was incompetent to answer, or even to comprehend, being totally ignorant of the subject, having never at that time seen a person weave. I controverted, however, the impracticability of the thing, by remarking, that there had lately been exhibited in London an automaton figure which played at chess. Now, you will not assert, gentlemen, said I, that it is more difficult to construct a machine that shall weave than one which shall make all the variety of moves which are required in that difficult game.[1]

"Some little time afterwards, a particular circumstance recalling this conversation to my mind, it struck me that, as in plain weaving, according to the conception I then had of the business, there could only be three movements, which were to follow each other in succession, there would be little difficulty in producing and repeating them. Full of these ideas, I immediately employed a carpenter and smith to carry them into effect. As soon as the machine was finished, I got a weaver to put in the warp, which was of such materials as sail-cloth is usually made of. To my great delight, a piece of cloth, such as it was, was the produce. As I had never before turned my thoughts to anything mechanical, either in theory or practice, nor had ever seen a loom at work, or knew anything of its construction, you will readily suppose that my first loom must have been a most rude piece of machinery. The warp was placed perpendicularly, the reed fell with a force of at least half a hundredweight, and the springs which threw the shuttle were strong enough to have thrown a Congreve rocket. In short, it required the strength of two powerful men to work the machine at a slow rate, and only for a short time. Conceiving in my great simplicity that I had accomplished all that was required, I then secured what I thought a most valuable property by a patent, 4th April 1785. This being done, I then condescended to see how other people wove; and you will guess my astonishment when I compared their easy mode of operation with mine. Availing myself, however, of what I then saw, I made a loom, in its general principles nearly as they are now made; but it was not till the year 1787 that I completed my invention, when I took out my last weaving patent, August 1st of that year."

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But the idea of weaving by machinery was not new. About the close of the preceding century, a drawing and a description of a similar loom (a circumstance unknown to Mr Cartwright) had been presented to the Royal Society of London. The movements, too, in both are the same with those of the inch-loom, a machine which had long been in use.

Mr Cartwright, after obtaining his second patent, erected a weaving factory at Doncaster, which he filled with looms. This concern was unsuccessful, and was at last abandoned. But still the invention was considered so important to the country, that some years after, upon an application from a number of manufacturers at Manchester, parliament granted Mr Cartwright a sum of money as a remuneration for his ingenuity and trouble.

About the year 1790, Mr Grimshaw of Manchester, under a license from Mr Cartwright, erected a weaving factory, which was to have contained five hundred looms, for weaving coarse sacking cloth. He intended also to attempt the weaving of fustians. But after a small part of the machinery had been set agoing, the work was destroyed by fire; and as the concern during the short trial that had been made did not promise to be successful, the mill was not rebuilt.

About the year 1794, Mr Bell of Glasgow invented another loom, for which also a patent was taken; and a factory of these looms was erected at Milton near Dumbarton. But this concern, although carried on for many years, was not more successful than those which had preceded it.

In 1801 Mr John Monteith of Glasgow erected, in the village of Pollokshaws, a weaving factory, containing two hundred looms. This concern also at first promised ill, but is understood to have afterwards succeeded; and the number of looms was increased to three hundred.

In 1805 a large weaving factory was erected at Catrine in Ayrshire, by Messrs James Finlay and Company, to be carried on in conjunction with their extensive spinning-work at that place; and in 1808 they built another weaving factory at Doune, connected with the spinning-works there, the two containing 462 looms. The quantity of cloth produced in these establishments, in proportion to the number of hands employed in them, is understood to have been greater than had been obtained before in other works, and the undertaking is said to have done well from the outset.

After this period new weaving factories were erected in Glasgow or in its neighbourhood almost every year.

In 1817 there were in Glasgow or belonging to it fifteen weaving factories, containing 2275 looms. There were in 1832 sixty-three factories, containing 14,127 looms.

Mr Radcliffe's dressing machine.

Weaving by power, however, could never have succeeded

[1] It has already been noticed, under the heads ANDROIDES and AUTOMATON, on how slender a foundation the celebrity of this chess-playing automaton rests.—*Ed.*

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but for the discovery of a process for dressing the web before it is put into the loom; which happily was effected by Mr Radcliffe of Stockport. The stoppage of the work from time to time for dressing the web made it impossible to do more than attend to one loom; but by the acquisition of this process, one person can attend to two looms.

The contrivances for "dressing" are very ingenious, the machinery employed in it deriving its movement from the power which gives motion to the looms. The yarn is first wound from the cop upon bobbins by a winding machine, in which operation it is passed through water, to increase its tenacity. The bobbins are then put upon the warping mill, and the web is warped from them upon a beam belonging to the dressing-frame. From the beam, now placed in the dressing-frame, the warp is wound upon the weaving-beam, but, in its progress to it, passes through a strong dressing of starch. It is then compressed between two rollers, to free it from the moisture it had imbibed with the dressing, and drawn over a succession of tin cylinders heated by steam, to dry it. During the whole of this last part of its progress it is lightly brushed as it moves along, and fanned by rapidly revolving fanners.

Mr Marsland's improvement on the steam-loom.

Mr Peter Marsland of Stockport, who for many years had a large factory for weaving cotton cloth of a superior quality, was the inventor of an improvement upon the power-loom, by means of the double crank, for which, about the year 1807, he obtained a patent. The operation of the crank is to make the lathe give a quick blow to the cloth on coming in contact with it, and by that means render it more stout and even.

The weaving of calicoes by power did not succeed in Lancashire so early as it did in Scotland. In 1817, the number of power-looms in Lancashire was estimated to be about two thousand, of which only about one thousand were said to be then in employment. The cause of this was, that the price paid at the time we refer to for weaving by the hand had been forced down to the very lowest degree by the depressed state of trade, and the pressure of an overgrown population bearing upon the means of employment. Wages had fallen below the rate at which the goods could be produced by machinery. This struggle for existence between the two processes terminated, however, as might have been expected. The hand-weavers, finding it impossible to go on with the reduced wages, gradually gave way. Their numbers ceased to increase; and the extraordinary addition to the amount of the manufacture since that time has been the product of the power-loom. Goods of very low and fine qualities are still woven by the hand.

In 1832 there were 80,000 power-looms in Lancashire. The weekly produce of two power-looms, managed by a girl, is from 10 to 11 pieces of cloth, four-fourths wide and twenty-five yards long, woven in 11⁰⁰ reed; and for this she is paid eightpence per piece.

The following table, from Dr Cleland's *Statistics of Glasgow*, gives the numbers, the age, and sex of the persons employed in twenty of the weaving mills belonging to Glasgow, with the maximum and minimum amount of the weekly wages earned in 1832 by the different sexes, at the different ages.

Age.	Males.	Weekly Wages.		Females.	Weekly Wages.	
		s. d.	s. d.		s. d.	s. d.
9 to 10	1	1 6		9	2 6 to	3 6
10 .. 12	31	1 9 to	4 6	66	2 6 ...	7 6
12 ... 14	38	3 0 ...	6 6	220	3 0 ...	7 6
14 ... 16	60	3 0 ..	10 0	447	4 10 ...	9 0
16 ... 18	36	6 8 ..	12 0	538	6 1½ ...	10 0½
18 ... 21	56	7 0 ...	25 0	826	7 0 ...	10 2½
21 upwards	760	16 0 ...	24 0	1235	7 0 ...	9 9½

Dr Strang, in his Report on the Social Statistics of Glasgow for 1851, gives the following statement of factories and wages:—

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Cotton Factories in Lanarkshire.[1]

Description.	No Factories.	No of Spindles	No of Power-Looms	Total Numbers employed		
				Males.	Females	M & F
Spinning	31	585,230	...	2,093	5,295	7,388
Weaving ...	37	...	12,254	1,398	6,345	7,743
Spinning & Weaving.	17	278,858	6,557	1,522	5,810	7,332
	85	864,088	18,811	5,013	17,450	22,463

The factory wages were as follows:—Power-loom weavers averaged 7s. in 1841, and 7s. 3d. in 1851; spinners 21s. in 1841, and the same in 1851. Both worked 69 hours in 1841, and only 60 in 1851. The increase of wages arises principally from increased product through improvements in machinery.

The total in Scotland are as follows:—Cotton factories 168; spindles 1,683,093; power-looms 23,564; moving power steam 71,005; water 2842; persons employed, males 8797, females 27,528, total 36,325.

There is a branch of the cotton manufacture yet to be noticed; a branch not derived from the East, like muslin, but one that has had its origin in this country,—namely, the bobbinet, or Nottingham lace manufacture, which now furnishes employment to a large amount of labour and capital.

Lace manufacture.

That the stocking-frame should have been transferred into a machine for weaving point-lace, a fabric so different in character, was not to have been expected. About the year 1768, however, a frame-work knitter of Nottingham, looking at the lace on his wife's cap, thought he could fabricate a similar article by means of his stocking-frame. He tried, and was, on the first attempt, to a certain degree successful. In 1782 some advance was made in carrying his invention farther; but the design was not finally matured till 1809, when Mr Heathcoat of Loughborough, but afterwards of Tiverton, succeeded in bringing the machine to a perfect state, and took a patent for the discovery. In 1815 steam power began to be applied to the movement of the machine, but did not come into extensive use until 1820. In 1823, on the expiry of Mr Heathcoat's patent, the manufacture increased with extraordinary rapidity. The demand for the goods became immense; and the Nottingham lace-frame was found, in the fabrication of plain nets, to rival the most finished productions of France and the Netherlands. It is proper however to observe, that without the previous possession of the mule jenny, we could not have made the acquisition of the cotton-lace manufacture. Had Mr Crompton not given us the means of obtaining very fine yarn, of the quality required for the delicate texture of lace or bobbinet, fabrics of such beauty must have rested with their conception, for want of a material of sufficient fineness.

Mr Heathcoat's frame, on its introduction, at once took the place of the whole body of pillow-lace workers. After his patent expired, and the trade was thrown open, the eagerness to partake of the great profits produced a most active competition, and new and improved machines were brought forward in rapid succession, each in its turn rendering less profitable, and by degrees displacing, the one which had preceded it.

Again, when latterly the supply of the article came to overtake the demand, and prices were greatly reduced, the frames moved by power began to press hard upon those worked by the hand; and the value of the hand-machines, which when they were first started was as high as L.1200,

[1] It may be assumed that the persons employed therein are altogether dependent on Glasgow.

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sank to L.60. There are now (1854) in the course of being introduced into the manufacture machines possessing such power of production as must supersede the older ones.

The number of lace frames in September 1831 was 4501. Of these, 3501 were hand-machines; and seven hundred of them were held by workmen, who bore the twofold character of manufacturer and weaver, and to whom every fall in the price of the goods resolved itself into a fall of wages, leading to a reduction of the wages paid in the trade generally.

These machines worked up annually 1,600,000 pounds of sea island cotton, which were spun into 1,000,000 pounds of yarn, of the value of L.500,000, and gave employment to fifty-five spinning factories at Manchester, containing 860,000 spindles. The lace trade has, however, introduced another important branch of business in doubling the fine single yarn spun upon the mule, as lace or bobbinet requires a twofold thread for its production, and lace thread has therefore become an article of great consumption, not only in the manufacture of lace, but also as a mixture with wool and silk. It is calculated that 208,000 persons receive wages for the labour performed in the different processes of this manufacture—in spinning the yarn at Manchester, weaving the goods in Nottinghamshire and Leicestershire, and in the embroidery of them, executed in different parts of the kingdom. The product is estimated at 23,400,000 yards, and the value as it comes from the frame at L.1,891,875. Of this whole production, about four-eighths are exported in an unembroidered state to the Continent; about three-eighths are sold unembroidered for home consumption; and the remaining eighth is embroidered in this country. The total value of the goods, and of the work performed upon them in this country, has been estimated at L.3,417,700.

Having now given a sketch of the progress of the cotton manufacture of this country, from its first introduction to the present time, we shall endeavour to give some idea of its progressive increase, by tabular exhibitions of the quantity of cotton wool imported into Britain at different periods; and which will indicate the increase in mills and machinery in the whole cotton trade of the United Kingdom.

From the year 1716 to 1720, the average annual importation of cotton was 2,173,287 lbs. We have not been able to obtain any account of the cotton imported from that period to the year 1771; but the increase had not been great; for the average annual importation from 1771 to 1775, which commences two years after Hargreaves' and Arkwright's discoveries, and comprehends two years of the time after which calicoes began to be made wholly of cotton, was only 4,764,589 lbs. The importation from 1776 to 1780 was 6,766,613 lbs.; from 1781 to 1785, 10,941,934 lbs. from 1786 to 1790, 25,443,270 lbs; from 1791 to 1795, 26,000,000 lbs.; and from 1796 to 1800, 37,364,077 lbs.

Cotton Manufacture.

The quantity of cotton imported from 1771 to 1775 was 4,764,589 lbs., which gives an average for each of the four years of 1,191,147 lbs. The following table will show in pounds weight the quantity imported from 1781 to 1801, without discriminating the countries whence it was obtained; but it may be understood to have been supplied, in the earlier periods, chiefly by the West Indies, the first importation of American cotton of any consequence having taken place in 1793. (See ante, p. 447, note.)

	Lbs.		Lbs.
1781..	5,198,778	1793.....	19,040,929
1783.....	9,735,663	1795	26,401,340
1785...	18,400,384	1797.....	23,354,371
1787....	23,250,268	1799	43,379,278
1789	32,576,023	1801.....	56,004,305
1791	28,706,675		

The following Table gives the quantity of Cotton of different descriptions imported into Great Britain from 1820 *to* 1853. *The quantity is stated in packages, each package containing three hundred pounds.*

Years.	American.	Brazil.	East India.	Egyptian.	West India, &c.	Packages, Total.
1820	302,395	180,086	57,923	...	31,247	571,651
1830	618,527	191,468	35,019	14,750	11,721	871,487
1840	1,237,500	85,300	216,400	38,000	22,300	1,599,500
1845	1,499,600	110,200	155,100	82,000	8,800	1,855,700
1846	932,000	84,000	49,500	59,600	9,000	1,134,100
1847	874,100	110,200	222,800	20,700	4,900	1,232,700
1848	1,375,400	100,200	227,500	29,000	7,900	1,740,000
1849	1,477,700	163,800	182,200	72,600	9,100	1,905,400
1850	1,184,200	171,800	307,900	79,700	5,700	1,749,300
1851	1,393,700	108,700	328,800	67,400	4,900	1,903,500
1852	1,789,100	144,200	221,500	189,900	12,600	2,357,300
1853	1,532,000	132,400	485,300	105,400	9,100	2,264,200

The following Table gives the extreme prices of Cotton Wool at Liverpool on the 31*st December, from* 1818 *to* 1853, *showing the progressive reduction of the raw material during that time:—*

	1818.		1822.		1826.		1828.		1830.		1832.		1834.		1836.		1838.		1840.	
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
Sea Island...	33	*a* 48	14½	*a* 24	10	*a* 20	12	*a* 20	11½	*a* 20	..	*a* 18	13½	*a* 26	14	*a* 36	14	*a* 33	10	*a* 36
Orleans	16½	21	7	11	7	9	6	9	6½	8	8	9	7¼	12½	7	14	5	10	4½	9
Upland	17	19¾	6¼	8½	6⅞	7½	5¾	7	5⅞	7⅞	7	8	7¼	11	7⅛	12	5	9½	4½	7½
Egyptian ..	.	.	..	.	7¼	8½	7	8½	8	9½	9	9½	12	16½	11	18	8¼	16½	8	14
Pernambuco	22	23½	10¼	11½	10	11	7½	8½	7½	8¾	8¾	10½	9⅝	14½	10	15½	8¼	11	8¼	10½
Maranham .	20	20½	9¼	10½	8¾	9¾	7¼	7¾	7	7⅝	7⅞	9⅝	8¾	13¼	9¾	14	7	10	7¼	10
Demerara ..	19	24	8½	11½	8	11	6¾	9	6½	9	9½	10	8	15½	9	15	8	13	7	13
West India.	17	18½	7½	8¼	6½	7½	6	7	6	7	. .	...	...	...	...	...	...	...	...	...
Surat.....	8	14½	5¼	7¼	5	6½	3½	5	4½	5⅝	4¾	5½	5	8⅜	3½	9	3¾	6½	3¼	6¼

	1842.		1844.		1846.		1847.		1848.		1849.		1850.		1851.		1852.		1853.	
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
Sea Island...	7½	*a* 24	9	*a* 30	9	*a* 30	8	*a* 30	6	*a* 25	6½	*a* 20	9	*a* 20	8	*a* 22	10	*a* 28	13	*a* 36
Orleans.....	3¼	9	2⅝	8½	3	10	4¼	10	2½	8	3½	8½	5¼	10	3½	9½	3½	8½	4¼	8½
Upland.....	3¼	7	3	6¾	3⅛	7¾	4⅛	8¼	3	6	3⅜	7½	5⅜	8¾	3⅝	8⅝	3⅝	7	4½	7¼
Egyptian...	6	10½	5½	9	5¼	11	5¾	11	4¾	8	4¾	9	6	11	5	11	5	12	5	15
Pernambuco	6⅜	8¾	4¾	8	5½	8½	6	9¼	4½	8	4⅜	7½	6½	8¼	5⅞	9	5⅝	8¼	6½	8½
Maranham...	5	7¾	4⅛	7¼	4	8	4¾	8½	3½	7	3⅞	6¾	5½	7¾	4⅛	8¾	4⅛	8	5¾	8
Demerara....	5½	10½	4½	10	...	...	4½	9	4	7	3½	7½	5	9	4½	8	4½	9	4½	8½
Surat.....	2¾	5	2¼	5	2	6	2¾	6	2¼	4½	2½	5¼	3½	6¾	2¼	6½	2½	5½	2½	5¼

Cotton Manufacture.

The following Table gives the quantity of Cotton Yarn spun, and the quantities exported and worked up at home, from the year 1818 *to* 1853.

Cotton Manufacture.

Years.	Yarn produced.	Exported.	Consumed at home.	Years.	Yarn produced.	Exported.	Consumed at home.
	Lbs.	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*
1818	98,911,800	14,743,675	84,168,125	1836	293,064,496	88,191,046	204,873,450
1819	98,566,200	18,085,410	80,480,790	1837	324,031,851	103,455,138	220,576,713
1820	108,238,500	23,032,325	85,206,175	1838	379,486,510	114,596,602	264,889,898
1821	116,126,100	21,526,369	95,599,731	1839	342,826,571	105,686,442	237,140,129
1822	130,943,700	26,595,468	104,348,232	1840	406,864,913	118,470,223	288,394,690
1823	138,731,400	27,378,986	111,352,414	1841	370,768,077	123,226,510	247,541,567
1824	148,656,600	33,605,510	115,051,090	1842	372,754,144	137,466,892	235,277,252
1825	150,147,900	32,641,604	117,506,296	1843	437,589,441	140,321,176	297,268,265
1826	135,191,700	42,179,521	93,012,179	1844	445,577,480	138,540,079	307,037,401
1827	177,480,000	43,346,632	134,133,368	1845	494,766,487	135,766,487	359,621,622
1828	196,074,000	43,242,882	152,831,118	1846	552,870,000	160,554,673	392,315,327
1829	197,280,000	60,562,189	136,717,811	1847	397,260,000	119,489,554	277,770,446
1830	222,840,000	63,678,116	159,161,884	1848	518,840,000	131,500,141	387,439,859
1831	236,430,000	61,561,154	174,868,846	1849	566,910,000	148,275,885	418,634,115
1832	246,935,124	75,667,150	171,267,974	1850	529,380,000	124,241,100	405,138,900
1833	251,757,600	70,626,161	181,131,439	1851	593,010,000	131,587,577	461,422,423
1834	270,186,876	76,478,468	193,708,408	1852	665,190,000	129,385,924	535,804,076
1835	281,435,222	83,214,198	198,221,024	1853	685,440,000	129,190,507	556,249,495

The following Table gives the Markets to which the Cotton Yarn spun from 1818 *to* 1853 *was exported:—*

Years.	Russia and Ports in the Baltic.	Germany, Belgium, and Holland.[1]	France and Ports in the Mediterranean.[2]	Africa and North & South America.	India and China.	Spain, Portugal, and Madeira.	British and Foreign West Indies.	Mauritius, Batavia, New Holland.	Totals.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1818	5,913,691	7,937,234	876,957	13,932	1,861	..	..	...	14,743,675
1819	3,779,544	13,124,637	1,157,593	22,665	971	...	...	...	18,085,410
1820	9,060,052	11,859,802	2,089,451	22,009	1,011	...	. .	. .	23,032,325
1821	4,815,114	14,819,820	1,863,340	21,674	6,421	...	...	...	21,526,369
1822	4,948,619	18,764,070	2,838,828	20,673	23,278	. .	...	...	26,595,468
1823	7,148,497	16,694,715	3,383,204	29,035	123,535	. .	...	...	27,378,986
1824	12,304,373	16,497,594	4,652,063	45,616	105,864	...	. .	...	33,605,510
1825	9,369,333	19,721,419	3,264,078	51,408	235,366	...	...	...	32,641,604
1826	12,380,188	22,160,331	6,671,463	47,732	919,807	...	...	...	42,179,521
1827	11,481,650	23,225,400	5,675,140	170,797	2,793,645	...	...	...	43,346,632
1828	14,838,515	18,169,935	5,826,280	222,872	4,185,280	...	..	...	43,242,882
1829	17,564,062	31,262,142	8,203,385	636,274	2,896,325	...	...	...	60,562,189
1830	17,855,541	29,718,184	11,485,195	327,483	4,291,713	...	...	...	63,678,116
1831	14,352,638	28,023,322	10,792,384	1,689,155	6,703,655	...	...	...	61,561,154
1832	20,276,467	40,674,870	5,787,081	1,306,771	3,409,810	93,601	11,016	110,889	71,670,495
1833	20,928,831	37,154,396	5,025,231	1,128,622	2,973,462	70,414	11,091	155,733	100,447,780
1834	17,971,001	39,234,784	12,619,805	1,164,475	4,071,796	3,089,741	5,932	6,486	77,964,017
1835	22,545,249	45,729,349	7,201,674	1,472,012	5,305,212	274,505	3,450	241,786	82,773,231
1836	19,852,028	47,313,075	7,654,537	853,548	9,006,052	340,621	17,580	80,488	85,118,929
1837	24,858,382	55,561,403	12,173,355	2,971,921	9,013,319	316,464	149,365	10,016	105,054,225
1838	19,928,127	64,605,444	15,960,898	1,496,967	10,969,816	741,162	80,831	36,665	113,817,910
1839	19,963,004	60,061,809	9,167,476	776,002	8,486,915	549,762	33,240	5,416	99,037,624
1840	19,563,024	61,876,626	11,520,018	947,017	12,806,830	438,632	54,598	199,509	107,386,254
1841	19,058,777	61,425,243	16,866,468	1,360,840	15,639,562	861,287	37,275	5,934	115,282,386
1842	24,229,404	74,004,879	19,364,670	534,303	17,706,211	618,599	9,100	990	136,468,156
1843	26,918,476	75,650,199	25,450,623	833,586	19,531,056	644,920	66,160	111,428	149,206,448
1844	27,248,334	59,192,277	20,484,850	1,108,376	20,020,175	887,605	247,905	16,857	129,206,379
1845	21,052,973	71,347,963	20,926,780	1,174,511	16,518,987	808,540	91,633	43,222	131,964,609
1846	19,195,932	82,735,136	27,719,193	919,852	24,502,908	965,764	52,689	17,262	156,108,736
1847	16,104,094	58,883,022	20,610,398	1,409,656	22,482,384	...	...	...	119,489,554
1848	16,207,198	58,791,200	32,063,348	2,549,851	21,888,544	...	...	...	131,500,141
1849	11,666,761	74,703,743	33,036,017	2,844,980	26,024,384	. .	...	. .	148,275,885
1850	6,694,493	71,828,257	23,111,116	1,676,635	20,930,601	. .	..	...	124,241,102
1851	6,881,505	62,882,777	28,687,983	1,966,759	31,668,553	...	...	...	131,587,577
1852	5,313,886	59,852,243	31,894,538	2,056,542	30,295,795	...	...	...	129,385,924
1853	5,978,007	63,186,988	28,931,959	2,681,334	28,952,219	...	..	...	129,190,507

The value of the present annual production of the cotton manufacture of Great Britain is estimated at L.54,000,000 sterling, of which nearly L.33,000,000 is the value of goods and yarn made for exportation. The capital invested in buildings and machinery may be calculated at nearly the same as the annual amount of the manufacture, and more than double what it was thirty years ago, while the quantity of goods annually produced is much more than triple; yet, from the improvement of the processes, and consequent diminution of the expense of production, with the reduction which has taken place at the same time in the price of the raw material, this more than tripled quantity of the manufactured ar-

[1] This column includes Trieste and the Austrian ports from 1832.
[2] This column includes Turkey, Egypt, and the Levant from 1832.

Cotton Manufacture.

ticle does not represent more capital than was represented by, and required for bringing to market, the lesser amount during the preceding period. In the year 1812, when Mr Crompton applied to parliament for a remuneration for his invention, he found by as accurate an investigation as he could make, that the number of mule spindles in this country was between four and five millions; and Mr Kennedy, in his memoir of Mr Crompton, has stated that the number in 1829 had increased to seven millions. In 1817, he estimated the number of persons employed in the spinning of cotton in Great Britain at 110,763, and the number of spindles in motion at 6,645,833, and the quantity of yarn produced at 99,687,500 lbs. The quantity of cotton yarn spun in 1832 was 222,000,000 lbs., of which 132,000,000 lbs. have been manufactured into cloth, giving employment to 203,373 looms; but in 1853 the yarn spun was 685,440,000 lbs.

No exact estimate of the capital invested, in the cotton trade can be given. What is offered above is a mere approximation. The following details, however, possess much interest, and may be relied upon.

In 1838, the total number of cotton factories in Great Britain and Ireland was 1815; thus apportioned:—

England and Wales	1599
Scotland	192
Ireland	24
Total	1815

The total number of hands employed in these factories was 206,061, of whom 114,129 were males, and 145,934 females, thus apportioned:—

	Males.		Females.
England and Wales	101,412	...	118,451
Scotland	10,950	...	24,626
Ireland	1,765	...	2,857
Total	114,127	...	145,934

There is no return of the number of factories at work in 1846, but the number of persons employed in them is thus given by Mr Burns in his *Statistics of the Cotton Trade*, from which the above particulars are taken:—

	Males.		Females.
England and Wales	123,320	..	153,708
Scotland	9,221	...	25,895
Ireland	1,550	...	2,633
Total	134,091	...	182,236
Total employed in the United Kingdom,			316,327

According to the census of 1851, the cotton manufacture of Great Britain employs 149,214 men, 143,268 women, 73,398 boys, and 104,437 girls—in all 470,317 persons; besides as cotton and calico printers 13,263 men, dyers 3,024 men, and youths and girls in large numbers.

Effects of the cotton manufacture on the condition of the country.

As the successive mechanical inventions which we have described came to be applied to the manufacture, they changed the principle of production, and made what till then had been nearly wholly a product of labour become almost entirely a product of capital Important results flowed from this change. It enabled Great Britain, the principal holder of these machines, to become the furnisher of a commodity which up to that time had been brought at a great expense from India. It further enabled her to reduce its cost, and render what till then had been accessible only to the rich, and of limited sale, an article of general wear. During the long struggle which took place between machinery and hand labour, this country continued to be the nearly exclusive possessor of the machines by which the reduction of cost was effected. Having in consequence, in a great measure, a monopoly of the supply, she was enabled to reap that harvest of prosperity which so unusual a combination of circumstances was calculated to produce. An improvement in the condition of every class of the community followed the advance of the manufacture. The progressive extension of the use of machinery, in place of lessening the demand for labour, as was at first dreaded, had the effect of increasing it to an extraordinary degree. There was a constantly growing want of hands to be employed in aid of the new machinery, and in the new branches of manufacture to which it gave birth. The wages of labour in consequence rose, at first moderately, but afterwards extensively; and the rise having pervaded every description of employment, not only gave the whole labouring class in this country a command of the comforts of life, but brought within their reach many little luxuries to which they were formerly unaccustomed. The condition of the higher classes of the community experienced a corresponding advance, the population rapidly increased, and an enlarged consumption of the products of the soil took place, in consequence of the improved circumstances, as well as of the augmented numbers of the people. More grain, more butcher-meat, were used; and an additional quantity of corn was required for the horses employed in the transport of commodities, in the conveyance of passengers, and in the operations of husbandry. All these causes gave a stimulus to agriculture, and produced a change on that important branch of industry, not less remarkable than that which was simultaneously taking place in manufactures.

Cotton Manufacture.

Previous to the year 1766, the industry, population, and consumption of the country had been for a considerable time stationary. We had, from the want of demand at home, been enabled during the whole of the preceding part of the century to export grain annually to a large amount. From 1766, however, we ceased to be exporters of grain. The improvement in the circumstances of the country had enlarged its power of consumption, which from that time has been so steadily progressive, and so great, that notwithstanding our having, by our improved agriculture, augmented our products threefold, we not only have never been able to bring our home supply to meet our demand, but have been obliged to import largely every year from other countries.

There can be no such satisfactory evidence of the improving condition of a people as a continued increase in their power of consumption; and the facts we have stated afford proofs of a degree of comfort diffused for a length of time over a great population, which we believe to be unexampled, while the influence of the cotton manufactures on the commercial prosperity of the country has been scarcely less striking.

To preserve this pre-eminence in manufacture against the competition of rival states, we have still to look to our economy, our capital, our machinery, and our superior skill in providing a variety of undefinable subsidiary aids to the manufacturing processes. From the European states we have little to fear; and the advantages which America possesses as a cotton-producing country is greatly neutralized by the other drawbacks to which it is subject. The Southern States of the Union, in which the cotton wool is raised, from their local defects, and the character of the lower classes, never can become a manufacturing country. To the Northern States, and to ourselves, the difference of cost of raw material cannot be great, particularly if the East Indies and South America be open for our supply. The high price of labour also renders the cost of production much dearer than in Britain, and operates as a serious bar to the extension of the cotton manufacture in the Northern States. The consequence is, that, notwithstanding the great efforts which have been made to naturalize that branch of industry in these provinces, and notwithstanding the well-known energy and intelligence of the people of North America, it has made but slow progress during the last twenty years, compared with the vast expansion which it has undergone in this country, as will be seen from the following table:—

Growth and Consumption of the United States of America.

Years.	Growth in bales	Consumption. in bales.
1829 — 1830	970,845	126,512
1830 — 1831	1,038,848	182,142
1831 — 1832	987,477	173,800
1832 — 1833	1,070,438	194,412
1833 — 1834	1,205,394	196,413
1834 — 1835	1,254,328	216,888
1835 — 1836	1,360,725	236,733
1836 — 1837	1,422,930	222,540
1837 — 1838	1,801,497	246,063
1838 — 1839	1,360,532	276,018
1839 — 1840	2,177,835	291,279
1840 — 1841	1,634,945	297,288
1841 — 1842	1,683,574	267,850
1842 — 1843	2,378,875	325,129
1843 — 1844	2,030,409	346,744
1844 — 1845	2,394,503	389,006
1845 — 1846	2,100,537	422,597
1846 — 1847	1,778,651	430,000
1847 — 1848	2,347,634	530,000
1848 — 1849	2,728,596	520,000
1849 — 1850	2,096,706	487,800
1850 — 1851	2,355,257	404,100
1851 — 1852	3,015,029	603,000
1852 — 1853	3,262,882	671,000

It is obvious, from this table, that the home consumption in the United States has always borne a most disproportioned ratio to the entire growth, and that even in the few last years, when it had attained to the highest point which it has yet reached, the quantity reserved for domestic use has only become a fifth part of the whole, and generally fell below it. It is deserving of notice, however, that in the period of time which this table comprehends, the internal consumption of the United States has been trebled; but large as this increase may seem in the eyes of a native economist, the conclusions from it will not be satisfactory if the collateral circumstances are not considered; and the chief of these is, that it is an increase upon small quantities, and indicates no more than the gradual growth of an infant trade, which the cotton manufacture was in North America in 1829.

Remarks on the exclusive system.

We believe that in this manufacture we have little to fear in the meantime from competition; but we are not equally confident that its prosperity may not be exposed to risk from our ill-judged anxiety to secure a monopoly of its advantages. Our practice of excluding from our markets the manufactures of other countries is not only contrary to sound political principle, but gives rise to a spirit of hostility unfavourable to our interests, and places us in such a state that, when other nations in retaliation exclude our manufactures from their markets, we have no right to complain.

That we may not decide this question rashly, let us examine what is the danger to which we should be exposed if we were to take the opposite system, and open our ports to the manufactures of other countries.

If we can now export annually to the value of about L.32,000,000 sterling of cotton goods, which, burdened with freight, charges, and the exporter's profit, we are able to sell in competition with foreign manufacture, can we have anything to fear from a competition with that manufacture in our home market, where the circumstances of the competing parties would be reversed? So far from the introduction of foreign manufacture into our market being an evil, we are inclined to think that it would be advantageous to our interests; and that, in the interchange of various fabrics which would be the result, the sale of our own manufactures would be increased. Commerce being altogether a matter of barter, it is necessary for every country to purchase in order that she may sell; and, fortunately, even in the same branch of manufacture, there is always room for such exchanges. There are shades of difference in the fabric of every article, upon which taste, or fashion, or caprice, never fails to fix an arbitrary value, thereby constituting them into separate commodities capable of being exchanged.

But the view we are taking of this important question does not rest altogether upon theory. Happily we have experience in support of it. No one disputes the advantage resulting from the interchange of commodities between Lancashire and Lanarkshire, or alleges that it would be for the benefit of either to have the manufacture of the other excluded from its market. Yet these two districts have their dependence upon manufactures which in their general features are the same.

It is well known regarding the commercial treaty with France, in which some approach was made to a free trade between the two countries, that while it lasted the sale warehouses of London and Manchester were resorted to by purchasers from the different towns of France, with the same freedom, and in nearly an equal proportion of numbers, as from the towns in England. And although in those warehouses French and English commodities of a similar description were to be found, and our shopkeepers were at the same time daily resorting to France to make purchases, in no period were our manufactures in a state of greater progressive prosperity than during the eight years (from 1786 to 1793) that this treaty existed.

There is no one, we believe, who has taken the trouble to investigate the matter, that will not say that both were benefited by this treaty, and probably exactly in the degree that the exclusive system in both had been departed from.

In addition to this, it may be proper to notice, that Switzerland and Saxony have always been open to the reception of cotton goods free of duty: and that in no other countries on the Continent is the cotton manufacture in a more thriving state. Might it not, therefore, be a wise measure to withdraw our restrictions against the importation of foreign manufactures, since the interference of these with our own products in the home market, supposing no interchange of the two to take place, never could counterbalance the amount of the sale we may be deprived of by following the opposite policy, and thus inducing the exclusion of our own goods from the foreign market?

Fears have been expressed that the lower wages for which the labourers of other countries that compete with us in the manufacture can work, and upon which, from the cheapness of their provisions, they can afford to live, may ultimately enable them to take the manufacture out of our hands. In reply to this, it may perhaps be sufficient to recal to our readers the small part of the cost of the commodity which now belongs to the labour of the hand, and the daily diminution which is taking place even of that part, by the introduction of new mechanical substitutes. Thus, for example, in 1767 each spindle required a person to work it; but now one man, with the aid of a few piecers to take up and join his broken ends, can work a thousand spindles. In Lancashire in 1818 there were not more than 2000 power-looms, and of these not a half in employment; while in 1832, so extensive had been the change from hand-weaving to weaving by power, the number had increased to 80,000.

According to the subjoined table, the cotton industry of Great Britain and Ireland yielded last year about fifty-four millions sterling, and which may be regarded as half the cotton industry of the whole world; but foreign countries, besides taking half of the raw cotton sent to market, receive large supplies of cotton yarns from Great Britain; and in Asia and Africa cotton is still largely spun by hand; hence the world's cotton industry may be valued at 120 millions, which would afford to every man, woman, and child on the face of the earth 2s. 9¾d. worth of cotton manufactures, or about fourteen yards per head per annum of excellent calico.

Cotton Manufacture.

Declared Value of British and Irish Cotton Manufactures and Twist and Yarn exported to the undermentioned Countries in the Year 1853.

Cotton Manufacture.

Population of Countries exported to.	Value per head of Exports to each Country.	Countries to which Exported.	Declared Value: Cotton Manufactures entered by the Yard.	Declared Value: Hosiery, Lace, and Small Wares.	Declared Value: Cotton Twist and Yarn.	Total. Declared Value
67,000,000	£0 0 0·625	Russia—Northern Ports	£34,333	£8,592	£137,324	£180,249
3,000,000	0 0 1 25	Ports within the Black Sea	9,462	102	4,186	13,750
2,864,831	0 0 4·50	Sweden	7,166	2,176	45,295	54,637
1,050,132	0 1 0 25	Norway	27,303	1,728	25,399	54,430
2 900,000	0 0 8·25	Denmark (including Iceland)	34,989	2,027	64,142	101,158
15,726,820	0 0 0·375	Prussia	537	200	26,508	27,245
20,000	0 0 0·75	Mecklenburg-Schwerin	...	...	60	60
2,003,200	0 1 5 50	Hanover	612	13	146,795	147,420
241,000	...	Oldenburg and Kniphausen	...	..	...	
384,000	7 19 7	Hanseatic Towns	785,395	202,268	2,076,717	3,064,380
2,000	...	Heligoland	.	2		2
2,444,550	0 17 11·50	Holland	473,700	81,435	1,692,043	2,247,178
3,533,538	0 1 8·25	Belgium	62,170	57,390	179,676	299,236
143,126	0 0 6·75	Channel Islands	46,565	1,253	474	48,292
36,897,152	0 0 1	France	65,552	46,574	43,584	155,710
4,530,000	0 3 0	Portugal Proper	611,195	10,858	42,310	664,363
271,416	0 3 7·75	Azores	47,609	803	1,140	49,552
90,000	0 4 0	Madeira	16,945	721	18	17,684
14,357.210	0 0 1·25	Spain—Continental, and the Balearic Islands	73,283	6,897	5,953	86,133
200,000	0 6 6	Canary Islands	61,839	3,035	401	65,275
17,024	23 14 2·75	Gibraltar	374,289	21,926	7,455	403,670
4,890,000	0 1 3	Italy, &c.—viz. Sardinian Territories	242,213	17,795	46,775	306,783
1,275,000	0 5 9·25	Duchy of Tuscany	236,676	26,695	104,742	368,113
2,500,000	0 1 3·25	Papal Territories	80,423	613	78,740	159,776
7,500,000	0 0 11·50	Naples and Sicily	148,621	13,272	199,630	361,523
7,835,000	0 0 10·46	Austrian Territories	200,304	6,052	135,113	341,469
120,000	1 3 6	Malta and Gozo	108,445	2,099	30,447	140,991
208,100	0 8 3	Ionian Islands	67,026	623	18,411	86,060
1,000,000	0 2 2	Kingdom of Greece	95,590	307	12,161	108,058
26,100,000	0 1 10·50	Turkish Dominions, exclusive of Wallachia, Moldavia, Syria, and Egypt	1,510,622	13,529	158,368	1,682,519
		Wallachia and Moldavia	77,460	538	75,332	153,330
		Syria and Palestine	242,639	651	33,430	276,720
		Egypt—Ports on the Mediterranean	318,143	7,601	27,795	353,539
100,000	...	Tunis	...	..	...	...
2,000,000	...	Algeria	...	...	...	...
15,000,000	0 0 1	Morocco, &c.	63,532	218	60	63,810
10,000,000	0 1 2·75	Western Coast of Africa	384,719	1,167	617	386,503
		British Possessions in South Africa	207,785	12,714	541	221,040
		Eastern Coast of Africa	1,580	...	...	1,580
		African Ports on the Red Sea	..	...	...	...
		Cape Verde Islands	2,737	...	...	2,737
		Ascension and St Helena	979	486	...	1,465
101,469	1 5 7·25	Mauritius	124,257	5,732	3	129,992
40,000	0 0 3	Aden	535	...	...	535
13,750,000		Persia	...	...	...	...
150,000,000	0 0 9	Continental India, with the contiguous Islands :—viz. British Territories	4,447,413	64,392	1,168,264	5,680,069
		The Birman Empire	...	...	..	..
5,000,000	0 1 9·50	Islands of the Indian Seas :—Java	412,194	5,727	30,344	448,265
2,500,000	0 2 9	Philippine Islands	333,160	8,855	2,140	344,155
360,000,000	... ·75	China	1,028,074	329	101,396	1,129,799
20.000	13 18 7·50	Hong Kong	177,921	3,624	97,089	278,634
25,000,000	...	Japanese Islands	..	...	..	.
2,695,000	0 7 8·50	British Settlements in Australia	806,715	225,588	8,218	1,040,521
600,000	0 0 0·75	South Sea Islands	18,704	176	.	18,880
2,456,046	0 6 1·25	British North America	665,635	60,161	23,456	749,252
944,800	0 8 4·25	British West India Islands and British Guiana	370,016	24,828	182	395,026
14,600	3 17 10 50	Honduras (British Settlements)	52,400	3,114	1,351	56,865
600,000	0 12 9·75	Foreign West India Islands :—Cuba	341,294	43,092	78	384,464
461,200	0 0 2 50	Porto Rico	4,773	144	...	4,917
120,839		Guadaloupe	..	...	...	...
135,000		Martinique	...	...	..	..
31,000	0 7 8 75	Curaçoa	11,316	662	...	11,978
		St Croix	..	..	...	..
8,000	36 19 3 25	St Thomas	275,046	16,379	4,283	295,708
		French Guiana	..	...	...	...
236,000	0 0 1	Dutch Guiana	1,010	21	...	1,031
860,000	0 1 9·25	Hayti	73,441	2,953	80	76,474
27,000,000	0 3 1	United States of America	3,524,629	648,601	9,671	4,182,901
8,000,000	0 1 10·50	California	82,979	6,914	670	90,563
		Mexico	473,216	47,720	11,719	532,655
		Central America	116,787	6,801	7,741	131,329
28,000	10 9 9·50	New Grenada	280,994	12,489	248	293,731
1,267,692	0 2 6	Venezuela	152,456	6,385	82	158,923
500,000	0 0 9 25	Ecuador	18,922	622	25	19,569
6,000,000	0 5 11·50	Brazil	1,727,537	60,009	820	1,788,366
860,000	0 6 1·75	Oriental Republic of the Uruguay	253,072	10,988	382	264,442
100,000	2 11 1 75	Buenos Ayres, or Argentine Republic	238,431	17,164	213	255,808
1,600,000	0 7 4 75	Chili	543,413	45,599	4,073	593,085
1,500,000	...	Bolivia	...	...	...	...
2,000,000	0 6 6·75	Peru	623,054	33,780	1,481	658,315
12,000	0 0 4	Falkland Islands	108	100	2	210
20,000	...	Greenland and Davis' Straits	...	...	...	...
850,665,745		Total.....£	£23,901,940	£1,915,309	£6,895,653	£32,712,902
27,512,687	0 15 5	Estimated consumption of Cotton Manufactures in Great Britain and Ireland				21,224,404
878,178,432	0 1 2·741	The amount of British Cotton Manufactures supplied for the whole World				53,[illegible]

Steam navigation has brought out the full benefit of our insular position. It has brought Bristol, Liverpool, Dublin, Belfast, and Glasgow, into constant and intimate relation; and the celerity and certainty belonging to the conveyance render this means of transport for our finer commodities invaluable. Suppose that a person in Glasgow receives an order for goods to be shipped by the first vessel for New York, and there is no vessel to sail immediately from the Clyde, but he knows that one of the packet ships from Liverpool will sail for New York in four days from that time; he puts his goods into the steam-boat from Glasgow to Liverpool, and they are on board of the packet for New York in three days after receipt of the order.

The railway, again, between Manchester and Liverpool, with its steam conveyances, has not only reduced the cost of carriage between these places, but has had the effect of bringing together these two immense manufacturing and trading communities, overleaping, as it were, space and time, in the rapidity of the communication. A manufacturer in Manchester can leave his house in the morning, purchase a supply of cotton at Liverpool, and have it delivered at his work in Manchester the same day.

Effects of the extensive use of machinery on the condition of the people.

The more perfect division of labour and separation of employment which takes place as the use of machinery advances, and the consequent limitation of the worker's attention to a single object, check the expansion of the faculties, and prevent that growth of intelligence in this class which under a more general employment of their powers might be expected. Another evil of a similar nature, but attended perhaps with more serious consequences, is produced by manufactures when they have arrived at this state, namely, the employment of children in factories, by which these young creatures are withdrawn from their parents and homes before they have received the elements of education, or can have acquired domestic or moral habits.

In noticing these evils, however, we must recollect that the state of manufacture which gives birth to them is not an optional one, not the production of regulation or institution, but has grown up in the progress of the arts of industry, prosecuted by an intelligent people. Although, therefore, it is our duty, in as far as we can, to correct their effects, we must lay our account with being exposed to them, so long as men are allowed to pursue their individual interest by whatever fair means they conceive likely to accomplish their object.

To remedy in as far as possible the interruption to education, schools have been established in many of the factories, in which the children are instructed gratis in reading and writing. An institution of this kind we consider it to be the interest of the proprietor of every work to provide. The expense cannot be great, and will be amply repaid in the superior description of workers it will be the means of rearing. In the meantime, something is done to supply the deficiency of this provision by Sunday Schools, which have been generally established in most of the manufacturing towns. In these, the children are not only taught to read, but are also instructed in the principles of religion, and in a knowledge of their moral duties.

In the year 1800, a course of lectures was given for the first time in Glasgow, in the Andersonian Institution, to the mechanics and working classes, with the view of affording them instruction in the science of their different employments. In the supplement to a former edition of this work, we thought it important to give an account of these lectures, in order to call public attention generally to the benefit which had been derived from them; but this account we think it unnecessary to repeat, as the "Mechanics' Institutions," which began soon after to be formed in Glasgow and in Edinburgh, Liverpool, Manchester, and Leeds, on the principles of this course, have since spread into every quarter of the kingdom. These establishments are calculated to counteract in a great degree the effects which we have noticed as arising from the minute division of employment, and confinement of attention to one object, in great manufactories.

So important does this species of instruction appear to us in the circumstances of this country, where so much depends on our being able to keep the lead which we have got in mechanical invention and discovery, that we think it worthy of consideration in a national point of view, whether, in the appointment of our parochial schoolmasters, it might not be declared indispensable that they should be qualified to teach the first principles of mechanics and chemistry.

With the stores of the raw material of machinery which we possess, might we not, with a proper training of our people, become machine-makers for all the nations who are less favourably circumstanced? The advantage of being able to occupy such ground would be incalculable.

Cotton manufacture in Ireland.

In Ireland some attempts to introduce the manufacture of cotton goods were made so early as 1770, but the manufacture continued on a very limited scale until the year 1790. After this period the progress was considerable, although far short of what took place during the same time in this country; indeed, its products have never been such as to enter into competition with those of Britain, or to become articles of general foreign sale. This probably arises from the high price of fuel, rendering the concentration of the processes by means of the power of steam, and the consequent saving in labour, in many situations impossible.

The chief seat of this manufacture in Ireland is Belfast, and the district of country situated within twenty miles of that town. But there are a good many calicoes, fustians, and cotton checks made in Dublin, Balbriggan, Bandon, and Cork. All these goods are consigned to factors in Dublin for sale; except a part of the calicoes, which the manufacturers are sometimes enabled to dispose of to printers on the spot.

Some of the spinners weave the whole of their yarn, while others do not weave any; but in either case, the weaving is carried on by capitalists, who give out the yarn to be woven, and pay the weaver wages for his work. The greater part of this business is carried on in the same district with the linen manufacture, in which the weaver is the sole manufacturer, buying the yarn for his web, and selling the cloth when he has finished it. Perhaps the difference in the manner in which these manufacturing processes are conducted, may proceed from the different way in which the yarns made use of in the two branches are produced. The yarn for the linen manufacture is spun by individuals scattered over the country. This, in the infancy of the business, and while little capital had been accumulated, may have led to the manufacturing process being carried on in a like detached manner; the weaver purchasing the yarn from his neighbour the spinner, and, after converting it into cloth, selling the web at the nearest market to the merchant. The cotton manufacture in Ireland did not grow up thus from small beginnings, but was introduced into that country at once from England, and with spinning establishments upon comparatively a large scale. It was in consequence necessary that the weaving should from the first take off the produce of those establishments; and there being no way of effecting this with certainty, but by employing the weavers upon wages to work up the yarn, the manufacture was begun, and has been prosecuted upon this plan ever since; while the linen manufacture, carried on in the same district, continues to be conducted upon the opposite system.

Large quantities of cotton yarn are sent from Britain to Ireland to be woven by the hand-weavers in that country; and several Glasgow houses have agents at Belfast for giving out their yarns, to be woven in that neighbourhood, and

Cotton Manufacture.

returned to them in cloth. The manufacture furnishes in this case employment to English capital and Irish labour.

The cotton trade of Ireland, which is centred almost wholly in Belfast and its neighbourhood, has of late years exhibited a tendency to improve. It now gives employment to nearly 5000 persons.

United States.

The government of the United States has evinced great anxiety to promote the establishment of the cotton manufacture in the northern part of the union, but without considering that manufactures are only valuable to a country in so far as by their means the people can be supplied with the article cheaper than they are able to procure it elsewhere. When a manufacturer requires the support of bounties, or of laws prohibiting the importation of similar articles, a part of the national wealth is consumed in fostering a branch of industry incapable of maintaining itself. There is no greater error in policy than this; and yet we see it every day committed by young nations, when they endeavour to force manufactures before the circumstances of the country admit of such undertakings; and by old nations, when they persist in the manufacture of articles which, from natural disadvantages, they cannot produce at so low a price as that at which they might purchase them from others.

A manufacture, to attain a permanently profitable establishment in a country, must grow up in it naturally. It must be to a certain degree indigenous, or there must exist circumstances affording special advantages and facilities for carrying it on. Manufactures may indeed be forced, in the same manner that grain may be made to grow on soils not congenial to its culture; but in both cases the application of capital will be unprofitable. Where industry is left to follow its natural course, every country will betake itself to the production of those articles which circumstances enable it most advantageously to supply; and the consumers, in consequence, will be furnished with the articles they require at the lowest possible cost. Every man's means of consumption will, to the degree in which the cost is reduced, be enlarged, and his command of the comforts and enjoyments of life be extended.

The favourite system of a country supplying everything within itself, is alike adverse to individual advantage and to the increase of national riches. A division of employment among nations, founded upon existing local or accidental circumstances, is as much in unison with the principles of sound political science, and as much calculated to promote the general benefit, as is the division of labour and of employments among individuals. It is not by manufacturing everything it consumes that a nation becomes rich, but by its people being profitably employed.

If these principles be just, it must be a misapplication of American capital and industry, to withdraw them from the cultivation of the soil and the circulation of its products,—undertakings found to be highly profitable, and of boundless extent,—and to force them into manufactures supported by monopolies and bounties.

There cannot be a doubt, that sooner or later the American legislators will be compelled to relinquish the system they are pursuing. Even were they to continue to shut their eyes to its injurious operation, they would find it impracticable, in a community composed of federated states, with different local interests, to prosecute branches of industry which require to be protected against foreign competition. A federal compact, like a mercantile copartnery of individuals, presumes a perfect equality and community of interests among all the parties concerned; and, as in the case of a mercantile company, if any attempt were made to render the interests of certain of the partners subservient to those of the others, the concern would be immediately broken up, we may presume that, under like circumstances, the result will be similar with the federal compact of the United States. It would not be in the ordinary course of human affairs were the people of the southern states to continue to purchase articles required for their consumption at an advanced price, merely for the purpose of enabling the people of the northern states to manufacture them. Free trade then, we conceive, must accompany federated communities, wherever they are established; and we hail with satisfaction the prospect now opening of the attainment of this object in the western world, in every quarter of which the people appear to be resolving themselves into federal governments. The benefits of unrestricted intercourse between man and man, and between nation and nation, likely to be exhibited by these countries on so extended a scale, will open men's eyes everywhere to its advantages; and the period, we think, is not distant, when we shall look back with astonishment upon the wars we have carried on, the blood and treasure we have wasted, and the heavy burdens with which we have saddled ourselves, to acquire or retain colonial or commercial monopolies.

Cotton Manufacture.

In the account we are to give of the rise of the American cotton manufacture, we shall chiefly refer to the public documents, in which its growth is studiously detailed, and the difficulties it has had to struggle with anxiously dwelt upon.

Before the year 1791, America possessed no manufacture except for domestic production and family use. But in that year a cotton mill was erected in the state of Rhode Island, as appears from a report of the secretary to the American treasury, drawn up in 1810.

This report further informs us, that another mill was erected in the same state in 1795, and two more in the state of Massachusetts in 1803 and 1804; that during the three succeeding years ten more were erected in Rhode Island, and one in Connecticut, making together fifteen mills, working about 8000 spindles, and producing about 300,000 pounds of yarn a-year; that by a return which was made at the date of the report, eighty-seven additional mills had been erected in the end of the year 1809, sixty-two of which (forty-eight water and fourteen house mills) were then in operation, and worked 31,000 spindles; and that the other twenty-five mills were expected to be in operation in the course of the year 1810, and, together with the former ones (all of which are increasing their machinery), would, by the estimate received, work more than 80,000 spindles at the commencement of the year 1811.

The capital required to carry on the manufacture on the best terms is estimated at the rate of a hundred dollars per spindle; but it is believed that not more than at the rate of sixty dollars is generally employed. Each spindle produces annually about thirty-six pounds of yarn from forty-five pounds of cotton, and the value of the yarn may be averaged as worth one dollar twelve and a-half cents per pound. Eight hundred spindles employ forty persons, viz. five men and thirty-five women and children.

We learn the farther progress of this manufacture from a report of the house of representatives, presented in the spring session of 1816. The report states—

"That the quantity of cotton manufactured in the year 1815 was 90,000 bales, a quantity nearly equal to that used in the cotton manufacture of France:—That the quantity used in 1810 was 10,000 bales; in 1805, 1000 bales; and in 1800, 500 bales." This statement the committee say they have no reason to doubt, nor have they any to question the truth of the following succinct statement of the capital which is employed, of the labour which it commands, and of the products of that labour.

Capital employed	40,000,000 dollars.
Males employed from the age of seventeen and upwards	10,000
Women and female children	66,000
Boys under seventeen years of age	24,000
Cotton manufactured, 90,000 bales	27,000,000 lbs.
Cotton cloth of various kinds manufactured	81,000,000 yards.
Cost	24,000,000 dollars.

Cotton Manufacture.

The report proceeds to say, "that the manufacturers of cotton, in making application to the national government for encouragement, have been induced to do so for many reasons. They know that their establishments are new, and in their infancy; and that they have to encounter competition with foreign establishments that have arrived at maturity, which are supported by a large capital, and have from the government every protection that can be required."

At the date of this report the duty upon cotton goods imported into the United States was 15 per cent.; but before charging it, 10 per cent. was added to the invoice, and the duty thus raised to 16½ per cent. Upon the recommendation of the committee, 10 per cent. more was imposed; and the whole being charged upon L.110 for every L.100 of net value, brought it up to 27½ per cent.

Besides this, all cotton goods below 13½d. per yard, were ordered to be rated at 13½d., and the difference added to the amount of the invoice before calculating the duty.

New tariff acts were successively passed in 1824, 1828, 1832, and 1854, in each of which the duty upon cotton goods imported was declared to be 25 per cent. *ad valorem*, rating the coarser fabrics in the same manner as in 1816.

The manufacture, under this protection against foreign competition, rapidly increased. Power-loom works were erected; the most approved processes both in spinning and weaving were adopted; and the business was generally successful. The manufacture, however, is still almost wholly confined to the states of New York, Rhode Island, and to the New England states. In the former of these it is very extensive; and in the neighbourhood of the city of New York nine new mills have been erected in the course of the last twelve months. Within the same period, 500,000 spindles are supposed to have been added to the cotton manufacture of the States. In both the spinning and weaving departments, the processes are conducted on the most approved principles, and there seems only to be wanting that skill and sleight of hand in the execution of the operations, which are indispensable to securing either excellence of quality in the article, or largeness of quantity in the product. These are not to be obtained until the manufacturer acquires such a command of labourers as will enable him to enforce the early and attentive training of the workers.

The following returns, based partly on the official census, show the number of mills and spindles in each of the New England states using cotton wholly, leaving out all of those engaged in the manufacture of warps for satinets, merino shirts, mousseline-de-laines, and shawls of mixed materials, of which it forms a component part:—

Mills, Spindles, and Looms in New England.

	Mills.	Looms.	Spindles. 1850.	Spindles. 1840.
Maine	15	3,439	113,900	29,736
New Hampshire	40	12,462	440,401	195,173
Massachusetts	165	32,655	1,288,091	665,095
Vermont	12	345	31,736	7,254
Rhode Island	166	28,233	624,138	518,817
Connecticut	109	6,506	252,812	181,319
Total	507	82,640	2,754,078	1,597,394

If the protecting duties can be maintained, the prosperity of the American cotton manufacture will continue until its product exceeds the demand for the home consumption. If the surplus cannot then be disposed of in foreign markets, the manufacturers must experience similar distress to that of the cotton manufacturers of France from the year 1827 to 1832. The circumstances, however, giving rise to this state of things in the two countries are different. In America they are of a temporary character, and will quickly pass away. Possessed of the natural advantages for a successful prosecution of this description of employment, the northern states of the union only require population to become the seat of extensive manufactures. They have coal and iron, the want of the first of which in France, and the consequent high price of their iron, must prove an obstacle to the successful prosecution in that country of every branch of industry in which machinery is largely used.

Cotton Manufacture.

Much has been spoken and written by alarmists of the danger to which the cotton-manufacturing interests of this country are exposed from the competition of America and the continental states of Europe. These fears we believe to be in the meantime utterly without any real foundation. So overwhelming is the superiority of this country in machinery and manufacturing skill, and so completely does Britain command the market, that in 1850 the cotton exports of America, the most formidable of these rivals, only amounted to about L.1,000,000 sterling, of which it is believed that more than a half must stand for the value of raw material exported.

The sole superiority which America at this moment possesses over England is the greater facility and cheapness with which she can provide herself with the raw material, and even this advantage is almost counterbalanced by the higher rate of wages for which alone Americans can be found to work. Still less than America can the central states of Europe withstand the competition of British capitalists. They are obliged to obtain their supplies of the cotton-wool from some of the great seaports of northern and southern Europe, such as Hamburg, Genoa, or Marseilles; and even with the present improved means of communication, a bale of cotton can be conveyed more cheaply from South Carolina to England than from any of the seaports in question to Switzerland, Saxony, or central Europe. Another great disadvantage under which these inland states labour, is the want of coal, which necessitates the employment of water as a moving power. As every available stream in these countries is said to be now occupied, their manufactures may be considered as having already attained their acme. In France alone is the cotton manufacture progressing in a satisfactory or healthy way. It was found that in the interval which elapsed from 1812 to 1826, the French cotton manufactures had advanced at a ratio of 310 per cent.; while during the same period those of our own country had only increased 270 per cent. This, however, was easily to be accounted for. Previous to the first of these dates, it had been almost impossible for French capitalists to introduce the raw material into their country. When peace was proclaimed, however, and government fostered French at the expense of foreign manufactures, it was natural that factories should multiply so as nearly to supply the immediate demand. After the supply, however, came nearly to equal the demand, the extent of the manufactures began considerably to diminish. The ratio of progress is still very satisfactory, though now quite inferior to what it was in the years already mentioned, as also to the present ratio of British progress. The only department of this branch of industry in which we are outstripped by the continental states is that of dyeing; but even in the orienta. markets, where brilliancy of colour is especially looked for, the sober-coloured cotton goods of Britain are, from their cheapness, gradually supplanting the brighter colours of other states.

These and other considerations lead us to think that England, differing in this from the central states of Europe, has not yet by any means reached the full development of the resources laid open to her by her cotton manufactures. Great as her progress within the last twenty years has been, it is in reality greater than appears from the foregoing statements; inasmuch as her capitalists are now to a greater extent than before directing their efforts to the production of a finer and more valuable class of goods, leaving the trade in inferior wares to her competition.

Cotton ‖ Cotys.

The subjoined Table contains Comparative Estimate of the quantities of Raw Cotton consumed in the chief Manufacturing Countries during 1836 *to* 1853 *inclusive (in millions of pounds weight).*

Cotytto ‖ Coulomb.

Countries.	1836	1837	1838	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	Spindles required in 1850 to produce the quantities into 40's Mule Yarn.
Great Britain, ...	350	369	435	362	473	422	462	531	543	597	604	425	591	627	584	648	745	734	17,975,384
Russia, Germany, Holland, and Belgium	57	58	61	48	72	65	78	82	86	96	97	105	112	160	133	118	172	185	4,092,308
France	118	121	133	110	157	154	163	152	146	158	159	126	127	186	142	149	199	194	4,369,230
Spain	...	..	..	.	.	.	.			...	.			.	29	34	44	42	892,308
Countries bordering on the Adriatic	28	32	26	26	28	29	38	44	26	38	39	31	29	47	45	45	55	45	338,461
United States of N. America.	86	82	92	103	111	115	105	131	143	158	175	175	209	205	188	158	237	265	1,384,615
Sundries, Mediterranean, &c.	...	.	...		.	.	.	.	.		...	.	.	...	..	23	29	38	5,784,615
Total	639	662	747	649	841	785	846	940	944	1047	1074	862	1068	1225	1132	1175	1481	1503	34,836,921 Total Spindles.

(D. B—N.) (T. B—Y.)

COTTON, Charles, a celebrated writer of burlesque verses in the reigns of Charles II. and James II. His most noted piece is a travesty of the first and fourth books of the Æneid, entitled *Scarronides*, which is generally regarded as excelling Scarron's famous production. He also executed a burlesque translation of several of Lucian's dialogues under the title of *The Scoffer Scoff'd*, and wrote a more serious poem entitled *The Wonders of the Peak*. The exact period of Cotton's birth and death is nowhere recorded, but it is probable that he died about the time of the Revolution. He seems to have been in opulent circumstances, although on account of inserting a humorous description of his grandmother's ruff in the travesty of Virgil, he lost an estate worth L.400 a-year which the old lady had previously designed to bequeath to him.

Cotton, *Sir Robert Bruce*, an eminent English antiquary, descended from an ancient family, and born at Denton, Huntingdonshire, in 1570. His antiquarian tastes were early displayed in the collection of ancient records, charters, and other manuscripts, which had been dispersed from the monastic libraries in the reign of Henry VIII. With regard to these, Camden, Selden, Speed, and others, have confessed their obligations to him. He held a distinguished place in the society of antiquaries during the reign of Elizabeth; and at the first creation of baronets he was appointed to that honour by James I. To both of these sovereigns he rendered essential service by the zeal with which at their suggestion he investigated difficult questions of constitutional law and state policy; and his opinions recorded for their guidance are still preserved among the MSS. of the Cottonian Library. During the reign of Charles I., Sir Robert espoused the cause of the people; and having been represented as the author of a tract in favour of Tyranny, which was written by Sir Robert Dudley in 1615, and had escaped from his library, he was thrown into the Tower, and his collection was arrested. After his release he was still denied access to his library—a circumstance which affected him so much that he died soon after, May 6, 1631. His library, which received numerous additions from his son and grandson, after having been partly destroyed by fire in 1731, was transferred to the British Museum in 1757. A catalogue of its contents was published by Dr Thomas Smith in 1696, and another has since been made and published by Joseph Planta, Esq.

COTULA, or Cotyla, a liquid measure in use among the Greeks and Romans. Fannius says the cotyla was the same as the *hemina*, which was half a sextary: it contained nearly half a pint English.

> At cotylas, quas, si placeat, dixisse licebit
> Heminas recepit geminas sextarius unus.

Chorier remarks, that the cotyla was used as a dry measure as well as a liquid one; and this is confirmed by the authority of Thucydides, who in one place mentions two cotylæ of wine, and in another two cotylæ of bread.

COTYLEDON. See Botany, vol. v., p. 141.

COTYS, a name common to several kings of Thrace, of Cappadocia, and of the Cimmerian Bosphorus. The most ancient of these was Cotys, king of Thrace, who about the year B.C. 600 permitted Alyattes, king of Lydia, to transport to that country a colony of Mysians. The kings of this family regarded themselves as descendants of Eumolpus; and hence always preserved an intimate connection with the Athenians. Several of them enjoyed the title of citizens of that state. Cotys I. who was the son of Pentheus, became king of a portion of Thrace about B.C. 380, and was assassinated in 356. Of Cotys II. little or nothing is known. Cotys III. was the son of Sadales, and reigned over the Odryses about B.C. 57. Two other princes bore the same name, and also a king of Lesser Armenia, who was son of Cotys V

COTYTTO, or Cotys, the goddess of lewdness. Her worship was originally introduced into Greece from Thrace, and was celebrated at Athens, at Corinth, and in various other cities. Her festivals, called *Cotyttia*, are said by Strabo to have resembled those of the Cabiri and the Phrygian Cybele. They took place at night, and were notorious for the licentiousness and gross debauchery that prevailed on the occasion. Those who celebrated the Cotyttia were called *Baptæ*, in allusion to the purifications originally connected with the solemnity;—a term that has usually, but erroneously, been supposed to denote the priests of Cotytto.

Cotyttia were also celebrated in Sicily, where the votaries of the goddess carried about boughs hung with cakes and fruit, which it was lawful for any one to pluck off.

COUCH, in *Painting*, denotes a lay or impression of colour, in oil or water, with which the canvass, wall, wainscot, or other matter to be painted is covered. It also denotes any lay or impression used to make a thing firm and consistent, or to screen it from the weather. In gilding leather a couch of water and the albumen of eggs is laid on the leather previous to the application of the gold or silver leaf. Gold-wire drawers apply the term to the gold or silver leaf with which they cover the mass to be gilded or silvered before they draw it through the iron which gives it its proper thickness. Among gilders it denotes the quantity of gold or silver leaf applied on the metals in gilding or silvering.

Couch, in *Surgery*. See Cataract.

COUCHANT, in *Heraldry*, a term applied to a lion or other beast when lying down, but with the head raised, which distinguishes the posture of *couchant* from that of *dormant*, or sleeping.

COUCHE. See Heraldry.

COULAN. See Quilon.

COULOMB, Charles Augustin, a profound and ingenious theoretical mechanic and natural philosopher, descended from a distinguished family of Montpellier, was born at Angoulême, on the 14th of June 1736. At an early period of his life he felt a strong preference for mathematical studies, and would gladly have devoted his whole attention to the pursuit of science; but he found it more convenient to enter the military profession as an engineer. This department, however, afforded him ample scope for

Coulomb. the exercise of his powers of observation and calculation; and after having been ordered on service to America, and remaining abroad nine years, with some injury to his health, he presented to the Academy of Sciences, in 1773, a memoir on cohesion, and on the resistance of various works of masonry, which, for the accuracy and originality of the views it exhibits, for the clearness and neatness of the demonstrations, and for the practical utility of the results, is fully equal to any of his later productions, and shows a mind still in the vigour of youth, and yet matured by the approach of middle age. The academy paid him the compliment of making him one of its correspondents; and in 1779 he had the satisfaction of sharing, with the laborious Van Swinden, the prize proposed for improvements in the construction of compasses. He resided for some time at Rochefort, where he had abundant opportunity of prosecuting, in the naval arsenal, his experimental researches on friction, which obtained him in 1781 the double prize for the theory of the effects of simple machines. In the same year he had the good fortune to be stationed permanently at Paris, and becoming a member of the academy, he devoted himself entirely to the investigation of the laws of electricity and magnetism, and of the force of frictions and resistances of various kinds. He is generally supposed to have been the first who proved, by direct experiments, the law of the decrease of electrical and magnetic forces in the proportion of the squares of the distances; but it must not be forgotten that the late Lord Stanhope had published an experiment five years before the date of M. Coulomb's researches, which sufficiently established this law with respect to electricity; although the extension of the same law to the operation of magnetism appears to belong exclusively to M. Coulomb. He continued to occupy himself in these researches till the time of the revolution, when he was expelled from Paris by the decree which banished all the nobility; having before given up the appointment of intendant-general of fountains, and having otherwise very materially suffered in his property. He retired with his friend Borda to a small estate which he possessed at Blois; and during his residence there, made some observations on vegetable physiology, which he afterwards presented to the Institute.

He was recalled to Paris in order to take part in the new determination of weights and measures, which had been decreed by the revolutionary government. He returned, soon afterwards, into the country, wishing to devote himself to the care of his family, and of the remains of his little fortune. But upon the establishment of the National Institute, he again became an inhabitant of the metropolis. He had, however, occasion to undertake a tour of considerable extent, in discharging the duty of an inspector of public instruction; and he was remarked, in his examinations of the young students, for the singular good nature and paternal tenderness of his manners. He still continued his application to his favourite pursuits, and in particular to the investigation of the magnitude of forces of various kinds, by means of the principles of torsion. And his last study was an inquiry respecting the universal diffusion of the magnetic power through nature, which he at first supposed to be almost unlimited; although he afterwards found reason to conclude, that its general cause was the presence of a minute quantity of iron. A short summary of his numerous and elaborate memoirs will best illustrate the extent and accuracy of his researches.

1. *Statical Problems relating to Architecture. Mém. Sav. Etr.* vii. 1773, p. 343. The fluxional modes of ascertaining maxima and minima are applied, in this admirable memoir, to the determination of the strength of blocks of stone, and of pillars of masonry, and to that of the resistance of semifluids, and the thrust of earth. The author's manner of considering the subject was at that time new; it has been still further extended by some subsequent researches in this country (Hutton's *Mathematical Dictionary*, article *Pressure*); and many of the calculations contained in the articles Bridge and Carpentry of this work are principally founded on the same basis. M. Coulomb very properly objects to Musschenbroeck's mode of representing columns as exerting their passive strength like bars resisting flexure; and it is surprising that M. Lagrange did not profit by his remarks, in abridging his laborious investigations of their elastic force. M. Coulomb appreciates the friction of soft materials by the angle at which they will stand unsupported; an angle which has been termed in this country the angle of repose, by an author who perhaps imagined there was more novelty in the idea, than he would have done if this memoir had been fresh in his mind. For the thickness of the walls of an embankment, one seventh of the height is recommended as a good proportion in common cases, with an increase of one sixth towards the bottom; but the calculation is left in some measure incomplete, although it may be sufficiently accurate for the cases which most commonly occur in practice. In the last place, the proper direction of the joints of flat arches is determined; and the point of easiest fracture of arches in general is investigated, by an approximative method, applied successively to each joint. Coulomb.

2. *On the improvement of the construction of the Compass Mém. Sav. Etr.* ix. p. 165. This memoir contains a laborious and accurate investigation, both of the operation of the force of magnetism, and of the resistances exhibited to the motion of a needle by friction or by other causes. The author lays down, as a fundamental principle, the equality of the accelerative force acting on a given needle, in all positions, when referred to the direction of the meridian; so that the properties of its vibrations become precisely similar to those of a pendulum actuated by the force of gravity. From the existence of an attractive and a repulsive force at the same time in each particle of the body, with respect to the opposite magnetical poles of the earth, he concludes the total impossibility of explaining the effects by means of any ethereal currents or vortices, which had been admitted by some of the best mathematicians of the century, then still surviving. He examines the comparative force of needles of different dimensions, and proves the extreme delicacy of the suspension afforded by a long fibre, whether of hair or silk; and he describes a compass in which the reading is performed by means of a microscope fixed to a graduated arm, serving as a vernier. In order to find the true direction of the magnetic action of a needle, he turns it upside down, and takes the mean of the observations. He ascertains the magnitude of the friction of steel on glass by measuring the angle of repose; and he finds that it is equal to $\frac{2}{11}$ths of the pressure. He then proceeds to calculate the friction of a pivot, supposing it to be compressed most at the centre; but concludes, from a hasty experiment, that the magnitude of the surface is not much changed by a change of pressure. He infers, however, that a light needle has an advantage over a heavy one. A perforation in the middle of a needle appears to interfere but little with its magnetic force. He proposes to ascertain the position of the dipping needle, by measuring the frequency of the horizontal vibrations, and the force required to keep it level; and he concludes his memoir with an account of the diurnal variations of the needle, and a conjecture respecting the operation of the sun and his atmosphere, which he compares to a large aurora borealis; referring the secular change of the variation to the slow motion of the sun's apogee.

3. *Recherches sur les moyens d'exécuter sans l'eau toutes sortes de Travaux Hydrauliques.* 8. Par. 1779. Rozier xiv.

Coulomb. Par. 393. *Addition.* Rozier xvii. Par. 301. Ed. 2. 8. Par. 1797. The academy of Rouen had proposed a prize for an essay on the best mode of lowering a rock in the Seine, at Quillebeuf, which was about a foot below water-mark. This essay was originally written for the prize, but it was published without waiting for the competition, at the request of some engineers, who wished to have it made known without loss of time. The method recommended consists in employing a floating air-chest in the manner of a diving bell, forcing out the water from its lower part by means of bellows, after shutting up the workmen in the upper part. In the additional paper, printed in the *Journal de Physique*, a stronger pneumatic apparatus is described, somewhat resembling the air vessel of a fire engine, which discharges its air into the chest, and is then filled again by letting out the water; it is also proposed to employ mercury, in a similar manner, in the construction of an air-pump. The proposed apparatus does not appear to have been tried; but there can be no doubt that it might often be of advantage, when the inequalities of the rock, or any other causes, prevented the construction of a cofferdam.

4. *Theory of Simple Machines, comprehending the effects of friction and of the stiffness of ropes. Mém. Sav. Etr.* x. p. 161. This essay gained the double prize proposed by the academy for 1781; the difficulty of performing experiments on a large scale having probably prevented the presentation of any memoir sufficiently comprehensive the preceding year, when the subject was first proposed. The author's principal merit consists in the determination of the different magnitude of the initial adhesion, according to the time that the substances had continued in contact with each other, and had been pressed together, and of the effect of the magnitude of the surface of contact of particular substances, as well as of the causes of the occasional difference of friction, with different velocities, especially when the unctuous substances employed are rendered too soft by the heat which is produced by the motion. He compared the effect of the mutual contact of a great variety of substances; and, for the purpose of launching ships, he recommends the use of oak, sliding on elm, previously well rubbed with hard tallow; but in some other cases he found tallow, if not frequently renewed, rather injurious than serviceable. He observed, that the rigidity of ropes increased more rapidly than their diameter, but somewhat less rapidly than their strength; and that in order to overcome this rigidity, besides a constant force, an additional force was required, proportional to the weight employed. With every allowance for resistance of all kinds, he calculates, that a well-constructed machine, for instance a simple capstan, raising a large weight, will produce an effect equivalent to nine tenths of the force employed. But, in many of the simple machines in common use, for instance in ships' blocks of the ordinary construction, it appears, from the reports of other authors, that the loss frequently amounts to more than half of the power.

5. *Observations on the force of Windmills, and on the form of their sails. Mém. Ac. Par.* 1781, p. 65. The inclination of the sails found to succeed best in practice varied from sixty to eighty degrees in their different parts. The force was estimated by the weight of the stampers raised in the process of extracting rape oil, and it appeared that only about one seventh of the power of the wind was lost. On an average, the wind was observed to blow eight hours a day, with the velocity of fifteen English miles an hour; and the work of the mill was generally so arranged that the velocity of the sails was in a certain proportion to that of the wind, experience having shown that the effect thus obtained was the greatest possible. M. Coulomb attempted to become a tenant of one of the mills for a few months, in order to make experiments on it with the greater convenience; but the proprietors suspected that he wished to discover some of their secrets, and refused to comply with his proposal. Coulomb.

6. *Theoretical and experimental researches on the force of Torsion. Mém. Ac. Par.* 1784, p. 229. The force of torsion is here very accurately and elegantly determined for substances of different diameters: and it may be inferred from M. Coulomb's experiments, that the resistance of a steel wire, to a force tending to twist it, is always equal to that of a fixed axis, supposed to be $\frac{15}{100}$ as great in diameter, having the same wire coiled round it, or rather simply attached to a point of its circumference. For brass wire the proportion must be $\frac{9}{100}$; and, according to Mr Cavendish's experiments, it must be $\frac{1}{10}$ for copper. The reaction of brass, notwithstanding its greater flexibility, is more perfect and durable than that of steel, and it is therefore preferred for the construction of balances for the measurement of minute forces by the effect of torsion, several varieties of which are here described. And as an instance of their utility, the author has ascertained, that the resistance of liquids depends almost entirely on two forces, the one varying as the velocity, the other as its square, the constant portion of the resistance being scarcely perceptible in any case. He proves, that tempering a bar or wire of any metal has no effect in the immediate force of its resistance at a given flexure, although it very materially modifies the extent of its action. Continued twisting of a soft wire seems to produce a very equable degree of hardness, which enables it to retain nine times as much magnetic power as in its original state; and on account of this increase of hardness only, a soft wire appears to exhibit a greater extent of elastic recoil when it is twisted round several times, than when only once or twice.

7. *Description of a Compass. Mém. Ac. Par.* 1785, p. 560. The needle is suspended by a number of single threads of silk, made to adhere by dipping them in hot water, or by means of a little gum, each thread being capable of bearing a weight of about fifty grains. The needle is to be so suspended that the thread may have no tendency to cause it to deviate from the magnetic meridian; and this is to be ascertained by substituting a copper wire in its place. Cassini was in the habit of employing a compass of this construction, for making accurate observations on the diurnal variation.

8. *Three Memoirs on Electricity and Magnetism. Mém. Ac. Par.* 1785, p. 569, 578, 612. The first memoir is devoted to the description of an electrical balance, founded on the force of torsion, and to the demonstration of the law according to which small bodies similarly electrified repel each other with a force decreasing as the squares of the distances increase. One of the instruments employed was so delicate that each degree of the circle of torsion expressed a force of only one-hundred-thousandth of an English grain; another, suspended by a single fibre of silk four inches long, made a complete revolution with a force of one-seventy-thousandth of a grain, and turned to the extent of a right angle when a stick of sealing wax which had been rubbed was presented to it at the distance of a yard. The second memoir relates to the laws of electric attraction, and of the magnetic forces, which are all found to vary in the same proportion as the electric repulsion. The direct experiments on the attraction of balls contrarily electrified presented some difficulties, and the vibration of a small needle, at different distances from an electrified body, was employed for a collateral experiment. The poles in which the magnetic forces appear to be concentrated are at some little distance from the respective ends of a magnetic bar, and not exactly at the extremities. In the third memoir, M. Coulomb investigates the laws of

Coulomb. the gradual loss of the electricity of an insulated body, which seems to be always proportional to the intensity of the charge, and independent both of the form and of the conducting power, except in the case of sharp points or edges; it appears also to vary nearly as the cube of the quantity of water contained in the air, though probably somewhat diminished by an increase of temperature. It is however remarkable, that changes of moisture, indicated by the hygrometer, are not discoverable in the conducting power for a considerable time afterwards. The quantity of electrity carried off by the air being ascertained, that which is lost by the imperfection of the insulating support remained to be determined; and it was found that a certain length of a fibre of silk, varying as the square of the intensity, produced complete insulation with respect to all weaker charges.

9. *Fourth Memoir on Electricity. Mém. Ac. Par.* 1786, p. 67. It is here shown that the capacity for receiving electricity is totally independent of any chemical attraction of the body for the supposed fluid; since balls of copper and of pith, or plates of iron and of paper, when brought into contact with each other, divide the electricity in equal proportions. It is also experimentally proved, by boring cylindrical holes in a large piece of wood, and touching the bottom of the holes with a small circle of gilt paper, that the interior parts of an electrified body remain in a state of indifference.

10. *Fifth Memoir on Electricity. Mém. Ac. Par.* 1787, p. 421. When a large globe touches a smaller, the smaller receives a charge, which is stronger than that of the larger, but never twice as strong. It is proved by measuring the intensity of the electricity of a varnished wire or cylinder, that bodies are not surrounded by an electric atmosphere, but receive the charge within their substance; for the varnish, which is impermeable to the fluid, does not sensibly affect the capacity of the cylinder.

11. *Sixth Memoir on Electricity. Mém. Ac. Par.* 1788, p. 617. This interesting investigation relates to the distribution of electricity between a number of equal globes; in the different parts of a long cylinder; between a large globe and a number of small ones; and between a globe and a cylinder. In showing the agreement of the theory with experiments, M. Coulomb's industry and ingenuity are very successfully exerted in order to overcome the difficulties of the approximative calculation, although it might perhaps have been not much more laborious, and yet far more satisfactory, to have proceeded to a more correct and conclusive analysis. In a series of twenty-four globes, the charge of the first was to that of the second as three to two, and to that of the twelfth as seven to four; in a cylinder fifteen diameters long, the intensity at the end was to the intensity at the middle as twenty-three to ten. Of twenty-four small globes in contact with a larger, the last exhibited an intensity about four times as great as the first. The experiments on globes and cylinders combined are still more interesting, as affording an immediate application to the effects of conductors in carrying off electricity. At the remote end of a long cylinder equal in diameter to one twelfth of that of the globe, the intensity was nearly twenty times as great as that of the globe; and it increased almost in the same proportion as the diameter of the cylinder or wire was diminished; but a short wire received a much weaker charge. From the formulæ founded on these experiments, M. Coulomb calculates that a cloud, a thousand feet in diameter, will cause a wire a line in diameter, raised by a kite, to receive an electricity at the lower end more than sixty thousand times as great as its own. He also observes, that a point projecting but little from a large surface discharges electricity but slowly; a plane touching a globe received an electricity equally intense with that of the globe, on both its surfaces. M. Coulomb considers the hypothesis of the existence of two electric fluids as less objectionable than the theory of Franklin, Æpinus, and Cavendish, though he does not attempt to give any direct proof that he can decide the question; but he finds it difficult to believe that matter can repel matter, and attract the electric fluid, with forces precisely equal, at the same time that matter is known to attract matter with a force of gravitation varying according to the same law, but incomparably less active. It does not, however, appear that this difficulty is by any means a very important one, since we may avoid it altogether, by supposing that matter only repels matter, and that it attracts the electric fluid, with which matter is commonly saturated, with a force somewhat greater, so that the difference of these forces constitutes gravitation; which thus, like the recently-discovered chemical attractions depending on electricity, may be reduced to a modification of the power of this wonderfully universal agent; an agent which appears almost to combine the subtilty of spirit with the energetic qualities of matter. It must, however, be remembered, that we have no evidence of the separate existence of electricity independently of matter; it does not pass, like light and heat, through the vacuum of the barometer; nor, in all probability, through the empty spaces interposed between the different parts of the solar system; although the accelerative force depending on it is not confined by these or by any other limits; and it will probably long remain a question, whether electricity may not rather be a modification of matter or motion in the bodies concerned, than a semi-material substance pervading them; especially among those who even doubt of the materiality of light and heat as separate substances. Coulomb.

12. *Seventh Memoir, relating to Magnetism. Mém. Ac. Par.* 1789, p. 455. In order to check the irregular oscillations of needles very delicately suspended, M. Coulomb finds it convenient to attach to them a horizontal plate, immersed in a vessel of water. The directive power of a needle of given thickness appears to be nearly proportional to its length, the quantity of magnetism accumulated near the ends being constant, except that it extends to the distance of about twenty-five diameters; and if the needle is too short to allow space for this accumulation, the directive power decreases as the square of the length. The directive forces of similar needles, composed of pieces of the same twisted wire, are nearly as their weights. M. Coulomb observes the difficulty of accounting for the well-known fact, that neither half of a needle, when it has been divided, appears to be attracted either northwards or southwards; and he thinks, that whether we admit the existence of one magnetic fluid or of two, it will still be necessary to consider every magnet as made up of minute parts, each possessing a north and a south pole, of intensities varying according to their situation; and he remarks, that the high charges of electricity, supported by very thin plates, afford an analogy favourable to the existence of this kind of partial charge of magnetism. He might also have added, after the happy combinations of Volta, that the electro-chemical battery exhibits an arrangement almost identical with that which he attributes to a magnet. With respect to the forms of needles, the rhomboid appeared to have some advantage over the rectangle; the temper required to be neither very hard nor very soft, and it was found best to anneal the needles to a dark red, or to employ plates of a spring temper when they required to be larger. A number of needles combined into a mass lost more than half their strength, so that it is of advantage to attach several parallel needles, at a distance from each other, to the card of a compass. M. Cou-

Coulomb. lomb's mode of communicating magnetism is to lay the ends of the bar on those of two strong magnets, placed opposite to each other, and to draw two other magnets repeatedly along it, in an inclined position, from the middle to the respective ends, in opposite directions, at the same time. His large battery consisted of a number of plates surrounding two pairs of pieces of soft iron, which formed the ends of each compound magnet, while the middle was left hollow; the whole weighed thirty or forty pounds, and would lift eighty or a hundred, and it communicated to common needles as much magnetism as they were capable of retaining when their ends were merely placed on it without any further operation.

13. *Examination of the Friction of Pivots. Mém. Ac. Par.* 1790, p. 448. M. Coulomb tacitly acknowledges, in this paper, a slight inaccuracy in his former experiments on the friction of pivots, the result of which seemed to indicate that the rotatory resistance of the friction was simply as the pressure, independently of any change of the magnitude of the minute surface of contact. He now finds that this is only true of smaller weights, when the pivot has already supported a larger, and its surface has probably been a little flattened; otherwise the observation agrees more nearly with the theory, and perfectly so on the supposition of a conical point affording a resistance proportional to the displacement of the surface. The friction of steel on garnet is a little less than half as much as on steel, on agate a little more than half, and on glass four fifths. Light needles, with a pivot tapering in an angle of about 20°, seem to be the most advantageous for common purposes; but if the needle is heavy, the point must be more obtuse. The conoidal caps, commonly used for suspending needles, had always an irregularity at the centre, which made the friction many times greater than that of a well-finished surface uniformly concave.

14. *Experiments on the Circulation of Sap. Mém. Inst. Sc.* ii. p. 246. M. Coulomb seems to have sufficiently ascertained that the sap appears to rise, in the poplar, near the centre of the tree, mixed with a considerably larger portion of air, which is extricated with a hissing noise when the tree is cut or bored; it is not, however, certain that this air is in an elastic state while the vessels remain closed. The phenomenon was first observed in April, and continued throughout the summer, being most distinct in the hottest sunshine.

15. *Observations on the Daily Labour of Men. Mém. Inst. Sc.* ii. p. 380. This memoir was read to the Academy of Sciences in 1775, but was not then published. M. Coulomb's general conclusion is in favour of the employment of strength in ascending stairs; but he observes, that former authors have very frequently exaggerated the whole amount of a man's daily labour. In fact, the day's work which he assigns to a man of ordinary strength thus employed, is less than half of that which Desaguliers attributes to a labourer turning a winch; and Professor Robison has recorded more than one instance of a much larger result of the labour of a man ascending an inclined plane, even besides the force lost in the machinery employed; so that we must suppose the labourers in France to be commonly less vigorous than in Great Britain; almost in the same proportion as M. Coulomb has observed the work of the same man in Martinique to be less than in France.

16. *Comparison of the Magnetic Powers of Different Needles. Mém Inst. Sc.* iii. p. 176. A number of accurate experiments are here adduced, in confirmation of the theoretical conclusion, that needles of a similar form, and composed of portions of the same wire, possess directive powers which are very nearly proportional to their weights.

17. *On the Cohesion of Fluids, and their Resistance to Slow Motions. Mém. Inst. Sc.* iii. p. 246. The interesting experiments here related demonstrate that the constant part of the resistance of fluids is insensible; that the portion varying simply as the velocity is more than seventeen times as great in oil as in water, while the portion which varies as the square of the velocity is nearly equal in both these fluids. The resistance did not increase with the depth of immersion; on the contrary, it was a little greater when the body was partly above the surface. It was observed that very slow oscillations were somewhat accelerated even by the motion of a carriage passing along the street. Greasing the surface of the solid did not sensibly lessen the resistance to its motion, nor was it materially increased by sprinkling sand on the grease; so that the particles of the liquid seemed to slide rather on each other than on the solid. But it is probable that these differences would have been more perceptible in greater velocities; for it seems reasonable to expect that the friction between a fluid and a solid should partake, in a slight degree, of the nature of the friction between two solids, so as to increase less rapidly with an increase of velocity, than the friction of the particles of fluids among themselves. Coulomb.

18. *A new method of determining the Position of the Dipping Needle. Mém. Inst. Sc.* iv. p. 565. The method suggested in a former memoir is compared, in this short essay, with the mean of four observations made in the common way, the magnetism of the needle being reversed during the experiment; and it appears that the error of either method is not likely to exceed ten or twelve minutes.

19. *On Universal Magnetism. Bullet. Soc. Philom.* N. 61. 63; *Journ. Phys.* liv. p. 240, 267, 454; *Journ. R. Inst.* i. p. 134. The experiments mentioned in the first of these papers were immediately repeated in this country, with results less satisfactory than those which M. Coulomb had obtained; and he soon found reason, upon a further examination, to change the opinion which he had at first inferred from them, observing that a grain of iron was sufficient to communicate sensible magnetism to twenty pound weight of another substance. There still remain, however, some difficulties respecting the magnetism of brass, which have not yet been sufficiently explained.

M. Coulomb's moral character is said to have been as correct as his mathematical investigations. At an early period of his life he gained the grateful acknowledgments of the inhabitants of Brittany for his disinterested exertions in preventing the execution of some public works which threatened to be ruinous to the province. His manners were serious but gentle, and sometimes diversified by a mild gaiety, which made him very amiable in society. His disposition was generous and benevolent; but, notwithstanding all his modesty, he could exhibit sufficient spirit when he was called upon to repel an unjust attack. Such occurrences were, however, far from being frequent, for his merits and his success were universally acknowledged, and he was extremely popular, without having ever excited envy. In the particular department of science which he cultivated, he may fairly be ranked in the same class with Franklin, Æpinus, and Cavendish. He was less original than Franklin, but much more profound. He gave to the speculations of Æpinus both a more defined application and a more satisfactory demonstration; and he was equally accurate with Cavendish, but much more persevering with respect to the more limited objects of his researches; and his improvements in the theory of electricity may be considered as having immediately prepared the way for the elegant inventions of Volta, and the still more marvellous discoveries of Davy. In short, among all the men of science who have

Coulommiers ‖ Counsel.

done honour to France, it would be difficult to point out a single individual who, with regard to the cultivation of terrestrial physics, could at all be put in competition with M. Coulomb. His health had long been extremely feeble, and, in addition to his more chronic complaints, he was at last attacked by a slow fever, to which he fell a victim on the 23d of August 1806. He had been a lieutenant-colonel of engineers, a chevalier of the order of St Louis, and a member of the legion of honour; but he had acquired little property, and he left to his two sons scarcely any other patrimony than the public gratitude and esteem for his merits and his virtues. Delambre, *Mém. Inst. Sc.* ii. *Hist.* p. 206. (T. Y.)

COULOMMIERS, a town of France, department of Seine-et-Marne, and capital of a cognominal arrondissement, on the right bank of the Grand Morin, 14 miles S.E. of Meaux. It has an active trade in corn, flour, cattle, and the famous Brie cheeses. Pop. 4151.

COUNCIL (Lat. *concilium*), in a general sense, an assembly of persons summoned or convened for consultation, deliberation, or advice.

In Britain the history of parliamentary government is in a great measure that of the amalgamation of an advising council to the monarch, a meeting of chiefs or representatives, and an assemblage of feudal vassals. The council of the monarch became subsequently a separate body in the privy council, when at a later period it came to be the practice to select a smaller administrative body called the cabinet. See CABINET, PARLIAMENT, PRIVY COUNCIL, &c.

COUNCIL *of War*, an assembly of the principal officers of an army or fleet, called by the general or admiral who commands, to concert measures for their conduct.

COUNCIL, in *Church History*, an assembly of prelates, convened for the purpose of regulating affairs relative to the doctrine and discipline of the church. The exact number of these it is impossible to ascertain. Sir Harris Nicolas estimates them at 1604. The title of *Oecumenical* or *general*, is given to those which are regarded as representing the universal church. Of these the adherents of the Church of Rome generally acknowledge eighteen as regular and infallible, but differ materially among themselves in regard to the individual councils which are to be included in the list. The Italians, and immediate dependents of the Pope, accept three, viz., those of Lyons, Florence, and the fifth Lateran, which the French deny, and replace by the Councils of Pisa, Constance, and Basle. These rival councils swell the list to twenty-one, which convened as follows:—

	Place.	Business.	Date.
1.	Nice (1.),	Heresy of Arius,	A.D. 325
2.	Constantinople (1.),	Do. Apollinarius,	381
3.	Ephesus,	Do. Nestorius,	431
4.	Chalcedon,	Do. Eutyches and Dioscorus,	451
5.	Constantinople (2),	Do. Origen and Theodoret,	553
6.	Constantinople (3.),	Do. Monothelites,	680-1
7.	Nice (2.),	Regulation of image worship,	787
8.	Constantinople (4.),	Heresy of Photius,	869
9.	Lateran (1.),	Right of investiture,	1123
10.	Lateran (2.),	Temporalities of ecclesiastics,	1139
11.	Lateran (3.),	The decrees of the antipopes, and suppression of the Vaudois,	1179
12.	Lateran (4.),	Albigenses and Crusades,	1215
13.	Lyons (1.),	Excommunication of Frederick II.,	1245
14.	Lyons (2.),	Procession of the Holy Spirit,	1274
15.	Vienna,	Suppression of Knights Templars,	1311
16.	Pisa,	Deposition of Benedict XIII.,	1409
17.	Constance,	Condemnation of Wycliffe, Huss, and Jerome,	1414
18.	Basle,	Reformation of the Clergy,	1431
19.	Florence,	Schism of the Greeks and Latins,	1439
20.	Lateran (5.),	Pragmatic sanction; Turkish war,	1512
21.	Trent,	Condemnation of the Reformers,	1545

COUNSEL, in a general sense, signifies advice or instruction how to act in any difficult matter.

COUNSEL, or *Advocates*, in English courts of law, are of two degrees: barristers and serjeants.

Counsellor ‖ Count.

"From both these degrees," observes Mr Justice Blackstone, "some are usually selected to be her Majesty's counsel, learned in the law; the two principal of whom are called her *attorney* and *solicitor-general*. The first king's counsel, under the degree of serjeant, was Sir Francis Bacon, who was made so *honoris causa*, without either patent or fee; so that the first of the modern order (who are now the sworn servants of the crown, with a fixed salary) seems to have been Sir Francis North, afterwards lord keeper of the great seal to Charles II. These king's counsel answer in some measure to the advocates of the revenue, *advocati fisci*, among the Romans; for they must not be employed in any cause against the crown without special license, in which restriction they agree with the advocates of the fisc. But in the imperial law the prohibition was carried still further, and perhaps was more for the dignity of the sovereign; for, excepting some peculiar causes, the fiscal advocates were not permitted to be at all concerned in private suits between subject and subject. A custom has of late years prevailed, of granting letters patent of precedence to such barristers as the crown thinks proper to honour with that mark of distinction, whereby they are entitled to such rank and preaudience as are assigned in their respective patents: sometimes next after the king's attorney-general, but usually next after his Majesty's counsel then being. These, as well as the queen-consort's attorney and solicitor-general, rank promiscuously with the queen's counsel, and, together with them, sit within the bar of the respective courts; but receive no salaries, and are not sworn, and therefore are at liberty to be retained in causes against the crown. And all other serjeants and barristers indiscriminately may take upon them the protection and defence of any suitors, whether plaintiff or defendant, who are therefore called their *clients*, like the dependents upon the ancient Roman orators. Those indeed, practised gratis, for honour merely, or at most for the sake of gaining influence; and so likewise it is established with us, that a counsel can maintain no action for his fees, which are given, not as *locatio vel conductio*, but as *quiddam honorarium*, not as a salary or hire, but as a mere gratuity, which a counsellor cannot demand without doing wrong to his reputation; as is also laid down with regard to advocates in the civil law, whose *honorarium* was directed by a decree of the senate not to exceed in any case 10,000 sesterces, or about L.80 English money. And in order to encourage due freedom of speech in the lawful defence of their clients, and at the same time to give a check to the unseemly licentiousness of prostitute and illiberal men (a few of whom may sometimes insinuate themselves even into the most honourable professions), it hath been holden that a counsel is not answerable for any matter by him spoken relative to the cause in hand, and suggested in his client's instructions, although it should reflect upon the reputation of another, and even prove absolutely groundless; but if he mention an untruth of his own invention, or even upon instructions, if it be impertinent to the cause in hand, he is then liable to an action from the party injured." Before the 9th and 10th Vict., cap. 54, with the exception of appeals from the revising barristers under the 6th and 7th Vict., cap. 18 and 61, serjeants had exclusive audience at the sittings *in banco* of the Court of Common Pleas. See BARRISTER

COUNSELLOR, in general, a person who advises another. Thus we say, a counsellor at law, a privy counsellor, and the like.

Privy COUNSELLOR. See PRIVY COUNCIL.

COUNT (in Lat. *comes*), a nobleman who possesses domain erected into a county. English and Scottish counts have the title of earls; foreign ones still retain their proper designation. The dignity of count is intermediate between that of duke and baron. According to modern usage, most plenipotentiaries and ambassadors assume the title of counts though they have no county. Under Charle-

Count. magne all generals, counsellors, judges, and secretaries of cities, were called counts; the distinguishing character of a duke and a count being this, that the latter had but one town under him, whereas the former had several.

Counts were originally lords of the court, or of the emperor's retinue, and had their name of *comites* either *a comitando* or *a commeando;* and hence those who were always in the palace, or at the emperor's side, were called *counts palatine*, or *comites a latere*.

In the times of the commonwealth, *comites* among the Romans was a general name for all those who accompanied the proconsuls and proprætors into the provinces, there to serve the commonwealth; as the tribunes, prefects, scribes, and others.

Under the emperors, *comites* were the officers of the palace. The origin of what we now call counts seems to date from the time of Augustus, who took several senators as his *comites*, that is, to accompany him in his voyages and travels, and to assist him in the hearing of causes, which were thus judged with the same authority as in full senate. But Gallienus seems to have abolished this council, by forbidding the senators to appear in the armies; and none of his successors re-established it.

These counsellors of the emperor were really *comites*, or companions of the prince; and they sometimes took the title accordingly, but always with the addition of the name of the emperor whom they accompanied; so that it was rather a mark of their office than a title of dignity. Constantine was the first who converted it into a dignity, and under him the name was first given absolutely. But the title being once established, it was in a little time indifferently conferred, not only on those who followed the court, and accompanied the emperor, but also on most kinds of officers —a long list of whom is given by Du Cange.

Eusebius tells us that Constantine divided the *comites* into three classes: the first bore the title of *illustres;* the second that of *clarissimi*, and afterwards *spectabiles;* whilst the third were called *perfectissimi*. Of the first two classes the senate was composed; those of the third had no place in the senate, but enjoyed several other of the privileges of senators.

There were *comites* who served on land, and others at sea; some in a civil, some in a religious, and some in a legal capacity; as *comes ærarii, comes sacrarum largitionum, comes sacri consistorii, comes curiæ, comes capellæ, comes archiatrorum, comes commerciorum, comes vestiarius, comes horreorum, comes opsoniorum vel annonæ, comes domesticorum, comes equorum regiorum vel comes stabuli, comes domorum, comes excubitorum, comes notariorum, comes legum vel professor in jure, comes limitum vel marcarum, comes portus Romæ, comes patrimonii, &c., &c.*

The Franks, Germans, and other nations, on passing into Gaul and Germany, did not abolish the form of the Roman government; and as the governors of cities and provinces were called counts, *comites*, and dukes, *duces*, they continued to be so designated. They commanded during war, and in time of peace they administered justice. Thus, under Charlemagne, counts were the ordinary judges and governors of the cities.

These counts of cities ranked below the dukes and counts who presided over provinces. The counts of provinces were in nothing inferior to dukes, who themselves were only governors of provinces. Under the last of the second race of French kings, their dignity was rendered hereditary, and they even usurped the sovereignty. When Hugh Capet came to the crown, his authority was not sufficient to oppose their encroachments; and hence it is that they date the privilege of wearing coronets in their arms. They assumed it then, as enjoying the rights of sovereigns in their particular districts or counties; but by degrees most of the counties became reunited to the crown.

The dignity of count has now become very different from what it was anciently, being simply a title which a king grants upon erecting a territory into a county, with a reserve of jurisdiction and sovereignty to himself. At first there was no clause in the patent of erection intimating the reversion of the county to the crown in default of heirs male; but Charles IX., to prevent their being too numerous, ordained that duchies and counties, in default of heirs male, should revert to the crown. Counter.

The point of precedence between counts and marquises was formerly much controverted; and the reason was, that there were counts who were peers of France, but no marquises. The point, however, was given up, and marquises took precedence; although anciently, when counts were governors of provinces, they were on a level even with dukes.

William the Conqueror, as is observed by Camden, gave the dignity of counts in fee to his nobles, annexing it to this or that county or province, and allotting for their maintenance a certain proportion of money arising from the prince's profits in the pleadings and forfeitures of the provinces.

The Germans call a count *graaf* or *graff*, which properly signifies *judge*, and is derived from *gravio* or *graffio*, formed from γράφω, *I write*. They have several kinds of counts or graffs, as land-graves, march-graves, burg-graves, and pals-graves, or counts palatine. These last are of two kinds; the one of the number of princes, with the investiture of a palatinate, while the others have only the title of count palatine, without the investiture of any palatinate. Some assert that, by publicly professing the imperial laws for twenty years, a person acquires the title of count palatine; and there are instances of professors in law who have assumed the title accordingly; but this right has been much disputed.

COUNTER (French, *contre;* Lat. *contra*), a term which enters into the composition of various words of our language, and generally implies contrariety or opposition. When applied to deeds it means an exact copy kept by the contrary party, and sometimes signed by both parties.

COUNTER, of a horse, that part of a horse's forehand which lies between the shoulder and the neck.

COUNTER, in *Heraldry*, is a term of frequent use; as shown in the following examples:—

COUNTER-Changed, the intermixture or opposition of a metal with a colour

COUNTER-Flory, is said of a tressure the fleurs-de-lis of which are opposite to others.

COUNTER-Ermine, the contrary of ermine, being a black field with white spots.

COUNTER-Paled, when the escutcheon is divided into twelve pales parted per fesse; the two colours being counter-changed, so that the upper and lower are of different colours.

COUNTER-Passant, when two animals in a coat of arms are represented as proceeding in contrary directions.

COUNTER-Pointed, when two chevrons in one escutcheon meet in the points.

COUNTER-Quartered (*contre-ecartelé*) denotes that the escutcheon, after being quartered, has each quarter again divided into two.

COUNTER-Salient is when two beasts are borne in a coat leaping from each other directly contrariwise.

COUNTER-Guard, in *Fortification*, a small rampart or work formed usually before a bastion, consisting of two faces making a salient angle, and parallel to the faces of the bastion. Counter-guards are sometimes constructed before the ravelins.

COUNTER-March, a marching back; a returning. Also, a change of the wings or face of a battalion, so as to bring the right to the left or the front into the rear.

COUNTER-Mine, in *War*, a well and gallery sunk in the earth and running under ground, in search of the enemy's mine, in order to meet it, and so defeat its effect.

COUNTER-Point, in *Music*. See MUSIC.

Counter || County Rate.

Counter-Proof, in rolling-press printing, a print taken off from another fresh printed, which by being passed through the press gives the figure of the former, but inverted.

To counter-prove is to take off a design in black lead or red chalk, by passing it through a roller press with another piece of paper, both being previously moistened with a sponge.

Counterscarp, in *Fortification*, the exterior talus or slope of the ditch on the further side of the place, and facing it; but it is often applied to the covered way and the glacis; as when it is said, the enemy have lodged themselves in the counterscarp.

Countersign, to sign, as secretary or other subordinate officer, a writing signed by a principal or superior, in attestation of its authenticity. Thus charters signed by a king are countersigned by a secretary.

COUNTORS, Countours, or Counters, has been used for serjeants at law retained to defend a cause, or to speak for their client in any course of law.

It is of these Chaucer speaks:—

> A sheriff had he been, and a countour,
> Was nowhere such a worthy vavasour.

They were anciently called *serjeant countours*.

COUNTY, in *British Geography*, originally signified the territory of a count or earl, but is now used in the same sense with shire; the one word coming from the French, the other from the Saxon. The territory of England and Wales is divided into fifty-two counties, Scotland into thirty-three, and Ireland into thirty-two.

The origin of the division of England into counties or shires is not known. It is among the many other arrangements popularly attributed to the administrative genius of Alfred. Several of the English counties are identical, or nearly so, with ancient Saxon kingdoms. Others seem to have gradually formed themselves on the model of these old organizations. The county, as a Scottish territorial division, is of comparatively late application, yet nothing particular is known of its origin. In Ireland the division was adopted on the model of England, and it has only recently been popularly recognized.

For the execution of the laws in the several counties of England, excepting Cumberland, Westmoreland, and Durham, officers are appointed every Michaelmas term under the denomination of *sheriffs*. The other officers of the several counties are—lord-lieutenant, who has the command of the militia of the county, *custodes rotulorum*, justices of peace, bailiffs, high constable, and coroner.

The system of county courts has created a new class of judicial officers for administering local justice in a manner deemed by some to be a restoration of the old county administration.

Of the fifty-two English counties, there are three which, from their peculiar origin, are termed *counties palatine*, viz., Lancaster, Chester, and Durham.

County Rate, a local tax collected in England for purposes of local administration. It is of unknown origin, and came into force by custom and prescriptive usage. Originally consisting of several rates applicable to the different purposes, these were consolidated by statute in 1739. In a report on *The Local Taxes of the United Kingdom*, prepared by the Poor-Law Commissioners of England in 1846, there are enumerated seventeen different purposes to which the county rate is applicable. They may be grouped under the administration of justice, internal transit, and protective police; and practically they include the support of prisons, the removal of prisoners, the prosecution of vagrants and other classes of offenders, allowances to constables, the custody of the insane, the holding of coroners' inquests, the support of bridges, with many miscellaneous expenses connected with such musters as the militia, the census, the salaries of public officers, and the like. In 1844 (7th and 8th Vict., cap. 33) the old machinery for collecting the rate was abolished, and that which had been established ten years earlier under the English Poor-Law Act was substituted for it. The property liable to be assessed for county rate is the same as that which is liable for the relief of the poor. In Scotland, the tax most nearly resembling the county rate is called the rogue money. County edifices are generally supported under local acts, and there is a separate tax under distinct administration for the support of prisons. In Ireland, the county rate of England is more exactly represented by the grand jury cess.

County || Court.

County, *Representation of*. See Parliament.

COURANT, a French term synonymous with *current*, and properly signifying running. See Current.

Courant, or *Couranto*, a piece of music in triple time, which served as an accompaniment to the dance of the same name. The courant was long the most common of all the dances practised in England. It consisted essentially of a time, a step, a balance, and a coupee, but admitted also of other motions.

COURAYER, Pierre François, a Roman Catholic clergyman, distinguished for his charity, moderation, and learning, was born at Vernon, in Normandy, in 1681. While canon regular and librarian of the abbey of St Geneviève at Paris, he conducted a correspondence with Archbishop Wake on the subject of episcopal succession in England, which supplied him with valuable material for his *Defence of English Ordinations*, published in Holland in 1727. His opinions, however, having exposed him to a prosecution in his native country, he took refuge in England, where he was presented by the university of Oxford with a doctor's degree. In 1736 he published a French translation of Father Paul's *History of the Council of Trent*, in 2 vols. folio, and dedicated it to Queen Caroline, from whom he received a pension of L.200 a-year. Besides this he translated Sleidan's *History of the Reformation*, and wrote several theological works. Courayer died in 1776, after two days' illness, and was buried in the cloister of Westminster Abbey. In his will, dated two years before his death, he declared himself still a member of the Catholic Church, although dissenting from many of the opinions and superstitions which prevailed in the Church of Rome.

COURIER (French *courir*, to run), a messenger sent post or express with despatches.

The couriers employed by the ancients were of two kinds; first, those who ran on foot, called by the Greeks *hemerodromi*, or day-runners, regarding whom Pliny, Cornelius Nepos, and Cæsar mention that some of them would run twenty, thirty, thirty-six, and in the circus even forty leagues a-day; second, riding couriers (*cursores equitantes*), who changed horses as modern couriers do.

Xenophon attributes the first couriers to Cyrus. Herodotus says they were very common among the Persians, and that there was nothing in the world more swift than such messengers. That prince, says Xenophon, proved how far a horse could run in a day, and built stables at corresponding distances; and at each station a courier was always ready with a fresh horse to forward the packet to the next stage, and so on throughout the empire.

But it does not appear that either the Greeks or Romans had any regular system of couriers till the time of Augustus, Under that prince they travelled in cars, though it would appear that they afterwards went on horseback. Under the Western Empire they were called *viatores;* and under that of Constantinople *cursores*.

COURLAND. See Kourland

COURT (Saxon *curt*, Lat. *curia*, a senate-house;) a place inclosed by walls and open above, adjoining a house or habitation. It also denotes the palace or place where a king or sovereign prince resides; and is hence applied likewise to the retinue or council of a sovereign.

Court || Courthezon.

COURT, in a legal sense, is defined as a place in which justice is judicially administered. And as by our constitution the sole executive power of the laws is vested in the person of the king, it follows that all courts of justice, which are the medium by which he administers the laws, are derived from the power of the crown. For whether created by act of parliament or by letters patent, or subsisting by prescription (the only methods by which any court of judicature can exist), the king's consent in the two former is given expressly, and in the latter by implication. In all these courts the king is supposed, in contemplation of law, to be always present; but as that is in fact impossible, he is there represented by his judges, whose power is only an emanation of the royal prerogative.

For the more speedy, universal, and impartial administration of justice between subject and subject, the law has appointed a variety of courts, some with a more limited, others with a more extensive jurisdiction; some constituted to inquire only, others to hear and determine; some to determine in the first instance, others upon appeal and by way of review

COURT *of Arches* (*Curia de Arcubus*), the chief and most ancient consistory court belonging to the archiepiscopal see of Canterbury, for the debating of spiritual causes. It is so called from the church of St Mary le Bow (*de arcubus*), where it was formerly held. The judge of this court, styled the Dean of the Arches, or the Official of the Arches Court, has jurisdiction in all ecclesiastical causes except such as belong to the prerogative court; and all manner of appeals from bishops or their chancellors or commissaries, deans and chapters, archdeacons, and others, are directed thereto. The dean of the arches has also a peculiar jurisdiction over thirteen parishes in London, called a deanery, which are exempt from the authority of the Bishop of London, and of which the parish of Bow (*de arcubus*) is the principal. The persons concerned in this court are, the judge, advocates, registrars, proctors, &c. An appeal formerly lay from this court to the king in chancery, but it now lies to the judicial committee of the privy council, as regulated by the act of 1843, 6th and 7th Vict., cap. 38.

COURT-BARON (a baron's court, a court incident to a manor). A baron whose land had been erected by the king *in liberam baroniam*, had a jurisdiction both civil and criminal, which he might exercise either in his own person or by his bailie. But this jurisdiction was, by the Heritable Jurisdiction Act, 20th Geo. II. cap. 43, reduced to the right of recovering from his vassals and tenants the feu-duties and rents of the land, and compelling them to perform the services which they may be bound to render, and to the right of deciding in civil questions where the debt or damage does not exceed forty shillings, beyond which his civil jurisdiction cannot be prorogated. The criminal jurisdiction is, by the same statute, limited to assaults, batteries, and smaller offences, which may be punished by a fine not exceeding twenty shillings, recoverable by poinding, or, in default of goods, commutable into one month's imprisonment at the utmost. But this jurisdiction has been subjected to so many regulations and restrictions, that it is seldom or never exercised by the baron.

COURT-Martial, a tribunal occasionally instituted for the punishment of offences in officers, soldiers, and sailors. The powers of courts-martial in this country are regulated by the Mutiny Act.

Other courts, of various kinds, are noticed under their appropriate denominations.

COURT-Plaster, black silk varnished over ten or twelve times with a solution of isinglass, and usually perfumed with benzoin. To prevent its cracking, a small quantity of Chian turpentine is added.

COURTHEZON, a small town of France, department of Vaucluse, arrondissement and 11 miles N.N.E. of Avignon, on a branch of the Ouveze. Pop. 2500. About a mile S.W. of the town is a small salt lake.

Courtrai || Covelong.

COURTRAI, in Flemish KORTRYK, a manufacturing and fortified town of Belgium, province of West Flanders, 26 miles S.W. of Ghent. It is a neat well-built town, situated on both sides of the Lys, and connected by railways with most of the principal places in Belgium. Among its remarkable public buildings are the Hôtel de Ville, a Gothic edifice, built in 1526, and containing two singularly carved chimney pieces, representing the virtues and vices, and events in the early history of the town; and the church of Notre Dame, a Gothic structure founded in 1238, by Baldwin, Count of Flanders, and Emperor of Constantinople, but, except a small portion on one side, modernized and lined with marble. This church contains Vandyck's celebrated painting of the Raising of the Cross. In St Martin's church is a beautiful tabernacle of carved stonework in the richest Gothic style, dating probably about the end of the fifteenth century. Courtrai has also an exchange, college, academy of design, two orphan asylums, and a public library. A great part of its inhabitants are employed in the spinning of flax, and the weaving of plain and damask linens; besides which, cotton and woollen goods, lace, paper, sugar, tobacco, leather, soap, &c., are manufactured. The vicinity is highly cultivated, producing large quantities of the finest flax for supplying the manufactories of the town and for exportation. Courtrai existed in the time of the Romans, under the name of Cortoriacum, which was afterwards changed to Curtricum. In the seventh century it was a municipal city; and in 1302 was fought under its walls the famous battle of the Spurs, in which 20,000 Flemings, chiefly weavers from Ghent and Bruges, routed and put to flight a French army of 7000 knights and noblemen, and 40,000 infantry. About 700 gilt spurs were gathered on the field of battle, and hung up as a trophy in the church of the convent of Groenangen, now destroyed. The town was taken by the French in 1793, and made the capital of the department of Lys. Pop. (1851) 21,089.

COUSIN, a term of relation between the children of brothers and sisters, who in the first generation are called *cousins-german*, in the second generation *second cousins*, and so on. The word is commonly derived from *consanguineus;* though Menage deduces it from *congenius* or *congeneus* q. d. *ex eodem genere.*

COUTANCES, a town of France, department of La Manche, and capital of an arrondissement of the same name, is situated on a hill at the confluence of the Soulle and Bulzard, 16 miles west by south of St Lô. It is the seat of a bishop, and has a fine old Gothic cathedral, and two other handsome churches, a communal college, public library, theatre, &c. Its chief manufactures are woollen and cotton goods, tape, lace, parchments, and hardware; and it has an active trade in horses, cattle, grain, flax, hemp, and butter. Pop. (1851) 7295.

COUTH-UTLAUGH (Saxon *couth*, knowing, and *utlaugh*, outlaw), he who wittingly receives an outlaw and conceals him; for which offence he was in ancient times liable to the same punishment as the outlaw himself.

COUVIN, a town of Belgium, province of Namur, and 35 miles S.S.W. of the town of that name. It is celebrated for its iron works; and in the vicinity are rich iron mines. Pop. 2190.

COVE, the harbour and port of Cork. See QUEENSTOWN.

COVELONG, a town and fortress of Hindustan, in the south of India, on the coast of the Carnatic, 25 miles south of Madras. It was built by Anwar ud Deen Khan, within a musket-shot of the sea, near the ruins of another fort formerly belonging to the Imperial East India Company of Ostend, whose principal factory was established at this place. In 1750 it was taken possession of by the French; and it was again taken by the English in 1752, when its fortifications were demolished. Long. 80. 18.; Lat. 12. 47.

Covenant || Coventry.

COVENANT, in *Eccelesiastical History*, denotes the contract or convention agreed to by the Scotch in the year 1638, for maintaining their religion against innovation. In 1581 the General Assembly of Scotland drew up a confession of faith, or national covenant, condemning episcopal government, under the name of hierarchy. This covenant was signed by James I. and enjoined on all his subjects. It was again subscribed in 1590 and 1596. The subscription was renewed in 1638, and the subscribers engaged by oath to maintain religion in the same state in which it existed in 1580, and to reject all innovations introduced since that time. This oath annexed to the confession of faith received the name of the Covenant; as those who subscribed it were called Covenanters.

Solemn League and COVENANT was established in the year 1643, and formed a bond of union between Scotland and England for the united preservation of the reformed religion in the Church of Scotland, and the extirpation of popery and prelacy. It was sworn and subscribed by many in both nations, approved by the parliament and assembly at Westminster, and ratified by the General Assembly of Scotland in 1645. King Charles I. disapproved of it when he surrendered himself to the Scottish army in 1646; but in 1650 Charles II. by a solemn oath declared his approbation both of this and of the national covenant; and in August the same year he made a further declaration at Dunfermline to the same purpose, which was also renewed on the occasion of his coronation at Scone in 1651. In the same year also the covenant was ratified by parliament, and subscription to it required from every member; it being declared that without such subscription the constitution of the parliament was null and void. It was afterwards renounced by Charles, and declared illegal, 14th Car. II. cap. 4.

COVENANT, in *Theology*, is used analogically to designate the gracious engagement on the part of God to communicate certain unmerited favours to men in connection with a particular constitution or system through means of which these favours are to be enjoyed. Thus the *Covenant of Grace* indicates God's engagement to confer salvation on all who truly believe, and the *Covenant of Works* his engagement to bestow eternal happiness on all who perfectly obey. The *Covenant of Redemption* has reference to the engagement between the Father and the Son, whereby the Father secured a certain number of redeemed, and the Son engaged to be their surety.

COVENANTERS. See BRITAIN, vol. v., p. 428, *et seq.*

COVENTRY, an ancient city and municipal and parliamentary borough of England, county of Warwick, 18 miles E.S.E. of Birmingham. By charter of Henry VI. it was with certain adjacent villages constituted a separate county; but an act of parliament in 1842 incorporated it with the county of Warwick. It takes its name (*Conventre*, i.e. convent town) from a priory founded there in 1044 by Earl Leofric and his wife Lady Godiva. The city stands on a gentle eminence, and is watered by the Sherbourne and the brook Radford, which unite within the town. The old streets are generally narrow and darkened by high houses on either side, but the modern parts of the town and suburbs are better planned. The principal buildings are the churches, the spires of which from a distance have a most imposing effect. The chief of these is St Michael's church, one of the finest specimens of lighter Gothic in England, with a beautiful steeple 303 feet in height. The Holy Trinity church is a cruciform structure in the later English style, with a steeple 237 feet high, and containing the tomb of P. Holland, the translator of Camden's *Britannia* and other works. St John's church is a plain cruciform edifice founded in the reign of Edward III.; and attached to Christ church is the spire of an ancient monastery. St Mary's hall is a venerable building of the fifteenth century, the principal room of which is 63 feet by 30, with a grotesquely carved roof, and a great painted window facing the street. It is ornamented with portraits, inscriptions, coats of arms, and a curious piece of tapestry made in 1450, and measuring 30 feet by 10. A fine market cross 57 feet in height, with eighteen niches filled with statues, erected in 1554, was taken down in 1771. Among the other buildings may be mentioned the county hall, "mayor parlour," drapers' hall, jail, cavalry barracks. There are also a theatre, dispensary, mechanics' institute, public library, savings-bank, free grammar-school with five exhibitions three fellowships and one scholarship, several other schools, hospitals, and charities. Pop. (1851) 36,812. It returns two members to parliament, and is governed by a mayor, twelve aldermen, and thirty-six councillors. Registered electors (1851-2) 4502. Coventry was early celebrated for its manufactures. About the commencement of the fifteenth century woollen cloths, caps, and bonnets were considerable articles of trade, and woollens, broad cloths, and caps were its staple manufactures till the destruction of the Turkey trade near the close of the seventeenth century. In the early part of the sixteenth century it became famous for the manufacture of blue thread, called "Coventry true blue;" and during a part of the last century the manufacture of tammies, camlets, shalloons, and calimancoes was flourishing, but it now no longer exists. Its staple manufactures at present are silk, ribbons, and watches. According to the census of 1851, 9761 males were twenty years of age and upwards, and of these 1104 were watchmakers, 1233 in the silk, and 1895 in the ribbon manufacture. Coventry was in former times defended by walls and towers, but these were destroyed by Charles II. on account of the active part taken by the citizens in the parliamentary cause. Three gates and part of the walls still remain. The procession of Lady Godiva, who is said to have obtained important privileges to the city from her husband, Earl Leofric, by riding naked through the town, still takes place annually on Trinity Friday. "Peeping Tom" is said to have been an inquisitive tailor who was struck blind for looking out at her ladyship as she passed; and his effigy is still to be seen protruded from an upper window in High Street. The phrase "to send to Coventry" seems to have originated with military men who at one time were kept at a distance by the inhabitants.

Coverdale.

COVERDALE, MILES, the celebrated translator of the Bible, was born in Yorkshire in 1487. He was educated at Cambridge in the House of the Augustine Friars, and after having been admitted into that order, was ordained priest at Norwich in 1514. On the promulgation of the reformed opinions at Cambridge, Coverdale was amongst the first to abandon his allegiance to the Church of Rome; and probably finding it unsafe to remain in England, he went abroad, and assisted Tyndale in translating the Bible. In 1535 he published his own translation, with a dedication to Henry VIII., who had now come to an irreparable breach with the Pope. This was the earliest translation of the whole Bible in the English language, and the Psalms in it are those which are now used in the Book of Common Prayer. (See BIBLE, vol. iv. 702.) With the sanction of the king, Coverdale went to Paris to superintend the publication of a new edition; but a decree of the inquisition broke up the printing-establishment, and consigned the volumes already finished to the flames. A few copies, however, having been sold as waste-paper, were preserved; and the presses, which were transported to England, were used in printing *Cranmer's*, or *the Great Bible*, under the superintendence of Coverdale. In 1551, Coverdale was appointed to the see of Exeter; and in consideration of his poverty the customary payment of first fruits was remitted to him. On the accession of Mary he was thrown into prison, and released only on condition of leaving his native country.

Coveripauk || Cowell.

Invited by his kinsman, the king's chaplain, he repaired for a time to the court of Denmark, but afterwards retired to Geneva, where he was associated with other English exiles in executing the *Geneva translation*. On his return to England after the death of Mary, he was not reinstated in his bishopric; and in 1563 he declined the see of Llandaff. He held for some time the rectory of St Magnus, London Bridge, but resigned it in 1566. The rest of his life was spent in translating from the works of the Continental reformers, and in the publication of tracts for the spread of the Reformation. The date of Coverdale's death is uncertain, but he was buried in the chancel of the church of St Bartholomew, Feb. 19, 1568. The third centenary of the publication of Coverdale's Bible was held Oct. 4, 1835.

COVERIPAUK, a town in the south of India, in the Carnatic, nine miles east of Arcot. At this place a victory was gained by the British over the French and their allies in 1752. E. Long. 79. 33.; N. Lat. 12. 54.

COVERT, in *Law*. *Femme Covert* or *Couverte* denotes a woman married, and so under the coverture or protection of her husband.

COVERT *Way*, in *Fortification*, a space of five or six fathoms on the outer edge of the ditch, level with the adjacent country, and protected by a rising ground which has a gentle slope outwards, called the glacis. It is sometimes called the coridor.

COVERTURE, in *Law*. See COVERT.

COVIN, a collusive or deceitful agreement between two or more to deceive or prejudice a third person. Thus, if a tenant for life conspire with another, that this other shall recover the land which the tenant holds in prejudice of him in reversion, this is covin. The word is probably derived from the Norman French *covyne*, a secret place or meeting.

COVING, in *Building*, a term applied to an arch or arched projecture, as when houses are built so as to project over the ground-plot, and the turned projection is arched with timber, lathed and plastered.

The covings of a fire-place are the vertical sides which connect the jambs with the breast.

COVINUS, a war-chariot used by the ancient Britons and Belgæ, the spokes of which were armed with scythes. The Romans borrowed the word to designate a kind of close travelling carriage.

COW. See MAMMALIA; AGRICULTURE.

COW-POX. See VACCINATION.

COW-TREE (*Galactodendron utile*), a singular plant of the nat. ord. of *Urticaceæ*, particularly described by Humboldt (who however saw neither its flowers nor its seeds), as indigenous to the mountainous region skirting the coast of Caraccas. It is a handsome tree; and from its stem, when punctured, there issues a large quantity of milky juice, which has an agreeable flavour, and is very nutritious. It is considered as a valuable article of food in those countries where it abounds, and is known by the name of *Palo de Vaca*. It yields to analysis a considerable quantity of vegetable caseine, with oil and resinous matter. Humboldt and Bonpland considered the tree as allied to the genus *Brosimum*.

COWARD, in *Heraldry*, a term applied to a lion borne in an escutcheon with his tail doubled, or turned in between his legs.

COWBRIDGE (Welsh *Pontfaen*), a small borough and market-town of Wales, county of Glamorgan, 12 miles west of Cardiff. It consists chiefly of one long street divided by the Ddaw, over which is a good bridge. It contains a handsome church, town-hall, and a grammar-school with 2 fellowships, 2 scholarships, and an exhibition at Jesus College, Oxford. Market-day, Tuesday. It unites with Cardiff and Llantrissaint in sending a member to parliament. Pop. (1851) 1066.

COWELL, DR JOHN, a learned jurist, was born at Ernsborough, Devonshire, in 1554. He was educated at King's College, Cambridge, and ultimately became professor of civil law in that university and master of Trinity Hall. In 1607 he compiled a law dictionary; and for the opinions expressed in this work in regard to the king's prerogative he was prosecuted before the House of Commons by Sir Edward Coke, and saved from imprisonment only by the interposition of James I. Cowell also wrote a work entitled *Institutiones Juris Anglicani*. He died under the operation for the stone in 1611.

Cowes || Cowley.

COWES, WEST, a seaport-town of the Isle of Wight, at the mouth of the Medina, 4 miles N. of Newport, and 78 miles from London. It occupies a rising ground on the W. bank of the river, presenting a striking appearance from the sea. The streets are narrow and irregular; but many of the modern buildings are handsome, and in the vicinity are numerous elegant villas. It is much resorted to for sea-bathing, and has numerous hotels and lodging-houses for the accommodation of visitors. The harbour is safe and convenient, and its entrance is defended by a battery. It forms the rendezvous of the Royal Yacht Club, who hold their annual regatta here. It has a very considerable coasting trade. Exports, chiefly agricultural produce and malt; imports, coal, colonial produce, manufactured goods, &c. Ship-building is extensively carried on. On the opposite side of the river, which is here about half-a-mile broad, is East Cowes, where is the custom-house of the port, and near which is Osborne House the marine residence of Her Majesty. Pop. (1851) 4786.

COWHAGE or COWITCH (Hindustanee, *kiwach*), the short brittle hairs or spiculæ found on the pods of several species of *Dolichos* or *Mucuña*, indigenous both to India and America. The plants belong to the natural order of *Leguminosæ*. The species affording the cowhage are chiefly *M. pruriens*, *M. urens*, and *M. monosperma*. The hairs when applied to the human skin produce intense itching and inflammation; yet when mixed with syrup they are administered in the Eastern and in the Western World with advantage as a vermifuge, both to adults and to children.

COWL, or COUL (Saxon *cugle*; Lat. *cucullus*); a sort of hood or habit worn by the Bernardines and Benedictines. They are of two kinds; the one white, and very large, worn in ceremony; the other black, worn on ordinary occasions.

Mabillon maintains that originally the cowl was the same as the scapular. The author of the apology of the Emperor Henry IV. distinguishes two forms of cowl; the one a long gown with sleeves and a capuchin, used in ceremonies; the other a kind of hood to work in, called also a *scapular*, because it only covered the head and shoulders.

COWLEY, ABRAHAM, the last and most distinguished of the metaphysical school of English poets, was born at London in 1618. His father, who was a grocer in Fleet Street, died before his son was born, but his mother sent him at an early age to Westminster school, from which he removed, in the ordinary course, to Trinity College, Cambridge. In the tenth year of his age he composed a poem entitled *The Tragical History of Pyramus and Thisbe*; which, however, did not appear till the author had completed his fifteenth year. At that date it was published, along with others of Cowley's youthful productions, in a volume called *Poetic Blossoms*. He was first tempted to exert his poetic faculties by perusing the works of Spenser, which he says "were wont to lye in his mother's parlour." The reputation which he had gained for himself at school he increased at college, by the care with which he was accustomed to elaborate his exercises, and the success which attended his *Davideis*, an epic, in four books, illustrative of the history and character of the Psalmist of Israel. In the civil war, which broke out at this time in England, Cowley espoused the royalist cause, and was ejected from

Cowper. the university in 1643, shortly after graduation. Hereupon he retired to Oxford, the great focus of royalism, and was selected for the confidential office of deciphering the correspondence of the king and queen. In 1646 he went to the Continent; and on his return, after a residence there of ten years, he was seized as a spy by the Puritans, and compelled to give heavy security for his future conduct. The same year he published an edition of his poems; and in the following year, having obtained the degree of M.D. from Oxford, he gave to the world, as the result of his medical studies, a Latin poem on plants, in six books. In 1659 he went to Paris; and on the Restoration he returned to England, and claimed the mastership of the Savoy—an office which had been promised to him by Charles I. and his successor. His claim was passed over; but a compensation for this injustice was made to him in 1665, by his being selected to farm the queen's lands at Chertsey at a nominal rent. He died in 1667, in the forty-ninth year of his age, and was buried in Westminster Abbey, between Chaucer and Spenser, the authors who had at first awakened in him a love of poetry. Dr Johnson's criticism of Cowley's poetical merits is in most respects the justest that has as yet appeared. He says, "Cowley brought to his poetic labours a mind replete with learning, and his pages are embellished with all the ornaments which books could supply. He was the first who imparted to English numbers the enthusiasm of the greater ode and the gaiety of the less; he was qualified for sprightly sallies and for lofty flights; he was among those who freed translation from servility, and instead of following his author from a distance, walked by his side; and if he left versification yet improvable, he left likewise, from time to time, such specimens of excellence as enabled succeeding poets to improve it." Johnson's estimate of his classical diction is equally high. By that critic he is ranked even above Milton as a Latinist. But Johnson had perused so much of the bad Latinity of the middle ages that he had corrupted to a certain extent his own naturally fine taste, and we must take this dictum of his *cum grano*. The faults of Cowley's style are the wearisome conceits by which it is characterized; the needless exaggerations and far-fetched analogies that exist in every page; and the useless display of learning and classical allusion, that often obscures instead of elucidating the sense.

Besides the works already mentioned, Cowley composed when at college a satire called *The Puritan and the Papist*, and after leaving the university a comedy called *The Guardian*, which was subsequently reprinted under the title of *The Cutter of Coleman Street*. His poems, published on his return from France, appeared in four different parts; 1. *Miscellanies;* 2. *The Mistress, or several copies of Love Verses;* 3. *Pindaric Odes, written in imitation of the style and manner of Pindar;* 4. *The Davideis*, already mentioned. Of all his poems his amatory effusions are the worst; and the reason of this, as alleged by himself, is quite satisfactory—namely, that he never loved but once, and on that occasion could not summon sufficient boldness to declare his passion.

COWPER, William, the best of English letter-writers and the most distinguished poet of his day, was born on the 26th of November 1731, at Great Berkhamstead, Hertfordshire. His father, who held the living of the parish, was chaplain to George II. He married Ann, daughter of Roger Donne, Esq., of Ludham Hall in Norfolk. This lady, after giving birth to several children who died in infancy, expired in childbed in 1737, leaving two sons—William (the poet) and John. Cowper, who retained the most affectionate remembrance of his mother, embalmed her memory in one of the most affecting tributes that ever came from the heart of a son.

At the age of six years Cowper was placed at Dr Pitman's school, in Market Street, Bedfordshire. His health was delicate, and he was in consequence exposed to the laughter and ridicule of his rude companions. One boy seems especially to have been the object of his terror. "His savage treatment of me," he says, "impressed such a dread of his figure on my mind, that I well remember being afraid to lift my eyes upon him higher than his knees, and that I knew him better by his shoe-buckle than by any other part of his dress." The cruelty of this boy's conduct was such, that on its being discovered he was expelled the school, and Cowper was removed. The mental anguish he endured at this time aggravated, no doubt, the constitutional tendency to despondency which throws such a peculiar interest over much of his after-life. At the period of his removal from Dr Pitman's school he was afflicted with inflammation in the eyes; specks appeared in both of them, and it was feared that blindness would ensue. He was in consequence placed at the house of an eminent oculist, where he remained two years, deriving little benefit from his residence there, his cure being slow and imperfect. Cowper.

At ten years of age Cowper was placed at Westminster school. In after-life he lamented that his learning at this time consisted entirely of Latin and Greek, to the exclusion of the more important matter of religion. Surrounded by strangers, and unable from his unconquerable shyness to mingle with them on easy terms, his fits of depression grew darker and more frequent; and those unhappy views of his spiritual condition, which afterwards produced such deplorable results, began to oppress his mind. In his memoir he relates some of his religious experiences. Crossing St Margaret's churchyard late in the evening, his curiosity was excited by a glimmering light, and he went to see whence it proceeded. A gravedigger was at work with a lantern; and just as Cowper came to the spot a skull was thrown up which struck him on the leg. This circumstance gave an alarm to his conscience, and he afterwards considered it one of the most valuable religious impressions he received at Westminster. His mental excitement was followed by the notion that he was exempted from the penalty of death, which in its turn was displaced by lowness of spirits and intimations of a consumptive tendency. At thirteen he was seized with smallpox, which completely restored his eyesight. Although threatened by consumption he seems to have excelled at cricket and football, and to have distinguished himself in his studies. It is curious to know that Warren Hastings, Churchill, Lloyd, and Colman, were his fellow-students in Westminster.

Cowper was taken from Westminster at eighteen years of age; and, after spending a few months at home, was articled to Mr Chapman, an attorney in London. He seems to have most poetically disliked his new position and duties. Thurlow, afterwards lord chancellor, was engaged in the same office; and Cowper describes their leisure as being spent in "giggling and making giggle, instead of studying the law." The following is related of his intimacy with Thurlow a few years later:—One evening, in the presence of ladies, Cowper playfully said, "Thurlow, I am nobody, and shall always be nobody, and you will be chancellor. You shall provide for me when you are." Thurlow replied with a smile, "I surely will." "These ladies," rejoined Cowper, "are our witnesses." "Let them be so," answered the future chancellor, still smiling, "for I will certainly do it." After completing his three years articles with Mr Chapman, he removed to the Middle Temple in 1752. The solitariness of his life at this time was productive of the most pernicious results. In his melancholy memoir he describes the dejection and unrest, the horror and despair, he underwent during these miserable months. At length relief came. Sitting with a few friends by the sea near Southampton, the cloud of misery, which had overshadowed his spirit so long, rolled away, and so happy did he feel that he could have wept for transport had he been alone. Returning to

Cowper. London, and actuated by what he afterwards considered the instigation of Satan, he burned his prayers, and plunged into pleasure and gaiety. In 1754 he was called to the bar, but, instead of following his profession, he seems to have yielded himself up to the charms of literature and social intercourse. About this time his father died, leaving him a small patrimony. In 1759 he removed to Inner Temple, where law was still deserted for literature. He devoted much of his time to the study of Homer, and, in conjunction with his brother, translated some of the books of the *Henriade*. This appears to have been the gayest part of Cowper's life. He had formed literary acquaintances, amongst whom were many of his old schoolfellows; he became a member of the Nonsense Club; and occasionally contributed prose and verse to the periodicals of the day.

While in Mr Chapman's office, Cowper was a frequent visitor at the house of his uncle, Mr Ashley Cowper, in Southampton Row,—the attraction being his fair cousin. Miss Theodora Jane Cowper was the younger of two daughters (the elder of whom, afterwards Lady Hesketh, is well known as the poet's constant correspondent for many years), and by her brilliant beauty and fascinating manners won the heart of her shy relative. Excited by her presence and sparkling spirits, Cowper became cheerful and even gay, his bashfulness began to wear off; he mixed in company, and occasionally attempted to shine in conversation. He became fastidious in his attire, a critic in ruffles, a haunter of looking glasses. Seeing how matters were tending, Mr Cowper opposed their contemplated union on prudential considerations. His daughter pooh-poohed his fears. He asked what she would do if she married her cousin? "Do, sir," answered the high-spirited girl, "Wash all day, and ride out on the great dog at night." Mr Cowper afterwards changed his position, and objected to their marriage on the score of nearness of connexion. The lovers pled, but he was inexorable. Miss Cowper thought it her duty to obey her father. They parted and never met again.

During this courtship, Cowper addressed several poems to his cousin, which exhibit all the gentleness and tenderness of his nature. They are unlike the love-poems of every other poet. They have no fervour, no emotion, no fire. Perhaps Cowper's nature was incapable of strong and devouring passion. The memory of his love and his disappointment seems to have been soon and painlessly effaced. With the lady it was different; she could not so easily forget. The little poems which, in his brief dream of passion, he had addressed to her, she carefully treasured up. Unknown to him, her hand was unwearied in its kind and delicate attentions. She never forgot him, and although surviving his death many years, died unmarried.

Cowper's pecuniary resources being at this time slender, he became naturally anxious to obtain suitable employment. An influential kinsman presented him with the lucrative office of clerk to the committees of the House of Lords. Some difficulty, however, being raised as to his relative's right of appointment, an examination at the bar of the house was demanded to test Cowper's fitness for the performance of his duties. Although the prospect of such a public appearance must have been exceedingly painful to him, he resolved to prepare for the ordeal. He attended regularly at the office, and thus describes the result:—"The journal books were thrown open to me—a thing which could not be refused, and from which, perhaps, a man in health and with a head turned to business might have gained all the information he wanted; but it was not so with me; I read without perception, and was so distressed that had every clerk in the office been my friend it could have availed me little, for I was not in a condition to receive instruction, much less to elicit it out of manuscripts without direction." The dreadful trial that awaited him filled his days, and re-appeared in dreams. He found no rest. At a tavern he met some miserable men, and suicide became the subject of conversation. The idea was new to him, and held him with a horrid fascination from which he could not escape. He was pursued and goaded by imaginary voices, until at last in a paroxysm of madness he attempted self-destruction. The garter by which he was suspended broke, and he fell heavily to the ground. His laundress hearing the fall, and thinking him in a fit, ran to his assistance; but by the time she reached him he had crept into bed. His mind now became a prey to the keenest remorse. The wrath of God seemed hanging over him on account of his sin. In these circumstances, every thought of his official employment was, of course, abandoned: measures were adopted for his security, and in 1763 he was placed under the care of Dr Cotton of St Albans. Cowper.

After remaining two years at St Albans he removed to Huntingdon. Here he first met the Unwins, and so charmed was he with their society, that in a short time he became the inmate of their home. On the death of Mr Unwin in 1767 the family removed to Olney; and on the recommendation of the Rev. Mr Newton the curate of the parish, Cowper accompanied them. About this time his brother died; and in the winter of 1773 his malady returned. Through his long illness he was attended by Mrs Unwin with the most affectionate care. To beguile the tedium of recovery, he occupied himself with carpentry, gardening, and in domesticating his famous hares. Up till this time he had only written a few hymns: he now, at Mrs Unwin's suggestion, commenced a poem on the *Progress of Error*. Composition, once begun, was so ardently prosecuted that in a few months his first volume, consisting, with the poem already mentioned, of *Table Talk*, *Conversation*, *Truth*, *Expostulation*, *Hope*, *Charity*, and *Retirement*, was ready for the press. It attracted little attention. One critic declared that "Mr Cowper was certainly a good pious man, but without one spark of poetic fire." In 1781 he met Lady Austen, and the casual acquaintance soon ripened into the warmest intimacy. Her lively spirits chased from his mind the demon of melancholy. He wrote songs which she set to music and sang to the harpsichord. It is said that observing him one evening in a fit of depression, she related the story of John Gilpin, with which he was so delighted that after retiring to rest he turned it into verse and repeated it with great glee when they met next morning at the breakfast-table. The *Task*, undertaken at the suggestion of his new friend, was begun in the winter of 1783 and published in 1785. Its success was complete, and his reputation was at once established. Never, perhaps, in England had poetry been at so low an ebb as at this time. The brilliant point and antithesis of Pope had degenerated into the inflated diction of Darwin and the feeble sentimentalities of Hayley. Cowper's hearty and natural verse extinguished these weaklings for ever. Although Cowper cannot be placed in the first rank of English poets, yet few are attended with such retinues of love and blessing. His verse is a transparent medium through which you look into a gentle and most loveable human spirit, and you come to know him as thoroughly as if you had lived in the same house with him for years. His muse does not sit apart in sublime seclusion—she comes down into the ways of men, mingles in their every-day concerns, and is interested in crops and rural affairs. You see by the slight tan on her cheek that she has been much in the harvest fields. Cowper rather talks than sings. His blank verse makes no pretensions to majesty; it is colloquial sometimes in its bareness, yet in its artless flow is ever delightful as the conversation of a beloved and gifted companion.

Cowper brought back nature to poetry, and his influence has been extensive and lasting. He is, to a certain extent, the prototype of Wordsworth. Indeed many passages in the *Excursion* read like extracts from the *Task*. It is curious

Cowries ‖ Cox.

also to observe in Cowper's verse that subjectivity which is supposed to be the characteristic of more recent times. His ailings, his walks, his musings, his tamed hares, his friends, his indignation at slavery, his peculiar views of religion, are the things he delights to portray—the *Task* is a poem entirely about himself.

On Lady Austen leaving Olney, her place was filled by the Throgmortons, whose acquaintance Cowper had made on the occasion of a *fête* which they gave to the surrounding gentry. He was delighted with his new friends and spent much time in their society. During this period he was not idle; he had commenced his translation of Homer, and in the winter of 1785 had advanced as far as the 20th book of the *Iliad*. Owing to the rigorous care he bestowed upon his work it did not advance so rapidly as he at first anticipated, and was not published till 1791. Cowper was now in the zenith of his reputation. Rumours of his fame were wafted to the quiet residence of Olney from that world which he had so long forsaken, he was hailed the first poet of the day, and his old friend Thurlow (whose greatness he had foreseen) opened a correspondence with him and thanked him for his translation. To the mild spirit of Cowper the last circumstance must have been peculiarly grateful. While engaged upon Homer, his dreaded malady returned, but was happily driven away by the charms of society and constant literary occupation. He well knew that if he remained inactive the dark spirit would regain his throne; and no sooner was Homer given to the world than we find him engaged on an edition of Milton. But the labour was too much; his brain sunk beneath the incessant demands made on its energies, and so great was his distress that he was obliged to relinquish the undertaking. The clouds were now closing dark and heavy over the evening of Cowper's life. Mrs Unwin was an invalid; he was ever by her bedside, and nursed her with a tenderness if possible deeper than her own. Beneath the tension of sorrow the cord snapped. His malady returned, which was never destined in this life to be rolled away. Mrs Unwin died on the 17th of December 1796. Cowper, with wandering brain and feeble as a child, was led into the room; the presence of the dead drew from him one wild passionate exclamation, he then relapsed into silence, and it is said never more uttered her name. The deepest dejection, alternating with fits of spiritual despair, hung over him to the end. Dropsy appeared in his limbs; and after being reduced to the last stage of feebleness, he died peacefully on the 25th April 1800. (A. S—H.)

COWRIES, small shells employed in Africa and the East Indies as a substitute for money. The principal of this sort is *Cypræa moneta*, a native of the Maldive Isles, whence they are exported to Bengal, &c., for the purposes of commerce. The best are white, shining, from ¾ to 1 inch in length, with a distinct transverse ridge. A century ago their value in Bengal was 2500 for a rupee; but now they are sold at 3200 for the same coin.

COX, Richard, a learned English prelate, born at Whaddon, Buckinghamshire, in 1499. He was educated at Eton, and afterwards at King's College, Cambridge, of which he became a fellow in 1519. He was invited to Oxford by Cardinal Wolsey; but having imbibed the reformed opinions, he was stripped of his preferment, and thrown into prison. On his release, however, he was chosen master of Eton school, and in 1541 he was appointed prebendary of Ely cathedral. Through the influence of Cranmer he was chosen tutor to Prince Edward; and on the accession of that prince he was sworn of the privy-council, and made king's almoner. On the accession of Mary he was again stripped of his preferments, and committed to the Marshalsea. He escaped however to Strasburg, where he resided with Peter Martyr. Under Elizabeth he was elevated to the see of Ely, and died July 22, 1581. Cox was a man of considerable learning, but equally violent in the measures which he recommended for the extirpation of popery and dissent. He wrote *Two Latin Orations on the Dispute between Dr Tresham and Peter Martyr*, Lond. 1549, 4to. *Translation of the Four Gospels, the Acts of the Apostles, and the Epistle to the Romans, in the Bishops' Bible. Resolutions of some Questions concerning the Sacrament*, in the Collection of Records at the end of Burnet's *History of the Reformation*; and had also a considerable share in compiling and revising the liturgy.

Coxe ‖ Crabbe.

COXE, William, Archdeacon of Wilts, a distinguished historical and biographical writer, was born at London in 1747. He was elected fellow of King's College, Cambridge, in 1768, and afterwards went abroad on a visit to the different Continental states, where he prosecuted the researches which were afterwards incorporated into his historical works. On his final return to England he was appointed to the rectory of Bemerton, and in 1808 was preferred to the archdeaconry of Wilts. Towards the close of his life his vision became seriously impaired, and for nearly seven years before his death he laboured under total blindness. He died at Bemerton in 1828. Of his numerous works the most important are, *Travels in Switzerland*, 3 vols. 8vo, 1789; *Travels into Poland, Russia, Sweden, and Denmark*, 5 vols. 8vo, 1784; *History of the House of Austria, &c.*, 3 vols. 4to, 1807; *History of the Kings of Spain of the House of Bourbon*, 3 vols. 4to, 1813; *Memoirs of John, Duke of Marlborough*, 3 vols. 4to, 1817–19; *Memoirs of Sir Robert Walpole*, 3 vols. 4to, 1798; and the *Literary Life and Relict Works of Benjamin Stillingfleet*, 3 vols. 8vo. *The Memoirs of the Administration of the Right Hon. Henry Pelham*, 2 vols. 4to, were published posthumously in 1829.

COYPEL, Noel, (1628–1707), a French painter, who was appointed by Colbert director of the French academy at Rome. His son Anthony (1661–1722) was employed in painting the gallery of the royal palace at Paris, and was afterwards made first painter to the French king, and ennobled on account of his merit.

COZENING, tricking, defrauding. In law it denotes an offence where anything is done deceitfully, either with regard to contracts or otherwise, and which cannot properly be defined by any special name. In the civil law it is called *stellionatus*.

CRAB. See Crustacea.

CRABBE, George, was born at Aldborough, in Suffolk, Dec. 24, 1754, and was the son of an officer of the customs. He appears to have been designed by his father first for an employment similar to his own, and afterwards for the medical profession. He was apprenticed to an apothecary, and received an education merely sufficient to qualify him for such an occupation, and by no means to advance him in that literary career in which he became eventually distinguished. His poetical taste was first elicited by the casual perusal of some verses in the *Philosophical Magazine*, which his father, who was a mathematician, and averse to poetry, had separated from the scientific portions of that periodical, and thrown aside as unworthy. The spark thus kindled burnt steadily; and even while a schoolboy he versified much, and made sundry ambitious attempts in the highest walks of composition. The attainment of a prize offered by the editor of the *Lady's Magazine* for a poem on Hope, although a humble species of success, sufficed to encourage him to renewed exertions; and in 1778 he quitted the profession of medicine, which he had always disliked, and repaired to London, determined to apply himself to literature. His early efforts in his new career were attended with disheartening circumstances. The first poem he offered for publication could find no publisher. From the first that was printed he obtained no profit, in consequence of the publisher's bankruptcy. It was entitled

Crabbe. *The Candidate, a Poetical Epistle to the Authors of the Monthly Review*, and appeared anonymously in 1780. Soon afterwards he became acquainted with Mr Burke, an acquaintance from which may be dated the dawn of his literary rise. Without an introduction, and impelled by distress, he applied to Mr Burke, who kindly took him by the hand, afforded him the advantage of his criticism and advice, recommended him to Dodsley the publisher, invited him to his house, and made him known to many distinguished men of that time, among whom were Reynolds, Johnson, and Fox. Crabbe's first published poems, after the commencement of his acquaintance with Burke, were, *The Library*, and *The Village*, both of which received the benefit of Burke's observations, and the second of which was in a great measure composed at Beaconsfield. In 1781 Crabbe, who by the recommendation of Burke had been qualifying himself for holy orders, was ordained a deacon, and took priest's orders the following year. After serving a short time as curate at Aldborough, through the influence of this generous and distinguished friend he was introduced to the Duke of Rutland and became his domestic chaplain. Nor did Burke's kindness stop here; for he obtained for him from Lord Thurlow, in 1783, a presentation to the rectory of Frome St Quentin, in Dorsetshire, which he held for six years. About this time he married, and resided for some time at Swefling, county of Suffolk, officiating as curate to the minister of Great Yarmouth. About 1789 he was presented, through the instrumentality of the Duchess of Rutland, to the rectories of Muston in Leicestershire and West Allington in Lincolnshire. In 1813 he was preferred to the rectory of Trowbridge, county of Wilts, which, together with the smaller living of Croxton Kerryel, in Leicestershire, he held to the time of his death. After *The Village*, published in 1783, which had received the corrections and commendations of Dr Johnson, Crabbe next produced *The Newspaper*, published in 1785. After this time his poetical labours were long suspended, owing probably to the dedication of his time to domestic affairs and the duties of his profession, or, as he himself ascribes it, to the loss of those early and distinguished friends who had given him the benefit of their criticism. He had, however, the satisfaction of seeing his next work, *The Parish Register*, published in 1809, read and approved by Fox. The success obtained by these poems, which far exceeded that which had attended his earlier efforts, encouraged him to write again; and in 1810 he published one of his best poems, *The Borough*, and in 1812 *Tales in Verse*. His last publication was entitled *Tales of the Hall*, and appeared in 1819. The latter years of his life he spent in the tranquil and amiable exercise of his domestic and clerical duties, at his rectory of Trowbridge, esteemed and admired by his parishioners, among whom he died, after a short illness, on the 8th February 1832, aged 77. He was buried in the chancel of Trowbridge church. Crabbe's only prose publications were, a *Funeral Sermon on Charles Duke of Rutland*, preached at Beloni, and an Essay on the Natural History of the Vale of Beloni, written for Nichols's *History of Leicestershire*, in which it is thankfully acknowledged. His fame rests solely on his poems, of which *The Parish Register* and *The Borough* are destined to a reputation, if not as brilliant, yet probably as enduring, as that of any other contemporary productions.

Crabbe is one of the most original of our poets; and his originality is of that best kind, which displays itself not in tumid exaggeration or flighty extravagance—not in a wide departure from the sober standard of truth—but in a more rigid and uncompromising adherence to it than inferior writers venture to attempt. He is pre-eminently the poet of reality in humble life; and to its representation he has applied himself with a rigorous fidelity which startled the timid fastidiousness of many readers. He discarded the aid of those pleasing illusions with which humble life had previously been enveloped; condemned as fictitious the prevalent representations, and in their stead fearlessly exhibited the stern, harsh, naked truth, and determined to rely for popularity on the fidelity and vigour of his delineations. His chief characteristics are force and accuracy; and through these, and the originality of his style, he compels us to bestow our attention on objects that are usually neglected. His poetry, unlike that of others, directs our sympathy where it is well for the cause of humanity that it should be directed, but whence the squalidness of misery and want too frequently repels it. Much of his success arises from his graphic delineation of external objects, but more from his knowledge of the human heart, and his powerful treatment of the passions. Both the milder and the more violent emotions are portrayed with ability, but in the latter he is most strikingly successful. Despair and remorse are exhibited with a tragic strength that has been rarely equalled; and madness has been seldom drawn with a more powerful hand than in his poem of *Sir Eustace Grey*. He has been called the satirist of the poor; but we must be careful lest we attach to this expression too harsh an acceptation. It is true he discountenances those romantic day-dreams which associate virtue inseparably with poverty, and an Arcadian innocence with rural life. He shows that demoralization is the attendant of distress, and that villagers may be equally dissipated and more dishonest than the profligates of a wealthier class; but he shows this in a spirit rather of pity than of anger; and whilst he denounces and exposes crime, he makes us interested, not so much in its punishment, as, what is still better, in its prevention. He spares not the vices of the poorer classes; but at the same time he does more justice to their virtues, and renders them more important objects of consideration, than perhaps any other imaginative writer.

With many sterling merits as a poet, Crabbe has numerous defects. His descriptions are forcible and exact, but they are too detailed. They have too much of the minuteness of a Dutch picture; and it is a minuteness exhibited in the representation of disgusting objects. He never shrinks from the irksome task of threading the details of vice and misery. Abject depravity is a too favourite subject of his pen; and he does not seem sufficiently aware that there is a species of wickedness which counteracts our sympathy with suffering, and a degree of insignificance which extinguishes our interest in guilt. His skill in displaying the morbid anatomy of our moral nature has rendered him too prone to that unpleasing exercise of his talents; and his habit of tracing the deformities of character have given to his expositions too much the appearance of invective. His taste is very inferior to his other powers. Even with subjects naturally pleasing he is apt to blend disagreeable images. His descriptions of natural scenery, graphic as they are, have little in them of elevation. There is no genial glow about them, as if the contemplation of nature had warmed and inspired him. His deficiency of taste displays itself also sometimes in his humour, which is apt to verge upon buffoonery. His style is little to be commended. It is too often clumsy and ungraceful; diffuse without freedom, homely without being easy, and antithetical without being pointed. His diction is frequently harsh and quaint, and compels us to feel that the merit of his works resides rather in their ideas than in the dress in which he clothes them. His lines are deficient in refinement and polish, and frequently offend the ear by something uncouth and prosaic in the sound, and the absence of musical rhythm. Such are the defects which have conduced to deprive him of that popularity which his merits would otherwise have obtained for him. (T. H. L.)

Cracow. CRACOW, lately a republic bordering on the Prussian, Austrian, and Russian dominions, at the point where they

Cracow. meet. It stretches along the left bank of the Vistula, where the Rudowa falls into that stream. The territory is about 33 miles in length, and its extent is about 490 square miles, or 313,600 English acres. The land is fertile and well cultivated; and contains mines of iron, zinc, and coal. The inhabitants amounted in 1832 to 123,157, including the city. The form of government was democratic, with a president elected by the inhabitants, who must have been at least 35 years of age, must have been educated at a Polish university, and possess land paying a tax amounting to seventy-five shillings a-year. It was also necessary that he should have previously filled some public office. He exercised his power in common with a senate of twelve members, eight of whom were chosen by the chamber of representatives, two by the clergy of the cathedral, and two by the university.

The capital is fortified, and contains about 43,000 inhabitants, of whom about 11,000 are Jews. The cathedral is an ancient and still magnificent building, containing many antiquities of an historical nature belonging to the kingdom of Poland, whose monarchs were crowned in this edifice. In one of the crypts are the coffins of John Sobieski, of Poniatowski, and of Kosciusko. Near the city an enormous conical mound has been raised in honour of the latter. Cracow possesses some trade, for which great facilities are afforded by the Vistula. E. Long. 19. 50.; N. Lat. 50. 3.

In 1846, this last vestige of the kingdom of Poland was blotted from the map of Europe. The political outrage and perfidy employed by the partitioning powers in the previous dismemberments of this unhappy country were again resorted to in their seizure of this last little fragment.

In the partition of 1795, Austria took possession of this portion of Poland. Napoleon, in the campaign of 1809, wrested it from that power, and incorporated it with the duchy of Warsaw, which was placed under the rule of Saxony. In the campaign of 1812, the Emperor Alexander made himself master of this and the other territory which formed the duchy of Warsaw.

At the general settlement of the affairs of Europe in 1815, whether at the recommendation of the other powers, or as an adjustment between Austria (which had the right of the first captor), and Russia (which then held it as last conqueror), or whether in deference to strongly expressed public opinion, it was agreed that Cracow and the adjoining territory should be formed into a free state; and, by the General Treaty of Congress, signed by the plenipotentiaries of the seven chief states of Europe at Vienna in 1815 (Article VI.), "The town of Cracow, with its territory, is declared to be for ever a free, independent, and strictly neutral city, under the protection of Russia, Austria, and Prussia."

It was not to be expected that the inhabitants of Cracow would forget the past wrongs inflicted on their native country, or prove indifferent to the tyranny and cruelty daily perpetrated on their brethren in the dismembered districts.

In February 1846, an insurrection broke out in Cracow, apparently a ramification of a widely-spread conspiracy which the revolutionists expected would have broken out at Posen and other places at the same time, but which was suppressed by the energetic measures of the Prussian authorities. The senate and the other authorities of Cracow were unable to subdue the rebels or to maintain order, and, at their request, the city was occupied by a corps of Austrian troops for the protection of the inhabitants.

The three powers, Russia, Austria, and Prussia, made this a pretext for extinguishing this independent state. They alleged, that even before the insurrection of Poland in 1830, symptoms of fermentation existed in the state of Cracow; that, when the insurrection broke out, the intelligence was received by the inhabitants with the most marked enthusiasm; that it was necessary, after the destruction of the Polish revolutionary army, to occupy Cracow with a division of the Russian army; that Poles who were compromised in the revolution found an asylum within its bounds; that in 1836, when the territory was taken possession of by the combined troops of the three powers, nearly 2000 political refugees were found settled there. In fine, they alleged that "the free city of Cracow and the whole of its territory had, from the year 1830 to the year 1846, been in a state of permanent conspiracy against the courts who had called that state into existence." Was it to be wondered at, that, after having been galled for 16 years by the military occupation, the tyranny, oppression, and exactions of the powers calling themselves their protectors,—that the inhabitants of this city, mocked with the name of free, should have risen against their oppressors? It cannot, however, be denied, that the outbreak was rash and reckless, and that its career was stained with violence and outrage, which served as a pretext to the three powers whose dominions were menaced by it to suppress it by force of arms. Cradling || Cragus.

In the month of August the plenipotentiaries of the Three Powers met at Berlin, to consult on the course which they should adopt. At the same time, Lord Palmerston wrote to the British ambassador that he expected nothing would be done in regard to the state of Cracow at variance with the stipulations of the Treaty of Vienna; and he was assured by the Prussian minister, Baron Schleinitz, that there was no intention to pursue an opposite line of conduct.

The three courts, having established a conference at Vienna—after due deliberation, contrary to all the assurances previously given, and in opposition to the expressed views of the British and French governments—came to the resolution to extinguish the state of Cracow, and to incorporate it with the dominions of Austria; and on the 6th of November Prince Metternich wrote to Lord Palmerston that this was *un fait irrevocablement fixé*. Against this resolution Lord Palmerston sent a lengthened remonstrance, and concluded with these words—that this decision, if put in force, "would be a measure justified by no adequate necessity, and would involve a violation of positive stipulations contained in the General Treaty of Vienna;" and M. Guizot, in his official despatch, complains of the duplicity of the Three Courts, in giving the French Government an assurance in the months of February and March that the occupation of Cracow by the troops of the Three Powers was merely a temporary measure, and that it should cease with the necessity of the times. In strongly remonstrating against this violation of treaty, he uses these words: "Le Gouvernement du Roi ne fait donc qu' user d'un droit évident, et en même temps il accomplit un devoir impérieux en protestant solennellement contre la suppression de la République de Cracovie, acte positivement contraire à la lettre comme au sens du Traité de Vienne du 9 Juin 1815."

The Three Powers, calculating on the reluctance of the French or British governments to make this a *casus belli*, and trusting that the perpetration of this violation of treaty and oppression of the weak would pass with impunity, consummated their criminal purpose; but, as if by a providential retribution, within two years the capitals of Austria and Prussia were visited with the same insurrectionary troubles for which they had doomed Cracow to extinction.

CRADLING, in *Carpentry*, light timber-work introduced under floors to give support to coved ceilings.

CRAGG, a term applied by English geologists to the superior member of the tertiary formations of England. It is a calcareous rock, very rich in coralline remains, or a sandy deposit containing shells, water-worn pebbles, and occasionally bones of mammals. The formation is included in the pleiocene deposits of Lyell.

CRAGUS, in *Ancient Geography*, a mountain, or rather a mountain range of Lycia, on the southern coast of Asia Minor. The range consists of two parts, Cragus and Anticragus. Of these the latter stretches inland in a northerly

Craig. direction, and forms the western boundary of the river Xanthus; the former abuts into the sea with seven or eight bold headlands. The highest peak of Mount Cragus is about 6600 feet above the level of the sea, and is covered half way to the top with dense forests of valuable timber. Cragus is mentioned by Horace as a favourite retreat of Diana (Hor. *Carm.* i. 21). At the foot of Mount Cragus was a city of the same name, whose site has not yet been discovered or determined by modern geographers.

CRAIG, JAMES GIBSON, Bart., who bore a great part in the political history of Scotland, and a part even more influential than was conspicuous, was born in St John Street, Edinburgh, on the 11th October 1765. He was the second son of William Gibson, Esq., by Mary Cecilia, daughter of James Balfour, Esq. of Pilrig, and grandson of John Gibson, Esq. of Durie, by Helen Carmichael, sister of John, fourth Earl of Hyndford. His ancestor Sir Alexander Gibson of Durie, one of the senators of the College of Justice, under the title of Lord Durie, having married in 1595 Margaret, eldest daughter of Sir Thomas Craig of Riccarton (see CRAIG, Sir T.), in 1822 he succeeded under entail to the estate of Riccarton, in Mid-Lothian, with which he took the name of Craig. He entered on business for himself as a law agent in Edinburgh before he was twenty-one; and almost simultaneously began to take a part in the politics of the day. Of his professional career it is not fitting to say more here than that it was eminently successful; and that during the sixty-four years of its continuance he gained professionally the confidence of many of the chief of those with whom otherwise he was at war. As a politician, the qualities of courage, capacity, energy, and disinterestedness, were all necessarily inferred in the side and the share he took. In the political state of Scotland at that time, there was nothing to be gained, but much to be risked, by the profession or even suspicion of Whiggery; and nothing could be accomplished save by great labour and hardihood. In illustration of this, reference may be made to the case mentioned by Sir James himself, in a published letter, written in 1849, of an attempt made by him and others to celebrate, by a dinner, in Edinburgh, the fall of the Bastile in 1789; when only twenty-four persons (several of whom subsequently rose to high eminence in various departments) could be got together, whose names were taken down by the police as they entered, while the sheriff of the county and another official person were subsequently discovered, in an adjoining apartment, noting down as much of the proceedings as could be overheard through the partition. In 1794 the trials and severe sentences of Muir, Gerrald, and other persons engaged in the same object as Sir James, though in a different combination, only confirmed him in his course. Holding steadily on his way, and working energetically, he was by common assent assigned from the first a leadership, which he held until the last; it being his remarkable fortune to be the father and preceptor of the modern Whig party of Scotland, and to outlive almost all his political children and pupils. It was a chief characteristic of his public career, that while ready for every danger, he rather shunned *éclat*, speaking little, but working indomitably. For forty years, uncheered by success, he lent himself unsparingly in time, strength, and purse, inspiriting the timid, sheltering the weak, and (to an extent unsuspected at the time even by those with whom he was in closest alliance) aiding and recompensing the martyred. He had passed sixty-five years of age before the work in which he had been so resolute a labourer fructified in the "Reform" era of 1830-2. During all that critical period, when the country seemed day after day on the brink of revolutionary tumult, Sir James Gibson-Craig was in Scotland the centre-figure of the mass of the population, as he had been for more than forty years previous of the small band maintaining the doctrines which had at last sprung into such fierce popularity. His work now was to restrain the many, instead as heretofore to incite and convince a few; and he was known to spend almost an entire night on the streets of Edinburgh, going about from group to group, enjoining order and patience with as much energy and authority as he had been wont among his small party to urge courage and advance. To his influence, hard won and energetically exercised, is ascribed in a large measure the result of Scotland having got through that crisis without either wavering or outbreak. At this time he received the only honour or reward he could ever be prevailed upon to accept for himself or his family, and was made a baronet of the United Kingdom in 1831. The Reform struggle over, he was content to let much of the work, now become easy and gainful, fall into other hands. But he never lost either his zeal or his influence, and on several occasions during the next twenty years he re-appeared in his place as a leader with all his wonted vigour. These occasions arose out of what he thought dangers to the cause of religious liberty, of which, like most of his school, he had a thorough comprehension and strong love. Some of those related to questions merely local in their incidents, though not in their principle—such as an attempt to exclude an eminent citizen of Edinburgh from the chief magistracy on the ground of his being a dissenter; but one requires mention as more important and memorable. In the latter part of what is known as the "non-intrusion controversy," which resulted in the disruption of the Established Church of Scotland, Sir James thought it his duty to take part against the Non-intrusion party, not apparently on the ground of the original question, but on the ground that there was encroachment and danger in the claim of the church courts to a power of interpreting the statutes co-ordinately with the courts of law. Sir James was mainly instrumental in getting up a great public meeting in Edinburgh on this subject, the aim of which is indicated by a sentence in the speech of the chairman (Lord Dunfermline, a contemporary and life-long political ally of Sir James):—"The question is, whether the state is to control the church in what it is fit and proper the church should be by law controlled in; or whether the church is to control the state by asserting her supremacy in all matters which she thinks fit to declare come under her jurisdiction." The course then taken by Sir James was counter to that adopted by the law-officers and other leading members of the Scottish Whig party, and indeed may be said to mark a distinction between the old and the new sections of that party. The older Whigs having, as in the case of the Roman Catholics, stood up against the intrusion of the state into things religious, were equally jealous of the intrusion of the church upon the state.

Passing on to the more strictly personal or private qualities of Sir James Gibson-Craig, it would be a great mistake to assume, from the boldness and sternness of his political career, that he was of obtrusive temperament or habit. On the contrary, he was essentially modest—manly, it is true, and with a somewhat fierce impatience of everything like meanness and dissimulation; but, while firmly adhering to his own position, never forgetful of what was due to others, thus doing much to conciliate those opponents, especially of the higher class, with whom he happened to come into personal contact. In the whole circle of domestic relations he was in a remarkable degree gentle and faithful; he met his duties in public, but sought his delights at home. "Seeing Sir James Craig," says Lord Cockburn (Life of Jeffrey), "in his fields and among his villagers, or by his fireside, was one of the sights that show how, in right natures, the kind affections can survive public contentions." His personal habits, as might be inferred, were active, and, to the utmost extent consistent with the diversified nature of his labours, methodical. Till upwards of eighty, he was an early riser, going through a con-

Craig. siderable amount of business before breakfast; and he was all his life attached to athletic sports and rural pursuits. He died March 6, 1850, in the eighty-fifth year of his age, with his mind still active and undimmed. His last public act was attendance at a meeting regarding a monument to his personal and political friend Lord Jeffrey, at which he caught the cold that initiated his fatal illness. Opinions, of course, do and will differ as to the policy and measures of which Sir James Gibson-Craig was a champion, but not as to his having done much public work from pure motives; and his services are not the less worthy of record that his part was not that of orator or parliamentary leader, and that he was content to do what he thought his duty, careless alike of display, dissuasion, and reward. (A. R.)

CRAIG, *John*, a Scottish mathematician of the age of Newton, and one of the earliest writers on the fluxionary or differential calculus in this country. Newton no doubt had long been in possession of the principles of this calculus before his modesty allowed him to give his discoveries to the world, and he even revised[1] one of Craig's treatises previously to publication in 1685, the year after Leibnitz had announced his discovery in the Leipsic Transactions. During his residence at Cambridge, similarity of pursuit had made Craig acquainted with that truly great man; and on his return to Scotland he enjoyed the intimate friendship of the accomplished Dr Pitcairn, and of David Gregory,[2] professor of mathematics in the University of Edinburgh, and afterwards Savilian professor of astronomy at Oxford. His investigations, however, with the new calculus, subjected him to the severe strictures of the distinguished John Bernouilli, but obtained for him the support of Leibnitz, whose approbation may be considered as exempt at least from that national partiality with which he himself charges Craig.[3] But whatever praise may be due to Craig for his mathematical inquiries, it must be allowed that his *Principia* of the Christian religion, by a misapplication of the doctrine of probability to human testimony, rest on premises which lead to conclusions alike dangerous and absurd. Having assumed the position that human testimony can only amount to probability, and that this probability diminishes as the distance of time from the event increases; he readily obtains the startling and fallacious, though calculated, result of a period when faith would become evanescent, and disappear from the earth. If, however, it may be allowed to form an opinion of Craig's character from a letter to Dr Cheyne,[4] there may perhaps be some justice in attributing the erroneous principles of this work rather to theoretical mistake than to wrong intention. He seems ultimately to have been a Fellow of the Royal Society, and vicar of Gillingham, Dorsetshire,[5] but for some years he resided in London, where he died in 1731.

Besides communications to the Leipsic *Acta Eruditorum*, his contributions to the London Philosophical Transactions from 1697 to 1712 embrace essays on quadratures, length of curve lines, logarithmic curve and construction of logarithms, solutions of the problems of the solid of least resistance and of the line of swiftest descent, as well as of the problem of John Bernouilli. His separately published writings, now chiefly interesting with reference to the progress of mathematical science, are, 1. *Methodus figurarum lineis rectis et curvis quadraturas determinandi*, London, 1658, 4to. 2. *Tractatus Mathematicus de figurarum curvilinearum quadraturis et locis geometricis*, London, 1693, 4to. 3. *Theologiæ Christianæ Principia Mathematica*, London, 1699 (reprinted, with a refutation, at Leipsic, 1755). 4. *De Calculo Fluentium Libri duo, quibus subjunguntur libri duo de Optica Analytica*, 1718. (T. A.) Craig.

CRAIG, *Sir Thomas*, of Riccarton, one of the ablest lawyers whom his country has produced, appears to have been the eldest son of William Craig of Craigfintray, afterwards called Craigston, in the county of Aberdeen. The period of his birth is uncertain; but as he was sent to the university of St Andrews in 1552, we may suppose him to have been born about the year 1538. He was entered at St Leonard's College, and took the degree of A.B. in 1555; but as his name does not occur in the list of masters, he is supposed to have left the university before he had completed the ordinary course of study. For those destined for the legal profession, it was then the usual practice to finish their education in some of the French universities, which about that period attained to the highest eminence as schools of the civil and canon law. A similar practice prevailed almost universally till the earlier part of the last century; and a writer in the reign of Charles the First thought it not a little "strange to see ane man admitted to teach the lawes, who was never out of the countrie studieing and learning the lawes."[6] The law of Scotland is to a great extent founded on the principles of the civil law; and as at an early period, when the students of law were very few in number, the professors were without a sufficient excitement to exertion, the Scottish youth were compelled to seek for able preceptors in other countries.[7] The reputation of Cujacius, Donellus, Govea, Balduinus, Contius, Hotman, and many other great names, elevated the French schools of law beyond all competition. Their celebrity, however, was at length eclipsed by the more modern universities of Holland; and our countrymen then resorted to Leyden and Utrecht, instead of Bourges and Toulouse. Craig, as we are informed, completed his academical studies in France, and he has himself made more than one allusion to his connexion with the university of Paris. But at Paris the civil law was not then publicly taught; and it is scarcely to be doubted that he repaired to some other university, in order to acquire this branch of knowledge. His skill in the civil and the canon law was united with great proficiency in classical learning, for which we may conjecture that he was in no small degree indebted to the discipline of Paris, where philological studies were then cultivated with very eminent success.

Craig, having attained manhood, was admitted an advocate in the month of February 1563. In 1564 he was appointed the deputy of the justice-general, Archibald Earl of Argyle. It belonged to his office to try the highest offences; and his name very frequently occurs in the criminal records of that period, which have now been rendered more accessible by the labours of Mr Pitcairn. This distinguished lawyer appears to have steered a prudent course in the midst of those disorders which prevailed in Scotland during a great part of his life; he appears to have devoted himself with great assiduity to the studies and duties of his profession; and, shunning the dangerous path of political ambition, to have sought a more pleasing solace of the mind in his recreations with the Muses. He published several Latin poems, which were afterwards inserted in the *Deliciæ Poetarum Scotorum*, and which are allowed to evince

[1] Quo tempore (1685) Cantabrigiæ commoratus D. Newtonum rogavi, ut eadem, priusquam prælo committerentur perlegere dignaretur, quodque ille pro summa sua humanitate fecit. (Præf. ad Lect. De Calculo Fluent.)

[2] In patriam postea redeunti magna mihi intercedebat familiaritas eruditissimo medico D. Pitcairnio et D. D. Gregorio. (Præf. De Calculo Fluent.)

[3] Si Dominus Craigius librum Cheynæi laudat, non miror; laudatus *ab ipso et Scotus* loquens *de Scoto*. (Com. Phil. Ep. 157.)

[4] Phil. Transact., 1703.

[5] Phil. Transact., 1712.

[6] Spalding's History of the Troubles in Scotland, vol. i., p. 179. Edinb., 1828–9, 2 vols. 4to. The individual to whom he alludes is James Sandilands, professor of the canon, and afterwards of the civil law, in King's College, Aberdeen.

[7] "Ea enim ætate sapere, nisi Romano jure, homines non videbantur." (Gadendam, Hist. Juris Cimbrici, p. 54. Hamb. 1770; 8vo.)

Craig. no mean portion of poetical spirit.[1] His earliest publication bears the title of "Henrici illustrissimi Ducis Albaniæ, Comitis Rossiæ, &c. et Mariæ serenissimæ Scotorum Reginæ Epithalamium." Impressum Edinburgi per Robertum Lekprevik, 1565, 8vo. This poem, relating to a very inauspicious subject, is not inserted in the collection. Here we find another poem, entitled "Jacobi serenissimi Scotorum Principis, Ducis Rothesaiæ, Genethliacum," which must likewise have been printed, although we have not been able to trace it, in a separate form.

A few years after he was called to the bar, he married Helen, the daughter of Heriot of Trabroun in the county of Haddington. His wife was probably the cousin of Buchanan, whose mother, Agnes Heriot, belonged to the same family. At the age of 34, his eldest son, Sir Lewis Craig, was raised to the bench in February 1604 by the title of Lord Wrightslands.[2] It was then customary for the judges to wear their hats on the bench; but whenever Craig had occasion to plead before his son, the latter sat uncovered, and listened to him with filial reverence. We may reasonably suppose that the same interest which had raised the son, might as easily have raised the father to the bench; but the modesty of his disposition perhaps led him to prefer a less elevated station;[3] nor is it improbable that the salary of a judge would not have exceeded the emoluments of his extensive practice, added to those of his different appointments. He is not mentioned as the deputy of the justice-general after the close of the year 1573; and in the course of the following year he appears as sheriff of Edinburgh, so that he probably resigned the one office on being nominated to the other. At a much later period, namely in 1606, he is described as advocate of the church. This seems to complete the catalogue of his regular preferments, but we likewise find his name inserted in occasional commissions of importance.

The greatest of his literary labours was his treatise on the feudal law. Such an undertaking was at that period attended with many difficulties. The municipal law had not received any considerable degree of cultivation; of systematic treatises it possessed few or none; written authorities of every kind were scanty and inaccessible; and the collecting of materials must therefore have been not a little tedious and laborious. The feudal law, in its general principles, was taught in the foreign universities as a necessary branch of jurisprudence, and the foreign lawyers, particularly those of Italy and France, had published a great variety of works on the subject; but it was Craig's special object to illustrate the principles of that law as they had been applied and modified in his native country, and in this department he was without a model and without a precursor. It is not therefore surprising, though it may justly be regretted, that he was unable to amass such a stock of materials as prepared him for throwing a clear and steady light on the progress of feudal rights and tenures from the earliest times. The character of his work is likewise affected by his patriotic zeal to facilitate the union of the two kingdoms, by assimilating their national laws and customs. "Sir Thomas Craig," says another able jurist, "who is always instructive when he describes the feudal customs of his own times, is seldom so when he goes back into history."[4] This remark of Dr Stuart may perhaps appear sufficiently just and discriminating. The value and importance of Craig's *Jus Feudale* is admitted by every competent judge, nor has it been superseded by any subsequent treatise: with the exception of Bruce's compendium, no professed work on the same subject has since made its appearance.[5] The author was evidently a man of superior talents, as well as of extensive learning; and it may perhaps be affirmed, without much hazard of refutation, that no other Scottish lawyer can so safely be brought into comparison with Lord Stair. Craig.

Craig did not himself commit his elaborate work to the press; and indeed the printing of any treatise on the law of Scotland seems then to have been considered as almost entirely out of the question. Nearly half a century after the author's death, it was published by Robert Burnet, who had married his grand-daughter; "Jus Feudale, tribus libris comprehensum," &c., Edinb. 1655, fol. Some copies bear the imprint of London. The editor has prefixed a preface, in which he speaks with learning and judgment of the author and his work. After a long interval appeared another edition, "cum præfatione Luderi Menckenii, JCti," Lipsiæ, 1716, 4to. This was speedily followed by the latest and best edition; "editio tertia, prioribus multo emendatior, opera et studio Jacobi Baillie, Advocati." Edinb. 1732, fol. Prefixed is an excellent portrait of the author, together with a short account of his life; and the typography of the edition is greatly superior to that of the other two. Of this work there are two manuscript copies in the Advocates' Library, and likewise two copies of "A Compend or Breviarie of the most substantiall Poynts relating to the Law: extracted forth of the bookes of that learned jurisconsult D. T. C. treating upon the Feudall Law."

Another ample and elaborate work, undertaken about the same period, is his treatise entitled "De Jure Successionis Regni Angliæ libri duo, adversus Sophismata cujusdam personati Dolomanni." Under the assumed name of Dolman, Robert Parsons had in the year 1594 published "A Conference about the next Succession to the Crown of England;" in which he chiefly aimed at superseding the claims of a Protestant successor to Queen Elizabeth. Although he did not proceed on the same philosophical principles, he arrived at a similar conclusion with Buchanan; namely, that all political power is derived from the people, and that the consent of the governed is an essential ingredient in all legitimate governments. The right of resisting kings was boldly taught by other Jesuits, and particularly by Mariana, well known as the historian of Spain,[6] but all their better speculations are mingled with Jesuitical notions of priestly power. Craig, adhering to the prevalent doctrines respecting the divine right of kings and the passive obedience of subjects, has at great length discussed the subject of regal succession and authority. Such a production cannot now be regarded as of much importance; but of so able a man, intimately acquainted with history, and with jurisprudence in all its branches, the labour could not be entirely fruitless. Parsons was likewise refuted by Peter Wentworth, Sir John Hayward, and other English writers.

King James succeeded very quietly to the throne of England, and the original of Craig's treatise *De Jure Successionis* it was not thought necessary to publish. Various manuscripts of it have however been preserved: one belongs to the Advocates' Library, another to the University Library, and a third to the writer of this notice. The second of these Gatherer describes as the original manuscript. The author's doctrines were afterwards found very palatable by the Jacobites; and the design of printing the work was formed by Dr Monro, who was principal of the university of Edinburgh at the period of the Revolution. He lost his preferments in the church and university, and being otherwise involved in the troubles of his party, he did not live to carry this design into execution. From the transcript which he had procured, a translation was however made and published (Lond. 1703, fol.) by his friend James Gatherer, who before the Revolution had been parson of Kilmaurs in Ayrshire, and who, having at length become a bishop among the non-jurors, died in the month of February 1733.[7] One biographer has been too liberal in conferring upon him, and upon divers other divines, the degree of doctor.

Of a similar denomination is Craig's work entitled "De Unione Regnorum Britanniæ Tractatus;" which relates to a subject of great interest to his contemporaries, and which is written with the author's usual learning and ability. "In point of matter and style," says Mr Tytler, "in the importance of the subject to which it relates, the variety of historical illustrations, the sagacity of the po-

[1] "Thomas Craigius Scotus, dum epicis regnatricem domum prosequitur, mortalitati se subducit." (Borrichii Dissertationes Academicæ de Poetis, p. 151. Francof. 1683, 4to.) Of his literary attainments Dempster speaks in the most favourable terms: "Nobili utriusque linguæ cognitione imbutus, magna lectionis varietate, judicio summo, comitate mirabili, ut uno verbo dicam, eruditissimis criticis aut jurisconsultis in Europa conferendus."

[2] Brunton and Haig's Historical Account of the Senators of the College of Justice, p. 244. Edinb. 1832, 8vo.

[3] "Ipse vero," says Dempster, "ut alter Mæcenas, cum summa posset capessere, mediocribus fuit contentus, et advocationis munus quam sustinuit feliciter, quam meruit submisse." (Historia Ecclesiastica Gentis Scotorum, p. 197. Bononiæ, 1627, 4to.)

[4] Stuart's Observations concerning the Public Law, and the Constitutional History of Scotland, p. 163. Edinb. 1779, 8vo.

[5] Principia Juris Feudalis, auctore Alexandro Brussio, JCto. Edinb., 1713, 8vo.

[6] Joannis Marianæ Hispani, e Soc. Iesu, de Rege et Regis Institutione libri III. ad Philippum III. Hispaniæ Regem Catholicum. Toleti, 1599, 4to. The zeal of Mariana, as the reader may easily conjecture, is only directed against heretical kings.

[7] See Dr Russell's edition of Keith's Historical Catalogue of the Scottish Bishops, p. 531. Edinb. 1824, 8vo.

Craig.

litical remarks, and the insight into the mutual interests of the two countries which it exhibits, it perhaps deserves to rank the highest of all his works."[1] This treatise has never been printed; but a manuscript, extending to 264 pages in folio, is preserved in the Advocates' Library. On the same subject two Latin disquisitions were published by Robert Pont, D.D., who was at once an officiating clergyman and a judge in the supreme court; and by David Hume of Godscroft, who is well known for his other writings in prose and verse. Craig performed another patriotic task by preparing a work which bears the following title: "De Hominio Disputatio adversus eos qui Scotium Feudum Ligium Angliæ Regemque Scotorum eo nomine Hominium Anglo debere asserunt." This work is likewise preserved in manuscript in the same library; but long after the death of the author, a translation of it was published under the title of "Scotland's Sovereignty asserted, by George Ridpath." Lond. 1695, 8vo. Craig had vindicated the independence of the Scottish monarchy against the imputations of English historians, particularly Holinshed, or his coadjutor Harrison; and the more recent attempt of Rymer is allowed to have been sufficiently repelled by Ridpath, who has shown that the supposed form of ancient homage bears several unequivocal marks of forgery. His publication was however followed by "Atwood's Superiority and direct Dominion of the Crown of England over the Crown and Kingdom of Scotland, asserted against Sir Thomas Craig." Lond. 1704, 8vo. This book was refuted by Anderson in 1705; and the superiority of the crown of England was re-asserted by Atwood in the course of the same year.

Archbishop Nicolson mentions an historical production of the same learned author. "I have likewise seen an abstract of a book on the same subject, by Mr Thomas Craig, the great civilian, entitled *De Scotorum Origine*; but where the book itself may be found, I know not."[2] And here we complete the enumeration of his writings in prose.

Towards the close of his life, he again indulged his poetical vein. He wrote some commendatory verses, which are prefixed to Thomas Jack's "Onomasticon Poeticum." Edinb. 1592, 4to. And seven years later, he wrote a short elegy on the death of Rollock, which, with many similar contributions, is subjoined to George Robertson's Vitæ et Mortis D. Roberti Rolloci Scoti Narratio." Edinb. 1599, 8vo. During one and the same year, he published three different poems. "Ad sereniss. et potentiss. Principem Jacobum Sextum, e sua Scotia decedentem, Paræneticon." Excudebat Robertus Waldegrave, 1603, 4to. "Ad serenissimum Britanniarum Principem Henricum, e Scotia decedentem, Propemptıcon." Edinburgi excudebat Robertus Charteris, 1603, 4to. "Serenissimi et invictissimi Principis, Jacobi Britanniarum et Galliarum Regis, Στεφανοφορία" Excudebat Robertus Charteris, 1603, 4to.

In the year 1604, Craig was nominated among the Scottish commissioners empowered to treat respecting the projected union of the two kingdoms. One of his associates was Sir John Skene, who had likewise contributed to illustrate the jurisprudence of his native country. The Scottish and the English commissioners met at Westminster, but their deliberations were not attended with any important consequences. This visit afforded him an opportunity of cultivating an acquaintance with Camden, and other learned men; and James determined to elevate him to the rank of knighthood; but Craig secretly withdrew himself, in order to avoid the intended ceremony. The king, however, commanded that he should be styled and reputed a knight; and accordingly his name is generally accompanied with a title which he himself had no wish to assume.

Sir Thomas Craig died Feb. 26, 1608. His death was bewailed in Latin verse by his learned countryman Dempster, who, like himself, was a poet as well as a lawyer. He left behind him an estimable character and a fair estate. He was celebrated for his liberal style of hospitality, and for his zealous adherence to the Protestant faith. He had four sons and three daughters. Sir Lewis Craig, whom we have already mentioned as his eldest son, died in the year 1622. The second, James Craig, of Castle-Craig and Craigston in the kingdom of Ireland, was killed during the insurrection of 1641; and dying without issue, he bequeathed his estates to his next brother, John Craig, an eminent physician. Gassendi informs us that in the year 1592 Craig, a Scottish physician, published a tract against Tycho Brahe, under the title of *Capnuranæ Restinctio, seu, Cometarum in Æthera Sublimationis Refutatio;* and that an answer to it was written by Christianus Longomontanus.[3] The Danish astronomer himself published a *Responsio Apologetica ad quendam Scotum, Aristotelicum Philosophum, et Medicum Galenicum.* This is supposed to have been the third son, Dr Craig, who was successively physician in ordinary to King James, and first physician to King Charles. The youngest son was Robert Craig, whose son acquired by marriage the estate of Ramorgnie in Fifeshire. Margaret, the eldest daughter of Sir Thomas, became the wife of Sir Alexander Gibson of Durie; and from this marriage is descended the late possessor of the estate of Riccarton, Sir James Gibson Craig, Bart. Elizabeth, his second daughter, married James Johnston of Warriston; and their son Sir Archibald Johnston acted a conspicuous part in the proceedings of his own unhappy times: their daughter Rachel was married to Robert Burnet of Crimond, a judge in the Court of Session, and the father of Gilbert Burnet, the celebrated Bishop of Salisbury. Craig's third daughter, Janet, was married to John Belches of Tofts, and their son Sir Alex. Belches was likewise raised to the bench. (D. I.)

Crail ‖ Cramond.

CRAIL, a royal and parliamentary burgh and seaport of Scotland, in the county of Fife, nine miles S.E. of St Andrews. It is said to have been a town of some note as early as the ninth century. David I. had a palace here, of which the only part now extant is a fragment of a wall. It received from Robert Bruce the charter which constituted it a royal burgh. It was anciently the seat of a priory, the ruins of which are still to be seen below the east end of the town. Many of the houses of Crail are of that massive and antique description which indicate past splendour. The church is of great antiquity. The principal street is spacious and regular. With considerable capabilities as a port, the harbour is small and incommodious, and Crail at present possesses little or no trade. Along with St Andrews it sends one member to parliament. Pop. (1851) 1247.

CRAMOND, a small village of Scotland, situated on the south side of the Frith of Forth, and distant about five miles from Edinburgh, at the conflux of the Forth and Almond. It is only worthy of notice from having been a Roman station; and on the opposite bank of the creek of the Almond, on a craggy eminence, this people had a fortification. The iron-works of Cramond constitute the chief support of the place. The bridge of Cramond is famous in the traditionary history of Scotland as the place where James IV., when wandering in disguise over his dominions under the title of the "Gudeman of Ballengeich," was attacked by three robbers, and only saved perhaps from death by the intervention of a farm-servant who was thrashing corn in an adjoining barn. Hearing the noise of a scuffle, he rushed out; and seeing one man attacked by three, he joined the weaker side, and with his flail assisted the king in putting his assailants to flight. The king rewarded his deliverer by presenting him with the lands on which he had

[1] Tytler's Account of the Life and Writings of Sir Thomas Craig, p. 294. Edinb. 1823, 12mo.

[2] Nicolson's Scottish Historical Library, p. 15. Lond. 1702, 8vo. This learned prelate, who was successively bishop of Carlisle and Derry, and archbishop of Cashel, has frequently mentioned Craig in terms of high commendation. "I do still profess my self," he elsewhere remarks, "to have an extraordinary veneration and esteem for the memory of that excellent writer, and can therefore very readily allow Mr Atwood to call him a favourite author. Such, I do acknowledge, he is with me; and 'tis not impossible but I may, in the warmth of my affection, have express'd a more kind opinion of his performances than my nicer adversary thinks he deserves." (*Leges Marchiarum*, or Border Laws, pref. Lond. 1705, 8vo.)

[3] Gassandi Vita Tychonis Brahei, p. 154, 183. Paris, 1654, 4to. See likewise Dr Ward's Lives of the Professors of Gresham College, p. 120. Lond. 1740, fo'

Cramponee formerly wrought as a labourer, on condition that whenever a member of the royal family passed that way he should bring him a basin of water for him to wash his hands. When George IV. visited Scotland in 1822, the descendant of the farm-servant in question awaited His Majesty at Cramond Bridge as he passed that way, and held up a silver basin in which the royal visitor performed his ablutions.

Crank.

CRAMPONEE, in *Heraldry*, is applied to a cross which has at each end a cramp or square piece coming from it.

CRANBERRY, called also moss-berry and moor-berry, is the fruit of a species of *Vaccinium*, as *V. Oxycoccus*. These berries are much used in confectionary, but until baked their flavour is harsh and disagreeable. They are imported largely into this country from Russia and North America.

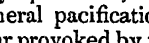
CRANBORNE, a market-town of Dorsetshire, 12 miles S.S.W. of Salisbury, and 93 miles from London. Pop. of parish (1851) 2737, chiefly engaged in agriculture. The town is pleasantly situated, and the surrounding district is fertile. The parish church is a fine old structure, surmounted by an elegant tower. On Castle Hill, S. of the town, is a round double-ditched camp of six acres. Bishop Stillingfleet was a native of this place.

CRANBROOK, a market-town of Kent, in the lathe of Scray, 48 miles S.E. of London. Pop. (1851) 1652. It consists of a main street, with a smaller one diverging from it. The parish church is a handsome and commodious Gothic edifice. The free grammar-school was endowed by Queen Elizabeth. Cranbrook was one of the earliest seats of the woollen trade in England.

CRANE. See index to Ornithology.

Crane, a machine for raising great weights. See Mechanics, § *Description of Machines*.

CRANGANORE, a town and seaport of India, on the coast of Malabar, the capital of a small district of the same name. It stands about three miles up a river, five leagues to the north of Cochin, and is only accessible for small vessels. It is an ancient place, and the Jews assert that they were in possession of it as early as the year 490, when the descendants of those who had escaped the final destruction of Jerusalem obtained permission from the local sovereign to form a settlement on the western coast of India. It was seized by the Portuguese in 1505, and retained by them till the year 1663, when it fell to the Dutch, who fortified it. But as they were unable to defend it against Tippoo, they sold it to the rajah of Travancore—a proceeding which occasioned a war between these two potentates. On the 8th May 1790, the troops of the sultan took possession of Cranganore; but the English, regarding this attack on an ally as an act of hostility against the British government, commenced military operations, and retook the place in 1791. At the general pacification in the ensuing year, which closed the war provoked by the sultan's attack, Cranganore was ceded to the British, in whose possession it still continues. Lat. 10. 14. Long. 76. 16. (E. T.)

CRANK, literally a bend or turn, is used in mechanics particularly to denote a contrivance for converting a rotatory into a reciprocating motion, and *vice versa*, either by means of a simple rectangular bend at the extremity of an axis, or by a double bend in any other part of its rectilinear length, thus  . As the axis revolves, the crank describes the circumference of a circle, and gives the rod attached to it a reciprocating motion. There are various modifications of this useful contrivance. See Mechanics, and Steam-Engine.

Crank, in sea language, is applied to a vessel when, from too much top weight, or the want of sufficient ballast or cargo, or from any other cause, she cannot bear much sail without danger of oversetting. It also denotes an iron brace for supporting the lanthorns on the poop-quarters of a ship.

CRANMER, Thomas, the first Protestant archbishop of Canterbury, was descended of an ancient family, and was born on the 2d of July 1489, at Aslacton in the county of Nottingham, being the second son of Thomas Cranmer and of his wife Agnes Hatfield. He received what was then considered as a suitable education for a gentleman; nor did he neglect the recreations of hunting and hawking, and the use of the bow. After his father's death, and when he himself was only fourteen years of age, he was sent to Jesus College, Cambridge, and about the year 1510 he was elected to a fellowship. Erasmus, one of the great restorers of solid and elegant learning, had already contributed his powerful aid in rescuing this university from scholastic jargon and monkish barbarism. The rectitude of Cranmer's understanding enabled him to give a beneficial tendency to his academical studies: not satisfied with the antiquated course, he likewise devoted a portion of his time to the acquisition of the Greek and Hebrew languages; and if he never became celebrated for the purity or elegance of Latinity, it must be recollected that his chief attention was devoted to higher objects. Before he had reached the twenty-third year of his age, he vacated his fellowship by marriage. His wife, who in reality appears to have been the daughter of a gentleman, some Catholic writers of his own time have industriously represented as a woman of low condition; and were we even to admit the accuracy of their representations, it is not easy to perceive that he would thus be curtailed of any portion of his moral dignity. He was now employed as a reader or lecturer in Magdalen, or, as it was then called, Buckingham College; and, says John Fox, "for that he would with more diligence apply that his office of reading, placed his said wife in an inn called the Dolphin, the wife of the house being of affinity to her. By reason whereof, and of his open resort unto his wife at that inn, he was much marked of some Popish merchants; whereupon rose the slanderous noise and report against him after he was preferred to the archbishopric of Canterbury, raised up by the malicious disdain of certain malignant adversaries to Christ and his truth, bruiting abroad everywhere, that he was but a hostler, and therefore without all good learning." His wife died about twelve months after their marriage; and it is an obvious proof of the estimation in which he was held, that he was immediately restored to the fellowship which he had vacated. He pursued his studies with renewed ardour; and adhering to the plan of reading with a pen in his hand, he now prepared a stock of materials which he found of no small value in his future controversies.

Cranmer

In the year 1524 he declined the offer of a fellowship in the college which Wolsey had founded at Oxford. About the same period he took the degree of D.D., and was appointed to the lectureship in that faculty by his own college. In 1526 he was nominated one of the public examiners in divinity; and in this situation he appears to have been instrumental in scattering the seeds of reformation. He had been entrusted with the education of the two sons of a gentleman named Cressy, who resided in the parish of Waltham-Abbey and county of Essex, and whose wife was related to Cranmer. Being driven from Cambridge by an epidemic distemper, the preceptor and his pupils retired to Cressy's house; nor does it clearly appear that he afterwards resided in the university. The king had made an excursion to the neighbourhood; and two of his attendants, Dr Gardiner, afterwards bishop of Winchester, and Dr Fox, afterwards bishop of Hereford, having met Cranmer at Waltham, began to discuss with him the momentous question of the king's divorce from Catherine of Aragon. This princess had been married to Arthur, the elder brother of Henry, but, according to

Cranmer. her own solemn averment, their nuptials had never been consummated. For the second marriage, a papal dispensation had been obtained in due form; nor does the king appear to have been accessible to any compunctious visitings, till he found this marriage an impediment to his union with Anne Boleyn. He then exerted all his influence with the pope to procure a sentence, declaring the nullity of a marriage contracted with his brother's widow; but although his holiness might otherwise have been disposed to lend a willing ear to such a suitor, he was restrained by the consideration that Catherine was the aunt of the emperor Charles the Fifth. Many intrigues had been employed, and much delay had intervened, when this casual discussion took place at Waltham, and when Dr Cranmer suggested the expediency of "trying the question out of the word of God, and thereupon to proceed to a final sentence." He strongly urged the propriety of continuing the appeal to canonists and divines, for the faculties of various universities had already been solicited to deliver a formal opinion; but it is clear that the peculiar merit of his advice must be resolved into a hint, more or less direct, respecting the necessity of deciding the question without the authority of the pope. This controversy, originating, not in the king's scruples of conscience, but in feelings of a very different nature, contributed in no small degree to the elevation of Cranmer, and to the downfall of the church. When Fox, who was then the royal almoner, communicated this plan of effecting a divorce, Henry "swore by the Mother of God, that man hath the right sow by the ear." His attendance at court was immediately required; and at their first interview, the king enjoined him to lay aside all other avocations, and to bend his faculties to the furtherance of this important *device*. In the mean time he commended him to the hospitality of the earl of Wiltshire, father to Anne Boleyn. It is evident that Dr Lingard has very erroneously described him as "a dependant on the family of the king's mistress;" for this appears to have been the true origin of his connexion with the family, and his real dependence was first on the hopes, and afterwards on the gratitude, of the king himself. Henry appointed him archdeacon of Taunton, and one of his chaplains; he likewise bestowed upon him some parochial benefice, of which the name is not ascertained.

Unwilling to hazard an open rupture with the visible head of the church, the king again had recourse to negotiation, and Cranmer was conjoined in a mission to the court of Rome, where he saw "many things contrary to God's honour." During the following year, 1531, he was commissioned as sole ambassador to the emperor. He resided for several months in Germany; and there, about the beginning of the year 1532, he married Anne, a niece of the wife of Osiander, an eminent pastor of Nürnberg. At the period of his first marriage he was a layman; but as he was now in priest's orders, he plainly disregarded the authority of the church. His residence in this country is, with great probability, supposed to have had the effect of bringing him much nearer to the sentiments of the Protestants: here he must have enjoyed many opportunities of becoming acquainted with their views and feelings; nor could his soundness of understanding and honesty of purpose be unprofitably exercised, in a situation so well calculated to second the impulse which his mind had already received. From the gross error of the real presence he only extricated himself by slow degrees. The human understanding had for many centuries been so stultified by this portentous doctrine, that it seemed incapable of regaining a sound and healthful state; and, in this Cranmer. article of belief, the progress of Luther and his followers was only from one absurdity to another; by rejecting *transubstantiation*, and adopting *consubstantiation*, they introduced a change of scholastic and unscriptural terms, leaving their ideas involved in the ancient maze of Popish errors.

Archbishop Warham, the patron of Erasmus, died in the month of August 1532, and Dr Cranmer was immediately recalled from Germany to fill the vacant see of Canterbury. This sudden and high preferment he is said to have accepted with no small reluctance; and one of the difficulties which presented themselves, is supposed to have been connected with the peculiarity of his situation as a married priest. During the preceding reign, it had been decided by the courts of law that the marriage of a priest was voidable, but not void; and consequently that his issue, born in wedlock, was entitled to inherit. But such a marriage was not reconcilable with the principles of the canon law, and much was to be apprehended from the capricious ferocity of the king. His wife was never publicly acknowledged; and, after the promulgation of the six articles in 1539, he found it expedient to send her to her native country. When he was afterwards charged with having thus entered into the state of matrimony, he admitted the fact, but at the same time affirmed "that it was better for him to have his own, than do like other priests, holding and keeping other men's wives." Before he took the oath of episcopal obedience to the pope, he adopted the expedient of making a formal protest, that he only took it in such a sense as was consistent with the laws of God, with the rights of the king and his realm, and with the liberty of declaring his own sentiments in matters of religion, even when they might be in opposition to the authority of the pope himself. How far this protest was privately interposed or publicly divulged, has been much and eagerly disputed between Protestants and Catholics, but it appears to be a question of very little importance. While we are ready to admit that his latest biographer has refuted various allegations of the Popish historians, we still retain a strong conviction that the character of Cranmer is not materially benefited by his zealous defence. To entitle the archbishop elect to receive the bulls from the pope, it was necessary for him to take a prescribed oath: the authority which imposed this oath manifestly left no room for private interpretation; nor can we regard such an expedient in any other light than that of a mere subterfuge. "It was," says Mr Todd, "the pleasure of his sovereign, but his own aversion, we have seen, that these forms should yet be followed. But instead of engaging himself to the oath, he declared to the king, that without the liberty of opposing it he would decline the honour that was proffered. Of this conduct he never afterwards repented."[1] But is not this a most lame and impotent conclusion? When swearing is not a mere act of profanity, it is in its very essence the act of a man engaging himself by his oath; and if Cranmer thus reserved to himself the liberty of *opposing* an oath, which he yet consented to take, he was openly swearing to perform what he secretly considered as unlawful. What his biographer subjoins is not more satisfactory. "Thus much for the notoriety of the protest. It has been wished that he had taken the papal oath, as his predecessor Warham had taken it, without reserve or explanation, and then proceeded quietly in opposition to the pontiff, as that prelate is believed to have done by submitting, not long before, to the regal supremacy, and thus

[1] Todd's Life of Archbishop Cranmer, vol. i. p. 68. Lond. 1831, 2 vols. 8vo.

Cranmer. advancing a decisive step towards a reformation. The clamour against Cranmer, as to disingenuousness, might then, it has been thought, have been comparatively little, or none. But Cranmer was sincere, and Warham the reverse." Casuists may suggest divers expedients and salvos, but an honest man has only one method of taking an oath.

That Cranmer's elevation is chiefly to be referred to the aptitude which he had discovered for promoting the dissolution of the royal marriage, is a fact which cannot well be doubted. Soon after his consecration he addressed to the king a letter, in which he zealously urged the necessity of bringing this important question to a determination; and as the pious monarch had already been declared the head of the church of England, he had no hesitation in returning an answer, which, says the biographer, "was in perfect accordance with the primate's suggestion; in which he forgot not to maintain *the supremacy he had lately recovered.*" Of the origin and progress of the anomalous, and, we will venture to add, very absurd maxim, that the king is the head of the church, this may be considered as rather a curious account; for in what sense could Henry the Eighth be said to recover a right or prerogative which had never been possessed by him or any of his predecessors?[1] The queen of England was cited to appear before the archbishop at Dunstable, within a few miles of Ampthill, the place of her residence; and on the 8th of May 1533, he opened his new court, assisted by the bishop of Lincoln as his assessor. Catherine having failed to make her appearance before this irregular tribunal, was, after the expiration of fifteen days, declared contumacious; and the marriage was adjudged to be null and void from the beginning, as having been contracted in defiance of the divine prohibition. In the month of January, Henry had privately married Anne Boleyn, after having cohabited with her for several years; but it seems to have been asserted without foundation that Cranmer was present at their scandalous nuptials. It is well known that she did not long retain the king's affections. Ardent love, in so ferocious a breast, was easily converted into deadly hatred; and Anne, when supplanted by a new favourite, was accused of various acts of infidelity, of which it is not certain that she was guilty.[2] The archbishop was again required to exercise his divorcing faculty. "The trial and condemnation of the queen," says Mr Todd, "almost immediately followed. Not content with this result, the king resolved on further vengeance; and after two days more, the afflicted archbishop *was obliged* judicially to declare her marriage invalid, and her offspring illegitimate." But how was the archbishop *obliged* to perform an act which is tacitly admitted to have been wrong? The reader must bear in mind that this sentence could have no reference to the queen's alleged adultery; for, according to the canon law, marriage, which is one of the seven sacraments, cannot be dissolved by any course of judicial procedure; and we may here remark, in passing, that although the modern law of England does not professedly adhere to this notion of a sacrament, it is not completely disentangled from the ancient superstition: the ecclesiastical courts may declare a marriage to have been invalid from the beginning, but they cannot dissolve the sacred bond of matrimony. Cranmer was now *obliged* to declare invalid from the beginning a marriage, which he had formerly pronounced good and valid; and there is too much justice in the remark of Dr Lingard, "never perhaps was there a more solemn mockery of the forms of justice, than in the pretended trial of this extraordinary cause." Nor is this the last case of divorce to be mentioned. After the death of Jane Seymour, the king married Anne of Cleves; and as he did not find her person agreeable to his taste, he again had recourse to the agency of the dutiful archbishop, and the sentence of invalidity was confirmed by the seal of Cranmer. The next consort of this atrocious tyrant, whom Cranmer has described as "a most godly prince of famous memory," was Catharine Howard, who was beheaded without being divorced.[3] Cranmer.

In these transactions, the archbishop of Canterbury appears to little advantage; nor is it easy to believe that he did not act against the clearest conviction of his own conscience. All or most that can be urged in palliation of his conduct is, that he had fallen on evil days, and that to resist the commands of such a master was certain death. In other respects, he was too much tainted with the errors of the time; but, if he was not exempted from the spirit of persecution, he was subject to an error which, however hideous it may appear to us, extended to nearly all his contemporaries. The execution of Servetus for his theological opinions was formally approved by Melanchthon,[4] who is universally regarded as one of the mildest of the early reformers. Soon after his elevation to the primacy, Cranmer acted as one of the inquisitors who condemned John Frith for denying the doctrine of transubstantiation. "His said opinion is of such nature," he states in a private letter, "that he thought it not necessary to be believed as an article of our faith, that there is the very corporal presence of Christ within the host and sacrament of the altar, and holdeth of this point most after the opinion of Oecolampadius. And surely I myself sent for him iij. or iiij. times to persuade him to leave that his imagination; but for all that we could do therein, he would not apply to any counsel, notwithstanding now he is at a final end with all examinations; for my Lord of London hath given sentence, and delivered him to the secular powers, where he looketh every day to go unto the fire. And there is also condemned with him one Andrew, a tailor of London, for the said self-same opinion. And thus fare you well. From my manor of Croydon." Is not this a cool contemplation of such an inhuman act as the burning of his fellow-creatures? It was Andrew Hewet who, honouring Frith, and adhering to his doctrines, was thus condemned to the same cruel death; and, after the lapse of a few years, Cranmer, following the dictates of common sense, adopted the very opinion for which his brethren had been doomed "to go unto the fire." These holy butcheries were followed by many others. The persecutions which commenced in the reign of the unrelenting father, were not discontinued in that of the milder son; but the case of Joan Bocher, commonly called Joan

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[1] Dr Martin, when counsel against the archbishop, reduced him to the necessity of admitting that, according to his principles, Nero was the head of the Christian church at Rome, and the Turk at Constantinople. "Then," rejoined the civilian, "he that beheaded the heads of the church, and crucified the apostles, was head of Christ's church; and he that was never member of the church, is head of the church, by your new-found understanding of God's word."

[2] See Dr Lingard's Hist of England, vol. iv. p. 239, and Mr Turner's Hist. of the Reign of Henry the Eighth, vol. ii. p. 458.

[3] Her crime was incontinency before her marriage. A modern civilian has laboriously discussed the question, "Utrum quis mulierem pro Virgine ductam possit repudiare, si postea comperiat, eam jam antea ab alio fuisse devirginatam?" (J. F. W. Pagenstecheri Jurisprudentia Polemica, p. 59. Hardervici, 1730, 4to.) He maintains the affirmative, for this among other reasons: "quoniam error circa virginitatem continet errorem circa substantiam, cum personæ. tum matrimonii."

[4] Calvini Epistolarum et Responsorum editio secunda, p. 306. Lausannæ, 1576, 8vo.

Cranmer. of Kent, deserves a more particular notice. The charge against her was to this effect: "That you believe that the Word was made flesh in the Virgin's belly; but that Christ took flesh of the Virgin you believe not, because the flesh of the Virgin being the outward man, was sinfully gotten and born in sin; but the Word, by the consent of the inward man of the Virgin, was made flesh."[1] For persisting in her refusal to recant this unhappy jargon, the poor creature was committed to the flames. When Cranmer excommunicated her as a heretic, and, in the true inquisitorial style, ordered her to be delivered to the secular arm, she exclaimed, "It was not long ago that you burned Anne Askew for a piece of bread, and yet came yourself soon after to believe and profess the same doctrine for which you burned her." The young king was extremely reluctant to imbrue his hands in the blood of such a victim, and a year elapsed before she was ordered for execution. It is plainly stated by the martyrologist that his scruples were at length overcome, or his resolution shaken, by the urgency of the archbishop. About the same period, George Van Paris, a Dutch surgeon residing in London, was burnt for denying the divinity of Christ; nor does it appear that, in any of the various cases which have been recorded, the archbishop felt, or professed to feel, the slightest doubt or misgiving as to the perfect propriety of committing such atrocious murders under the sanction of law and religion.

Another unequivocal proof of his having deeply imbibed the spirit of persecution, is to be found in the book entitled *Reformatio Legum Ecclesiasticarum.* The plan of this book had originated in the reign of Henry; and in that of his son, Cranmer was placed at the head of eight commissioners, who were enjoined to prepare it for the inspection of a much larger committee, and afterwards for that of the privy council. It is supposed to have been translated into Latin by Sir John Cheke, the king's preceptor, and by Dr Haddon, master of Trinity Hall at Cambridge, both of whom were eminent for their classical learning, but the latter was a greater master of Latinity. It is not to be regretted that this code of ecclesiastical law never obtained any public sanction. Much of the responsibility evidently belongs to Cranmer; and his biographer assures us that an abler canonist was not easily to be found within the realm. The title respecting the mode of proceeding in cases of heresy, contains a chapter on obstinate heretics, which adjudges them, after all other remedies have been attempted, to be delivered over to the civil magistrate in order to be punished. "Consumptis omnibus aliis remediis, ad extremum ad civiles magistratus ablegetur puniendus."[2] What is the language of the canonists when they deliver to the secular arm those unfortunate beings whom they describe as heretics? Lancelottus expresses himself in the following terms: "Sæcularis relinquentur arbitrio potestatis, animadversione debita puniendi."[3] Canisius thus delivers the same doctrine: "Relinquantur judici sæculari debita animadversione puniendi."[4] And Gravina, a more recent writer, conveys the same meaning in these words: "Sæcularis judicis punitioni traduntur."[5] To these three examples of such phraseology it would not be difficult to add ninety-seven more; and the direful import of such expressions in the mouth of a canonist, can only be doubtful to those who are unacquainted with the history of the inquisition. In point of form, the hands of churchmen must not be stained with blood; but the sentence of the ecclesiastical judge, when it awards a cruel and ignominious death, or any inferior degree of corporal punishment, must be inflicted under the sanction of the civil power. Mr Hallam has remarked, that "infamy and civil disability seem to be the only punishments intended to be kept up, except in case of the denial of the Christian religion; for if a heretic were, as a matter of course, to be burned, it seems needless to provide, as in this chapter, that he should be incapable of being a witness, or of making a will." But the Spanish inquisition did not punish with fire and fagot every offence against the Catholic faith; and when, in a subsequent chapter, Cranmer and his associates contemplate the possibility of a heretic avoiding extreme punishment, they do not necessarily disown the fellowship of their brother inquisitors. It is scarcely to be considered as a sufficient vindication of the archbishop, that in a manuscript copy of the work, formerly in his possession, the punishment of perpetual banishment or perpetual imprisonment is specifically mentioned. This correction is not in the hand-writing of Cranmer, but is supposed to be in that of Martyr;[6] so that we are by no means persuaded that the question of capital punishment is completely set at rest. Of the *Reformatio Legum Ecclesiasticarum*, the first edition was published by John Fox, in the year 1571, from a copy which had been transcribed by the archbishop's secretary, and corrected by himself as well as by Martyr. It is not therefore difficult to perceive where we must expect to find the text as it was finally adjusted. This bloody text seems to admit of another mode of illustration equally legitimate. The practice of the archbishop was in perfect conformity with the principles which we have here explained. In the reign of Henry, he was accessory to the death of several individuals who denied the Catholic doctrine of transubstantiation; and in the reign of Edward, he was accessory to the death of others who denied articles of the creed to which he then adhered. What meaning he himself attached to the expression of delivering a heretic to the civil magistrate, we have already ascertained in the case of Frith; in reference to whom he states, "my Lord of London hath given sentence, and delivered him to the secular powers, where he looketh every day *to go unto the fire.*"

Cranmer.

Such errors as these are too glaring to be easily concealed; but it is equally certain that his character was adorned by many private virtues, and that the great body of his countrymen cannot fail to regard him in the light of a public benefactor. Under his influence, books of religious instruction were circulated among the people,[7] and, what was of inestimable benefit, the Bible was opened to every man capable of reading his mother tongue. It was in a great measure owing to his exertions that the reformation of the church of England was nearly advanced to that point where it still rests. That this reformation should then have been left so incomplete, is less surpris-

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[1] Strype's Memorials of Thomas Cranmer, Archbishop of Canterbury, p. 181. Lond. 1694, fol.
[2] Reformatio Legum Ecclesiasticarum, p. 23. edit. Lond. 1640, 4to.
[3] Lancelotti Institutiones Juris Canonici, lib. iv. tit. iv. § 3.
[4] Canisii Summa Juris Canonici, lib. iii. tit. xv. § 3. Opera quæ de Jure Canonico reliquit, p. 997. Lovanii, 1649, 4to.
[5] Gravinæ Institutiones Canonicæ, p. 218. August. Taurin. 1742, 8vo.
[6] Todd's Life of Archbishop Cranmer, vol. ii. p. 334.
[7] Of the book which passes under the name of Cranmer's Catechism, an edition, begun by Bishop Lloyd, was recently published by Dr Burton. "A short Instruction into Christian Religion; being a Catechism set forth by Archbishop Cranmer in M.D XLVIII.: together with the same in Latin, translated from the German by Justus Jonas in M.D.XXXIX." Oxford, 1829, 8vo. The archbishop did not himself translate this catechism, but, as Wharton states, he "added a large discourse of his own to the exposition of the second commandment, and inserted some few sentences elsewhere."

Cranmer. ing than that it should scarcely have been resumed for two hundred and fifty years.

By the testament of King Henry, who died in the month of January 1547, the archbishop was placed at the head of a regency, consisting of sixteen individuals, of whom the greater part were favourably disposed to the reformed doctrines. Edward, who was of a tender age, was anxious to promote the same cause; and the seeds which had been sown during the late reign, now became much more vigorous in their growth. The chief instrument of the reformation was undoubtedly Cranmer, who promoted it by his talents and learning, as well as by the influence necessarily connected with his high station. He was one of the compilers of the service-book, and the author of at least three of the homilies, those on salvation, faith, and good works. He was likewise the sole or principal author of the first Articles of Religion, forty-two in number, which were slightly altered in the reign of Elizabeth, and reduced to the number of thirty-nine.

Edward died at a premature age in the year 1553, after having, at the instigation of the duke of Northumberland, nominated as his successor Lady Jane Grey, who had married the duke's fourth son, and who was the daughter of the duke of Suffolk, and grand-daughter of Mary, sister to Henry VIII. The king's two sisters, Mary and Elizabeth, were superseded on the ground of their illegitimate birth. To this scheme the archbishop acceded with no small reluctance. Jane was proclaimed queen, but, after a reign of a few days, was committed to the Tower, and soon died by the hand of the executioner. On the accession of Queen Mary, many of the Protestants were subjected to the extreme tortures which they had felt too little compunction in applying to others. Cranmer, Ridley, and Latimer, were first committed to the Tower, and were afterwards removed to Oxford, where they were confined in the common prison called Bocardo, and were at length condemned as obstinate heretics. A long interval elapsed before their execution. Ridley, who had been bishop of London, and Latimer of Worcester, suffered with that noble resolution which became martyrs of the truth, but the mind of Cranmer recoiled under so great a trial of human fortitude; the vain and delusive hope of life impelling him to deny his faith, and to sign no fewer than six recantations. The tender mercies of the wicked are cruel: his offences were not to be pardoned by such a sovereign under the influence of such counsellors; and on the 21st of May 1556, this learned, venerable, and aged man was committed to the flames. Rejecting his unfortunate recantations, he died in the pious profession of the Protestant faith, and suffered the cruel torture of the fire with an undaunted resolution, which his recent conduct had not encouraged his friends to expect. It is not for us, who are placed beyond the reach of such fiery trials, to condemn the weakness for which he made this atonement.

In the history of Cranmer's persecution, we find no mention of his wife, or any of his near relations. He however left a widow and two children, Thomas and Margaret. Another daughter, named Anne, had died before him. The surviving children were restored in blood by an act of parliament, passed in the year 1563, but it does not appear that they were reinstated in their property. It is asserted by Ames, who however quotes no authority, that the widow married Edward Whitchurch, an eminent printer,[1] who had been a merchant, and had been well known to her first husband. The archbishop's younger brother, Edmund Cranmer, was archdeacon of Canterbury, but in the reign of Mary was deprived of his preferment, Cranmer on the ground of his being a married priest. His elder brother John was still in possession of the hereditary manors of Aslacton and Whatton; and four sisters, all married to persons of distinction, likewise survived to bewail the cruel doom of their illustrious kinsman.

His principal works relate to the portentous doctrine of transubstantiation. The first is entitled "A Defence of the trve and catholike Doctrine of the Sacrament of the Body and Bloud of our Sauiour Christ, with a Confutation of sundry Errors concernyng thesame, grounded and stablished vpon Godes holy woorde, and approued by the consent of the moste auncient doctors of the Churche." Lond. 1550, 4to.[2] This publication was speedily followed by "An Answer vnto a crafty and sophisticall Cauillation deuised by Stephen Gardiner, Doctour of Law, late Byshop of Winchester, agaynst the trewe and godly Doctrine of the moste holy Sacrament of the Body and Bloud of our Sauiour Iesv Christe: wherein is also, as occasion serueth, answered such places of the booke of D. Rich. Smyth as may seeme any thyng woorthy of the aunsweryng. Item ye shall fynde here also the true copye of the booke written, and in open courte delyvered, by D. Stephen Gardiner, not one woorde added or diminished, but faythfully in all poyntes agreeyng with the oryginall." Lond. 1551, fol. Both these works were printed by Reynold Wolfe. Of the Defence, a Latin version appeared soon after the death of the author. It bears the title of "Defensio veræ et catholicæ Doctrinæ de Sacramento Corporis et Sanguinis Christi Servatoris nostri, &c. ab autore in vinculis recognita et aucta." 1557, 8vo. The place of printing is not mentioned. Prefixed is a preface of thirteen pages, omitted in the subsequent edition, in which likewise the title is somewhat altered. "Assertio veræ et catholicæ Doctrinæ," &c. Lichæ, 1601, 8vo.

Cranmer was a person of a vigorous understanding, improved by extensive learning. His travels and studies had rendered him as familiar with the French, Italian, and German, as with the Latin, Greek, and Hebrew languages. In theology and the canon law he appears to have been deeply skilled; and, possessing an acute intellect and a clear head, he was capable of applying his various stores of knowledge to the most useful and practical purposes. His works afford a very favourable specimen of the English style of that period; and we are glad that they are now easily accessible, as a complete edition of them has issued from Oxford university press. With his intellectual endowments he united many of the amiable virtues of private life: his natural disposition was mild and conciliating, and he was distinguished by the engaging affability of his manners. He was however capable of being roused to fierce indignation; for we learn from unquestionable authority, that, on a certain occasion, he offered single combat to the duke of Northumberland. He was a zealous encourager of learning, and eminently practised the virtues of charity and hospitality. But his character, as we have already seen, was not without glaring defects. His compliances with the unhallowed wishes of the king, are partly to be ascribed to his want of that invincible firmness which could alone have sustained him under the frowns of so unrelenting a tyrant; and much influence must doubtless be ascribed to the prevailing notion of the time, that the will of a sovereign prince is not to be resisted by any of his subjects. Compliance in almost every possible case seems to have been regarded as an act of duty; nor is it easy, on any other hypothesis, to account for the long and

[1] Ames's Typographical Antiquities, p. 205. Lond. 1749, 4to.

[2] An edition of Cranmer's Defence, with the orthography modernized, has been published by Mr Todd. Lond. 1825. 8vo.

Cranny ‖ Crashaw.

abject submission of the English nobility and gentry to the tyranny and caprice of the house of Tudor. Although this consideration does not increase our respect for the archbishop's character, it is nevertheless obvious that the pliancy of his disposition, by enabling him to retain the favour of the king, enabled him to become a more powerful instrument in promoting the cause of learning and religion. For his deep participation in the bloody persecutions of two successive reigns, we must likewise endeavour to find some apology in the current maxims of the age to which he belonged. His own nature was far from being ungentle; but his intellect was bewildered by the doctrines, and his heart hardened by the practices, of the church in which he had been educated. (D. I.)

CRANNY, in glass-making, an iron instrument with which the necks of glasses are formed.

CRANTARA, the fiery cross of the Scottish Highlanders, was a kind of military signal for collecting the distant and scattered clansmen to the standard of their chief. The ancient crantara was a fire-brand or stick burnt at the end, and dipped in the blood of a goat; and this symbol was sent to the nearest hamlet by a fleet messenger, who delivered it without uttering a word but the name of the place of rendezvous. The crantara, which was understood to denounce destruction by fire and sword to all who refused to obey the summons, was passed with great rapidity from place to place, so that in a little time the chief found himself surrounded by all his faithful adherents, ready to obey his commands. The crantara in Gaelic was called *Crean Tarigh*, which literally denotes "the cross of shame"—because disobedience to what the symbol implied inferred infamy.

This mode of collecting a scattered people together on any emergency is of great antiquity. It is described by Olaus Magnus as a custom of the ancient Scandinavians; and from them the Highlanders appear to have borrowed it. (*Gent. Sept. Hist. Breviarium*, v. 3.)

The last time that the *crean tarigh* was circulated in Scotland was during the Rebellion of 1745; and on one occasion it passed through the district of Breadalbane, a distance of 32 miles, in the short space of three hours. Scott, in the *Lady of the Lake*, canto iii., has introduced the use of the crantara with much effect.

CRANTOR, a Greek philosopher, born at Soli in Cilicia. He was a fellow-pupil of Polemo in the school of Xenocrates at Athens; and his commentaries on Plato's works made him to be regarded, at least at Rome (Hor. 2, Ep. ii., 4), as one of the most distinguished supporters of the doctrines of the Old Academy. His poems, which are said to have been deposited in the temple of Athena at Soli, have entirely perished, but of his celebrated work *On Grief* numerous extracts have been preserved in the treatises of Plutarch and Cicero *On Consolation*.

CRAON, a town of France, department of Mayenne, on the left bank of the Oudon, 12 miles W. by N. of Chateau-Gontier. It has a fine castle, and some trade in grain, cattle, flax, and thread. Pop. 3000. Volney the traveller, and author of *Ruins of Empires*, was born here in 1755.

CRAONNE, a town of France, department of Aisne, 13 miles S.S.E. of Laon. Pop. about 1000. It is celebrated for a great battle fought here on 7th March 1814 between the French and the Prussians under Blücher, in which the latter were defeated.

CRAPE, a transparent textile fabric somewhat like gauze, made of raw silk, woven without crossing, and stiffened with gum-water. Crape is usually black or white.

CRASHAW, RICHARD, an English poet, the son of a clergyman, was born at London, and educated at the Charter-house, London. He was sent to Pembroke-hall, Cambridge, and in 1637 became fellow of Peter-house. In both colleges he was distinguished for his Latin and English poetry. Having been deprived of his fellowship during the civil wars, he was converted, or rather, as Pope says of him, outwitted to the Roman Catholic faith, and went to Paris, where he lived for some time in great poverty.

Crasis ‖ Crates.

Cowley, however, hearing of his situation, sought him out and recommended him to Henrietta Maria, queen of England. From her he received letters of recommendation which enabled him to obtain employment at Rome as secretary to a cardinal, and afterwards procured him a canonry in the church of Loretto, where he died about 1650. Crashaw wrote two volumes of poems, entitled *Steps to the Temple*, and *The Delight of the Muses*. He also composed a hymn entitled *Carmen Deo Nostro*, and other sacred poems. His works were first collected and published in 1785.

CRASIS (from κεράννυμι, to mix or temper), the temper of the blood peculiar to every constitution.

CRASIS, in *Grammar*, a figure by which two different letters are contracted into one long letter or into a diphthong, as ἀληθῆ for ἀληθέα; τειχοῦς for τειχέος, &c. It is sometimes improperly confounded with synæresis.

CRASSUS, M. LICINIUS, the triumvir, surnamed the *Rich* on account of his opulence, which he acquired at first by educating slaves and selling them at a high price. The cruelties of Cinna obliged him to retire to Spain; but after Cinna's death he passed into Africa, and thence to Italy, where he ingratiated himself with Sylla. Having been sent against Spartacus, he gained a decisive victory in which 12,000 of the rebels were killed, and was honoured with an ovation at his return. Soon afterwards he was made consul with Pompey B.C. 72, and in this high office he displayed his opulence by entertaining the populace at 10,000 tables. He was afterwards censor, and with Pompey and Cæsar formed the first triumvirate. As his love of riches was greater than his love of glory, Crassus never imitated the ambitious conduct of his colleagues, but was satisfied with the province of Syria, which seemed to promise an inexhaustible source of wealth. In hopes of enlarging his possessions he set off from Rome, although the omens proved unfavourable, and everything seemed to prognosticate his ruin. Having crossed the Euphrates he hastened to make himself master of Parthia; but being betrayed in his march by the delay of Artavasdes, king of Armenia, and the perfidy of Ariamnes, he was defeated by Surena, the Parthian general, with the loss of 20,000 men. The darkness of the night favoured the escape of the rest; but Crassus, trusting to the clemency or avarice of the enemy, was taken prisoner. He was soon after put to death by having molten gold poured down his throat. His head was then cut off and sent to Orodes. See ROMAN HISTORY, and PARTHIA.

CRASSUS, *Lucius Licinius* (B.C. 140–91), a celebrated Roman orator, of whose history we know little previous to his prosecution of Carbo (B.C. 131). He was consul B.C. 95, and after the expiration of his magistracy was proconsul in Gaul. Crassus is styled by Cicero *eloquentium juris peritissimus*.

CRATE (Lat. *crates*, wicker-work), a large case or hamper of wicker-work for the transportation of goods, as glass, china, eggs, &c.

CRATER (κρατήρ, a *bowl*), the mouth of a volcano. See PHYSICAL GEOGRAPHY

CRATER (*cup*), in *Astronomy*, a constellation of the southern hemisphere, the stars of which in Ptolemy's catalogue are 7; in Tycho's, 8; in Hevelius's, 10; in the Britannic catalogue, 31.

CRATES, of Thebes, a celebrated Cynic philosopher, and pupil of Diogenes, flourished about B.C. 328. He is said to have renounced his fortune for a life of philosophic poverty, and to have placed his wealth in the hands of bankers for the benefit of his children if they should be

Cratinus || Crawford.

simpletons, and incapable of appreciating the benefits accruing from their father's choice. He was the author of several philosophical epistles and tragedies, but these, along with his biography by Plutarch, are now lost.

CRATINUS, an Athenian comic poet, who was born about the end of the 6th century B.C. He is said to have exhibited 21 plays, and gained nine prizes. Along with Eupolis and Aristophanes, he may be regarded as one of the great masters of the old comedy—a species of poetry to which his writings gave a new character and energy. Only the titles of his plays are extant.

CRATIPPUS, a celebrated Peripatetic philosopher, born at Mytilene. After teaching philosophy in his native city, he removed to Athens, where Brutus and the son of Cicero became his disciples. He was the companion of Pompey in his flight from Pharsalia, and endeavoured to comfort him by arguments drawn from philosophy. From a passage in Tertullian, *De Anima*, we may conclude that Cratippus was the author of a book on dreams, but no other work has been attributed to him.

CRAWFORD, ADAIR, a physician distinguished by his researches in chemical physiology, was born in Ireland about the year 1748. His father, the Rev. Thomas Crawford, was the Presbyterian minister of Crumlin, near Belfast, in the county of Antrim. The family were originally from Scotland; a remote ancestor, who was a clergyman, having fled from that country to Ireland during the reign of Charles II., in order to escape the fury of religious persecution directed against all who like himself had refused to conform. The zeal which had stood so severe a test appears to have been cherished and perpetuated as an honourable inheritance in the family, which exhibited for six generations the clerical profession descending from father to son. Adair Crawford was, from his early youth, remarkable for the sweetness of his temper, the excellence of his heart, and the strength of his understanding. He received his classical education from his father; and at the age of 14 was sent to Glasgow for the prosecution of his studies. His parents intended him for the vocation of Presbyterian clergyman, but he afterwards relinquished that plan on account of the weakness of his voice. It was then proposed to him to pursue the profession of the law. He accordingly turned his attention to this new course of study, which he pursued under the guidance of the celebrated Dr Millar of Glasgow. At this period his younger brother, a student of medicine in the college of Edinburgh, persuaded him once more to change his views; and whilst they were together at their father's house he one day left him, on setting out on a journey, a human skull and a few other bones, together with Monro's book on *Osteology*. On his return he found, as he had expected, that Adair had already outstripped his young preceptor in accurate knowledge of the subject. It was then decided that he should return to Glasgow in the ensuing winter, for the purpose of attending the medical classes. Next winter he went to Edinburgh, still pursuing the same objects of study at that university. His views of the theory of animal heat were favourably received by the professors, and were long taught by Dr Monro in his anatomical lectures. In the ensuing spring, 1779, he went to London, where he then published the first edition of the work by which he gained so much celebrity. In the beginning of the same winter, a degree, probably an honorary one, of Doctor of Physic, was conferred upon him by the university of Glasgow. He was held in high estimation by the professors of that university, who from his long residence among them had ample opportunities of becoming acquainted with his worth and talents. It was observed by the celebrated Dr Reid, on his quitting that body, that he had left no man behind him better qualified for the professorships of Greek and of Natural Philosophy than Adair Crawford. The facility with which he acquired knowledge of every kind was, indeed, extraordinary, and appeared to be the result of the singular faculty he possessed of concentrating the whole force of his mind upon any subject to which he chose to direct his attention. He now determined upon settling in London, and soon after offered himself as candidate for one of the dispensaries, to which, after a severe contest, he succeeded in being elected physician. His talents speedily brought him forward in the philosophical world, as well as in his own profession. He was elected a member of the Royal Society, and shortly afterwards he obtained the appointment of physician to St Thomas's Hospital. In the year 1788 he published a second edition of his work, greatly corrected and improved, under the title of *Experiments and Observations on Animal Heat, and the Inflammation of Combustible Bodies, being an attempt to resolve these Phenomena into a general Law of Nature*. His reputation as a philosopher was now established, and procured him the notice of all the most distinguished men of science in the kingdom, and the appointment of lecturer on chemistry to the academy of Woolwich. Being led from speculation to suppose that barytes might prove an efficacious article of the materia medica, he made several experiments on the effects of the muriated solution upon himself, principally with a view of determining the dose that might be taken with safety. He then applied the remedy to some bad cases of scrofula at St Thomas's Hospital, with a degree of success that raised in his mind the most sanguine expectations of its proving a specific for the cure of that intractable disease; expectations which, as has happened to so many new remedies, subsequent experience has far from realized.

Crawford.

Dr Crawford was now rising into great eminence as a medical practitioner; but his incessant application to the laborious duties of his profession, as well as to his philosophical pursuits, was beginning to undermine a constitution naturally weak. He was invited by the first Marquis of Lansdowne to his seat of Hardwell Cliff, near Lymington, in hopes that the change of air might have a beneficial effect upon his health. But the foundations of his disorder were too deeply laid: he gradually declined, and shortly after died at Lymington, on the 29th of July 1795.

In 1785 Dr Crawford married Miss Stone, a Devonshire lady, by whom he had four children, two sons and two daughters. His eldest son became a clergyman, the other a physician. The daughters, who were infants at his death, were principally educated under the immediate superintendence of the celebrated Miss Elizabeth Hamilton, who was first cousin to their father, and who adopted them as her heirs.

His eldest brother, the Rev. William Crawford, and the father of Dr Stewart Crawford of Bath, was a man of considerable literary attainments: he published *Remarks on Lord Chesterfield's Letters*, which met with success, and also *Translations from Turretine*, and a short *History of Ireland*. His second brother John was for many years a surgeon in the service of the East India Company, and published a pamphlet, showing, from a number of cases, the efficacy of calomel, conjoined with other purgatives, in the treatment of those morbid affections of the liver to which the inhabitants of India are so prone; a work which probably laid the first foundation of the practice which has since been so generally adopted. His brother Alexander was a physician at Lisburn in Ireland, and obligingly furnished the materials of the present notice.

The published works of Dr Crawford, besides that on *Animal Heat*, above noticed, were, a paper in the Philosophical Transactions, *On the power inherent in the Human Constitution of resisting high degrees of Temperature*; and another *On the effect of Muriate of Barytes in the Cure of certain Diseases*. A posthumous work of his, *On the effect of Tonics on the Animal Fibre*, was edited by his brother, Dr Alexander Crawford.

He had a taste for poetry, which, however, he indulged but sparingly. An elegy which he wrote *On the death of Lady Sarah Stewart*, the mother of Lord Castlereagh, afterwards Marquis of Londonderry, was supposed to have considerable merit, but he could never be prevailed on to publish it. (P. M. R.)

CRAYER, CASPAR DE (1585–1669), an eminent painter, born at Antwerp, was a disciple of Raphael Coxis, the son of the same Coxis who had studied under Raffaelle. He

soon gave such proofs of genius and an elevated capacity that he far surpassed his master. Of all his contemporaries, he was accounted to approach nearest to Vandyck, not only in history but in portrait. He principally painted religious subjects, and was continually at work. Although he lived to a great age, yet by temperance and constant regularity he preserved unimpaired the full use of all his faculties; and to the last month of his life his pencil retained the same force and freedom which it possessed in his youth. His principal works are at Brussels and Ghent.

CRAYON (French *craie*, chalk), a general name for all coloured earths or other substances used in designing in pastel or paste, whether these be used in their natural consistence, or have been reduced to paste and formed into pencils.

CRAYFORD, a village, formerly a market-town of England, county of Kent, on the Cray, 11 miles E. by S. of London. In the vicinity are extensive silk and calico-printing establishments, and flour mills. In 457 Vortigern was defeated here by Hengist. Pop. of parish (1851) 2935.

CREAM (Lat. *cremor, thick juice, pap*, &c.), in a general sense, any part of a liquor that separates from the rest, and collects on the surface. It is chiefly applied to the oily part of milk, which being specifically lighter than the rest of the fluid rises to the surface in the form of a scum.

CREAM *of Tartar*, purified argol. See ARGOL.

CREASOTE (*κρέας flesh, σώζω to save*), a fluid compound of carbon, hydrogen, and oxygen, obtained by Reichenbach by the distillation of wood-tar. It has a caustic and burning taste, and the flavour of peat smoke or smoked meat. It preserves animal matter from putrefaction, and is employed in medicine as an antiseptic, and to allay vomiting. See CHEMISTRY.

CREAT (French), in the manège, an usher to a riding master.

CREATION, in its primary import, signifies the bringing into being something which did not before exist. The term is therefore generally applied to the original production of the materials out of which the visible world was composed. It is also used, in a secondary or subordinate sense, to denote those subsequent operations of the Deity upon the matter so produced, by which the whole system of nature, and all the primitive orders of things, received their form, qualities, and laws.

For the alleged discrepancies between the results of geology and the account of the creation in Genesis, see THEOLOGY.

CREBILLON, PROSPER JOLYOT DE, a French writer of tragedy, usually ranked after Corneille and Racine, was born at Dijon, Feb. 15. 1674. He was originally destined for the profession of the law, and went to Paris with that view; but the impetuosity of his passions rendering him unfit for business, he was urged by some friends, who discovered his natural turn, to attempt dramatic composition. It was not without some reluctance that he at length complied with their desire; and after a time he produced a tragedy, which met with great success. He continued to advance in the career he had commenced till his marriage, which provoked his father to disinherit him. Although reestablished in his rights before his father's death, the poet had already squandered his patrimony by anticipation; and still continued in poverty. His miseries were increased by the death of his wife in 1711; but having soon after obtained the somewhat uncongenial employment of censor of the police, he continued in prosperous circumstances till his death in 1762. He was of an extremely robust temperament, ate prodigiously, and slept little; and was always surrounded with about thirty dogs and cats, and smoked large quantities of tobacco in order to neutralize the exhalations from these animals. When ill he made a jest of physic and physicians, and treated his case in whatever way his fancy suggested. The principal pieces of Crebillon are *Ictomenée, Rodogune, Atrée, Electre, Rhadamiste, Sémiramis, Catalina*, and *Le Triumvirat*. The *Pélopides* is considered as a failure. After the brilliant success of his *Catalina*, Louis XV. caused the *Œuvres de Crébillon* to be printed at the royal press of the Louvre, in 2 vols. 4to, 1750, the profits of which were given to the author.

His son Claude (1707–1777) obtained great popularity by the powerful delineations in his various very licentious novels. See ROMANCE.

CRÉCY, or CRESSY, a town of France, department of Somme, on the Maye, 12 miles N. by E. of Abbeville, with about 1600 inhabitants. It is famous in history for the great victory gained here in 1346 by the English forces under Edward III. over the French under Philip of Valois. Cannon are said to have been first used by the English in this battle.

CREDENTIALS, letters of recommendation and power, especially such as are given by a government to an ambassador or envoy, by which he obtains credence or credit at a foreign court.

CREDIBILITY is applied to a species of evidence less than certainty, and greater than mere possibility. It is nearly allied to probability, and may be regarded as a mean between possibility and certainty.

CREDIT, in the sense in which we are now to treat of it, is the trust which is given to a person when he obtains a loan of money, or purchases any article, the payment of which is to be made at an after period. Every sum of credit, therefore, must be founded on a transfer of a corresponding sum of capital; and the whole amount of credit existing at any time can never exceed that of the lent capital. Credit is, in reference to the person who gives it, the power of lending, and to him who receives it, the power of borrowing. The basis of credit is confidence, and this is found to exist extensively only where good faith and punctuality have been allowed to grow into habit, and where laws afford to creditors the easy and certain means of recovering their debts.

In young countries, before dealings have become multiplied, we find people inattentive to their money engagements, when there is no want of property with the debtor, and even when the payment of the debt has been fixed by document to a positive term. But as transactions increase, and population presses more closely together, a knowledge of the circumstances of individuals is rendered difficult, and a necessity for punctuality arises, to prevent doubts being entertained of the ability to pay. And this apprehension of discredit entertained by the debtor, and of its consequences to his future transactions, has more effect to establish and maintain good faith and exactness than the operation of the laws is able to produce.

When capital is abundant, relatively to the means of employing it, the competition of capitalists produces a facility of obtaining credit; and parties become enabled to borrow and purchase upon credit who could not do so before. Credit is then said to be high, but it is the value of the capital which, from the overstock, has become low. The capitalist, in these circumstances, grows less scrupulous about his security, that he may bring within the range of his dealings a greater body of borrowers or purchasers, and thereby be enabled to keep up his price.

When the supply of capital continues in this state for any length of time, it gives rise to an imprudence of conduct which lays the foundation of much after evil. Sales and loans are made at credits far beyond the ordinary periods; and those into whose hands the extra capital by this means passes, considering it as a fund with which they may trade, go on also extending their dealings and credits, until the whole system is put upon the stretch. In this situation any interruption to the sale of commodities occasions instant confusion and distress. The con-

Credit. fidence which had prevailed gives place to alarm and distrust, and the same effect is produced for the time by the retardment of the circulation that would have been experienced had the capital itself been withdrawn.

By the operation of credit, not only is the circulation of capital facilitated, and its employment increased; but by its means alone certain descriptions of capital can be brought into action.

When an article is sold upon credit, the seller places, for the time, a portion of his capital at the command of a party who may have no capital of his own. This person, nevertheless, by another operation of credit, is enabled to sell upon credit also, and still keep his engagement with the party from whom he bought. This he accomplishes by calling in the assistance of the money capitalist, the banker, who advances to him the amount of the sale upon his and his purchaser's joint security, and receives in consideration a rent for the sum advanced. By this process facility and extension are given to circulation, beyond what could take place if the commodity could be exchanged only for immediate value; whilst an opportunity is, at the same time, afforded of employing a branch of capital which would otherwise remain inactive and without use.

It is almost unnecessary to remark, that it is by the operation of credit that a return is got from the capital of persons who are incapable of employing it themselves, and which can be put into a state of useful activity only by lending it to others.

Even the fixed capital, when leased to a tenant, may be said to be put into circulation by credit. For when a landholder lets a farm, suppose of the value of L.10,000, at the rent of L.400 a year, he lends the tenant L.10,000 of capital, as much as if he lent him the money, and enabled him to acquire for the time the property upon which he is to operate.

In Scotland, after the disposition to commercial pursuits began to manifest itself, the progress was retarded, by the total want of commercial capital in the country. To get the better of this difficulty, and draw to these employments any little capital that otherwise existed, it became the practice, when a commercial undertaking was to be entered upon, to associate in the adventure some persons of known substance, and, upon the joint credit of the parties forming the company, to borrow the capital necessary for carrying it on. The credit which was thus established is called company credit, and is effectual to its proposed end of borrowing or purchasing with advantage, according to the supposed responsibility of the parties of whom the company is composed.

Up to the year 1793 a considerable proportion of the manufacturing and mercantile concerns of Scotland were carried on upon this plan; and to give strength to their credit, and encourage those who had money to lend to place it with them, a rule was established, and confirmed by decisions of the courts of law, that, in case of bankruptcy, a creditor of a company should be entitled to claim upon each of the partners' separate estates, in competition with the party's individual creditors, for the balance of his debt unpaid from the company's effects.

When a party purchasing or borrowing capital gives a written obligation for the amount, payable to the order of his creditor at a certain fixed period, he embodies a sum of credit capable of being exchanged again for capital; and the transference of these documents to new parties, who replace to the former creditor the capital he had lent upon them, is what is called a circulation of credit. Indeed, without the use of bills, or of some instrument of similar powers, credit must have been confined to a single operation between first contracting parties, and the circulation of capital limited to what could have been effected in this way. But a transferable document of the sum to be received becomes itself a negotiable or marketable article; and the collective credit of the parties through whose hands it may successively pass continuing to be engrafted upon it, a new facility is gained to circulation by every movement which it makes. Credit.

The whole of the credit embodied by bills, however, is not brought into circulation; a part only of the sellers or lenders requiring to have their capital replaced to them by anticipation. But it is according to the expected facility with which payments may be thus anticipated, that credit is at first freely and readily given; and whenever any thing occurs to impede the circulation of credit, there is an immediate disposition in the merchant to withhold or limit it.

Every transfer of capital made upon a buyer or borrower's own obligation of payment creates a new sum of transferable credit; and this is the case, although it should be the same capital that is again and again transferred. But a sale of goods, or an advance of money upon the obligation of a third party, indorsed to the seller or lender, forms no addition to the sum of circulating credit, the transaction being the circulation, not the creation, of a sum of credit. Neither does a succession of purchases or borrowings, effected by means of the same document indorsed from the one party to the other, add to the sum of credit in circulation. For although each of these transactions is the ground of a separate obligation between the parties contracting, there is with the whole but one absolute creditor, the holder of the bill, and one absolute debtor, the acceptor of the bill, the others being merely contingent debtors to the one, and contingent creditors of the other.

Circulated credit is to be classed into that circulated by loan, and that which is circulated by means of sale. The first is the circulation of the credit founded upon the obligation of individuals or private companies, and called private credit; the second, of that founded upon the obligations of the state, or the transfers of the stock of corporate bodies, and called public credit.

The documents of these two descriptions of credit possess different and distinct qualities, and are differently negotiable. It may be proper, therefore, to examine how they are employed as means of borrowing or purchasing, what are their separate powers, and what is the probable extent of the circulation of each.

We shall begin with those belonging to private credit, which are as follows:

First, Obligations payable to the bearer on demand, and which, being passed without recourse, are employed as money.

Secondly, Transferable obligations payable at an after date, as notes of hand and bills of exchange, which, being negotiated with recourse upon the preceding obligants, are taken as guaranteed pledges of a sum to be received when they become due.

The circulation of obligations, payable to the bearer on demand, or notes employed as money, is the circulation of a credit borrowed by the issuer of the note from the public; the holder of the note at the time is the creditor; and the property he gave in exchange for it is a loan from him to the banker.

As it is in the power of the party giving this credit at any time to put an end to it by calling for his money, these notes circulate upon the credit of the issuer alone. No assurance of payment is required from the person from whom they are received, as is the case with bills; the payment of which being at a future date, it is thought necessary to reserve recourse against the parties through whose hands they have passed. The circulation of notes

Credit. payable on demand is therefore a circulation of what may be termed single credit, and bills a circulation of collective credit.

When bank-notes are issued by a banker in discount of a bill, it may be supposed that a twofold credit is put into circulation; a credit to the party to whom the bill has been discounted, and a counter credit from him to the issuer of the notes. But in this stage of the transaction, no circulation of credit has taken place. Credit is circulated only when exchanged for capital, and in this case it has been but the exchange of one credit for another. The banker, indeed, in giving his notes payable on demand in exchange for a bill payable at a future date, gives what is of a quality different from that which he receives; for what he gives is immediately exchangeable for capital, and to the person receiving it is the same as capital. But still it is only credit he has parted with, which will not be in a state of circulation until it comes to be exchanged for capital. In as far as relates to circulation, the transaction is the same with that of a person lending his credit to another, by accepting a bill to him without value. A sum of credit is thereby created, but is not circulated until the bill comes to be exchanged for value.

The credit that is in circulation from the exchange of bank-notes for a bill, is a credit from the party who at the time has given capital or value for the notes. When the banker "cashes" them, he becomes the creditor, but while they remain in circulation the public is the creditor.

The amount of credit from the circulation of cash notes never can be pushed beyond what would have been the value of the specie that would have been in circulation had the currency been of the precious metals, which the notes only serve to represent. Should the notes cease to be convertible into specie, their amount, indeed, may be augmented at the pleasure of the issuer; but their value, and the credit in circulation from them, will still be regulated by this limit. The increased sum will represent the value which the smaller did before, and each note will be reduced in its value, in the proportion of the increase that may have taken place of the whole.

This description of circulating credit is of a quality different from the others. From supplying the place of capital, in its character of currency, it is lent out as capital; but loans from this fund are precarious, its amount depending upon the state of public confidence, and being liable to be diminished by every call upon the banks to replace the notes with specie.

Circulating notes, not convertible into specie, issued under the authority of the state, have been called a fabric of unreal credit. But this currency, however unsuitable to its proper ends, affords a circulation of real credit. It is indeed exposed to constant fluctuation of value, according to the amount of it in the circle; and the party taking it is obliged, for his own safety, to include in the price of what he gives for it, sufficient to cover the difference between it and specie, and the risk of further depreciation while it may remain in his hands. Still, however, an amount of credit, to the value of what has been given for the notes, in the first instance, is put into circulation, and an amount continued in circulation, to the value always of what they are exchangeable for at the time; the holders of them always remaining creditors of the issuer, to the extent of the whole sum which the notes profess to pay.

A currency of this description, however, is inapplicable as a measure of value, and therefore unfit to be employed as a circulating medium. And as to the other object, intended by its issuers to supply an amount of funds to the state; the depreciation with which it must be issued at first, and the loss to be sustained from taking it back again at par, render it an expensive means of borrowing. Credit.

With regard to obligations payable at a future date, which constitutes the second branch of private credit, and which we are next to consider, the credit founded on them is circulated, either in the transfers of the ordinary capital in sales, as when the credit of indorsed bills is employed to purchase goods, or in the transfers of the banking capital in loans, as when the credit of indorsed bills is employed to borrow money; the transfer under the latter, when the bill is exchanged for money, being often a further circulation of a credit previously circulated under the former, when the bill was exchanged for goods.

A fictitious bill, that is, an acceptance given without value, vests in the person in whose favour it is drawn a sum of transferable credit not less than would have been the case if it had been the document of a sale, or loan of property. Mr Thornton, in his treatise on Paper Credit, established the doctrine, till then disputed, that the credit of a bill does not rest upon the nature of the transaction in which it has originated, but upon the conceived ability of the obligants to discharge the debt.

The being able to embody in bills every sum of credit, has furnished the means of employing, with incalculable advantage to commerce, a portion of the capital of the country, which otherwise, it is probable, would have remained inactive.

The security they afford for the repayment at a stipulated period of the sums lent upon them, furnishes the means of an interim employment of money held for after occasions, which the party would not otherwise venture to lend out; of money which formerly lay idle in the hands of parties unacquainted with any safe means of using it; and of the money which traders are daily receiving in the course of their business, but which they do not immediately require. These different sums collected in the hands of a banker, form what is called the banking capital of the country; and which, lent out upon such securities, produces not only a profit to him, but interest to the parties who have placed them at his disposal. The importance of this intermediary fund in the transactions of the country is such, that when, from distrust, at any time, these deposits are withheld or withdrawn from the bankers, the mercantile body is convulsed throughout.

We now come to the second division of credit, that circulated by sale; the documents of the first branch of which are, the negotiable obligations of government, as exchequer bills, navy bills, &c., and the whole of the public funds, constituting what is termed the credit of the state.

When capital is to be competed for, this credit has an advantage in the market over the former. Its price rises according to the demand; and by that means it is enabled to secure whatever share it may require of the supply. This is not the case with the credit circulated by transfers of capital upon loan, the price or stipulated rent of which cannot, whatever may be the demand, rise beyond a prescribed limit. It has the effect, in these circumstances, to force the capital applicable to this part of the circulation to seek the employment of the other; so that the inconvenience produced by an interruption of circulation from a diminution of the general capital, falls entirely upon the circulation of bill credit, the supply for the circulation of the credit transferable by sale being kept full, at the expense of that applicable to the circulation of credit transferable by loan.

Hence all additions made to the national debt have an effect to operate against the circulation of the credit founded upon bills; for every new loan not only takes a

Credition ‖ Creech.

large sum permanently from the fund of circulation, but adds a proportion of the newly-contracted debt to the sum to be circulated; the consequence of which is a fall in the market value of these securities, according to the change which has taken place upon the two funds. But this diminution of the means of circulation does not interrupt the circulation of government obligations, which continue to command a supply of capital, by accommodating their price to the state of the market under every pressure of circumstances. But when they happen to be in this state, their circulation enters into competition with government itself, in its biddings for the capital of new loans. For the price they bear at the time fixes the terms upon which the minister is enabled to make his bargain with the money-lenders.

When government goes on for a length of time in a course of borrowing, there is a progressive depreciation of the value of these securities, in the exact degree in which the loans take from the amount of the circulating capital, and add to the sum of credit to be circulated. This was strongly evinced in the fall of the price of stock in the early period of the war of 1793, notwithstanding the influence at the time of an unprecedented accession of new capital, proceeding from the greatest flow of commercial prosperity which the country had ever experienced.

The transferable shares of public stock companies, from being occasionally a means of temporary investment of capital, have by some been considered as forming a part of the circulating credit of the country. But this is not the case. The stocks of these companies form a part of the ordinary circulating capital; and of consequence, the transfers of their shares are not operations of credit, but exchanges of capital between the buying and selling parties. The transfers of the premiums, however, paid in the purchase of this description of stock, which, although no part of the capital, form an immediate part of the price, may be fairly considered as a circulation of credit, to be added to the amount of the circulating credit of the country. The mode of circulating this credit being the same with that of the public funds, and its market value rising or falling with the general abundance or scarcity of capital, its circulation, when capital is scarce, immediately interferes with the circulation of credit by simple borrowing. (D. B—E.)

CREDITON, a market-town of England, county of Devon, on the Creedy, near its junction with the Exe, 8 miles N.W. of Exeter. Pop. (1851) 3934. It is situated in a narrow vale, between two steep hills, and is divided into two parts, the east or old town, and the west or new town. The church, formerly collegiate, is a noble edifice, in the later pointed style, with a fine tower 100 feet in height springing from the centre. There are places of worship for Baptists, Independents, Methodists, and Unitarians, a free grammar-school with three exhibitions to either university, blue-coat, national, and infant schools, a mechanics' institution, public library, and news-room. There were formerly extensive woollen and serge manufactories here, but the inhabitants are now chiefly engaged in agriculture. It returned two members to the parliament at Carlisle in the reign of Edward I., and previous to 1049 was the seat of a bishopric, which was afterwards removed to Exeter.

CREDITOR, a person to whom any sum of money is due, either by obligation, promise, or otherwise.

CREDULITY, easiness of belief; a disposition to yield assent to propositions or to facts on slight evidence, or no evidence at all.

CREECH, Thomas (1659–1701), well known for his translations of the ancient classics, was born near Sherborne, Dorsetshire. He received the elements of his education under Mr Curganven of Sherborne, to whom he afterwards dedicated a translation of one of the Idylls of Theocritus; and in 1675 he was entered as a commoner of Wadham College, Oxford. Wood states that his father, Thomas Creech, was a gentleman; but Giles Jacob, in his *Lives and Characters of English Poets*, says that the circumstances of his parents not being sufficient to afford him a liberal education, his disposition and capacity for learning raised him up a patron in Colonel Strangeways, whose generosity supplied that deficiency. In 1683 Creech took the degree of master of arts, and not long afterwards was elected probationer fellow of All Souls College; to which, Jacob observes, the great reputation acquired by his translation of Lucretius recommended him. Wood mentions that upon this occasion he gave singular proofs of his classical learning and philosophical attainments. He also took the degree of B.D. in 1696. In 1699, having taken holy orders, he was presented by his college to the living of Welwynn, Hertfordshire; but he had not long enjoyed his preferment when he put an end to his own life. The motives which urged him to the deed have been variously represented, as springing from slighted affection or from his own morose temper; but from an original letter of Arthur Charlett, preserved in the Bodleian Library, it seems to have been caused by the refusal of an intimate friend to grant him a sum of money, which his narrow circumstances constrained him to borrow.

Creed ‖ Crema.

Creech's principal works are, *A translation of Lucretius; A translation of Horace*, in which, however, he has omitted some few odes; *The Idylls of Theocritus, with Rapin's Discourse of Pastorals; A translation of Manilius's Astronomicon;* besides translations of several parts of Virgil, Ovid, and Plutarch, printed in different collections.

CREED, a brief summary of the articles of Christian faith. See Confession.

CREETOWN, a maritime village and burgh of barony in Scotland, stewartry of Kirkcudbright, beautifully situated at the mouth of the Cree, in Wigton Bay. It has some coasting trade, and in the neighbourhood is an extensive granite quarry employing upwards of 300 persons. Dr Thomas Brown was born here in 1780. Pop. (1851) 1303.

CREFELD, or Krefeld, a town of Prussia, capital of a circle of the same name, in the province of Düsseldorf, 10 miles N.W. of the town of that name. This town is one of the finest in Rhenish Prussia, being well and regularly built, while the surrounding fertile district is almost entirely laid out in gardens. It is the most important seat of the silk and velvet manufactures in the kingdom, affording employment to about 13,000 persons in the town and neighbourhood. Among its other manufactures are linen, cotton and woollen stuffs, earthenware, leather, spirits, tobacco, and soap. The manufactures to which Crefeld principally owes its present prosperity were introduced by religious refugees from the neighbouring duchy of Juliers, about the close of the 17th century. Pop. (1849) 36,134.

CRELLIUS, John, a famous Socinian, born in 1590, at a village near Nuremberg. In 1612 he went into Poland, and became lecturer on divinity and Unitarian minister at Cracow, where he died in 1632. Crellius wrote, 1. *Ethica Aristotelica, ad Sacrarum Literarum normam emendata*, 1650, 4to; 2. *De Deo et attributis ejus*, Cracow, 1630; 3. *De uno Deo patre, libri duo, in quibus multa etiam de Filii et Spiritus Sancti naturâ*, 1631, 8vo; 4. *Declaratio sententiæ de causis mortis Christi*, 1637, 8vo; 5. *Vindiciæ pro Religionis libertate*, 1637, 8vo; 6. *De Spiritu Sancto qui fidelibus datur*, 1650, 8vo; 7. *Catechesis ecclesiarum Polonicarum reformata et redacta primum per Faustum Socinum et alios, nunc a J. Crellio, etc. recognita*, Irenopoli, 1665, 1680, 1684, 8vo; and other works, including a German translation of the New Testament, and Commentaries on some of the Epistles.

CREMA, a town of Venetian Lombardy, province of Lodi and Crema, on the right bank of the Serio, here crossed by a bridge, 25 miles E.S.E. of Milan. Pop. about 8600.

Cremation ‖ Creodiba.

It is well built, is inclosed by a ditch and old fortifications, and has a castle, a cathedral, and numerous other churches, several palaces, hospital, asylums, &c. It has manufactures of lace, hats, thread, and silk; and the vicinity produces excellent flax.

CREMATION (Lat. *cremare*, to burn), a burning; particularly applied to the ancient custom of burning the dead. See BURNING OF THE DEAD.

CREMNITZ, a town of Hungary. See KREMNITZ.

CREMERA, in *Ancient Geography*, a small river of Etruria, falling into the Tiber not far from Rome. On the banks of this river the 300 Fabii established themselves when they set out from Rome on their expedition against the Vejentes, and kept the enemy in constant alarm, till they were surprised in one of their sallies, and cut off to a man, B.C. 477. This disaster occurred on the 16th of July, on which day many years later the Romans sustained the terrible defeat of the Allia. Some modern geographers have identified the Cremera with the Fosso di Valca; others, on apparently better grounds, with the Aqua Traversa, which falls into the Tiber about three miles from Rome.

CREMONA, a province of Austrian Lombardy, lying north of the Po, which separates it from Parma and forms its boundary on the south; on the north it has the province of Brescia, east that of Mantua, and west that of Milan. It is about 45 miles in extreme length, and 15 in breadth; containing 523 square miles, and (1851) 204,558 inhabitants. The surface is level, and the soil very fertile, producing abundant crops of wheat, rice, maize, and flax. Horses and black cattle are numerous, and silk is an extensive production, but the sheep are few. There are no important manufactures carried on except the spinning of silk.

CREMONA, the capital of the above province and the seat of a bishop, is situated on the north bank of the Po, crossed here by a bridge, 46 miles S.E. of Milan. It is well built, of an oval shape, about six miles in circumference, and surrounded by walls flanked with towers and wet ditches. It possesses many good buildings, principally churches, richly adorned with frescoes and paintings by native artists. The cathedral is an ancient structure, in various styles of architecture. The interior is composed of a nave, with two aisles, divided by eight immense pillars, and is gorgeously coloured and gilded. Near the cathedral is the great tower, founded in 1283, the highest in northern Italy, being 396 feet in height. In the third story is an enormous astronomical or astrological clock. Cremona has also civil, criminal, and commercial tribunals; a lyceum, gymnasium, theatre, public library, hospitals, asylums, and other charitable institutions; and numerous well-conducted schools. Its manufactures include silks, cottons, porcelain, earthenware, and chemical products. It has a considerable trade in agricultural produce, and the surrounding district is noted for its superior flax. It was formerly celebrated for its violins and other musical instruments, but the manufacture of these has now declined. Violins of Cremona have been known to sell at 100 and 200 guineas each. Pop. about 30,000.

CRENATE, or CRENATED (Lat. *crena*, a notch), in *Botany*, is applied to a leaf which has its edges serrated or scalloped. The diminutive *crenulate* is used by Linnæus in the same sense. It is also applied to the fine saw-like edges of shells, as exemplified in the cockle.

CRENELLATED, in *Architecture*, embattled, notched, or indented, as in the mouldings of Norman buildings. *Crenelles* are the openings in an embattled parapet.

CRENELLE, or IMBATTLED, in *Heraldry*, is applied to any honourable ordinary that is drawn like the battlements on a wall.

CRENOPHYLAX, in *Antiquity*, a public officer at Athens for superintending the wells and fountains.

CREODIBA, in the middle ages, signified a robbery and murder committed in a wood, with the burning of the body in order to prevent discovery of the crime. The word, says Wendelinus, is compounded of *cruy* and *diven*, that is, *wood-robbers*.

Creole ‖ Crepida.

CREOLE (Spanish, *criollo*), a name originally given to the descendants of the first Spanish settlers in America and the West Indies by native women. It was afterwards applied to the descendants of other Europeans, who were accordingly distinguished as French creoles, Dutch creoles, &c. In the Spanish colonies creoles were excluded from civil, military, and ecclesiastical offices, until Charles III., in 1776, granted them these privileges. The term is now commonly used to denote one born in America or the West Indies of European parents.

CREON, in *Greek Antiquity*, a mythical king of Corinth, was the son of Lycæthus. It was during his reign that Jason returned to Greece, bringing with him his Colchian bride, the renowned sorceress Medea. In his visits to the Corinthian court, Jason saw Glauce or Creusa, the only daughter of the king, and became enamoured of her. Creon promised to give her to him in marriage on condition that he divorced Medea, by whom he already had two children. Jason consented, and Creon ordered Medea to quit his dominions. She begged to be allowed to remain for a single day; and when this request was granted, she prepared during the interval a poisoned robe which she sent as a present to her rival. Glauce, unsuspicious, put it on and soon expired; and Creon, who had kissed her while in the agony of death, was seized with the contagion and likewise perished. This story forms the plot of Euripides' tragedy of *Medea*.

CREON, son of Menœceus, ascended the throne of Thebes at the death of Laius, who had married his daughter Jocasta. Alarmed by the ravages of the Sphynx, Creon offered his crown and his daughter in marriage to any who could solve the enigma propounded by the monster. Œdipus having accomplished the task, accordingly ascended the throne of Thebes, and married Jocasta, unconscious that she was his mother. By her he had two sons, Eteocles and Polynices, who mutually agreed, after their father's death, to reign in alternate years. Eteocles first ascended the throne by right of seniority; but having refused to resign at the appointed time, his brother attacked him at the head of an army of Argives. The war was decided by a single combat between the two brothers, who killed each other, and Creon governed during the nonage of Leodamus, the son of Eteocles. In this capacity he ordained that the Argives, and more particularly Polynices, who was the cause of all the bloodshed, should remain unburied; and that any who infringed this decree should be buried alive. Antigone, the sister of Polynices, disobeyed the edict by sprinkling dust upon her brother's body, and was punished accordingly. On this, Hæmon, the son of Creon, who was passionately fond of Antigone, killed himself on her grave; and Creon was afterwards killed by Theseus, who made war against him to avenge his inhumanity towards the Argives.

CREPANCE (Lat. *crepo*, to clatter, to crack), a chop or cratch in a horse's leg, caused by the shoe of one hind foot crossing and striking the other hind foot. It sometimes degenerates into an ulcer.

CREPIDA (κρηπίς), in *Antiquity*, a slipper used by the Romans, in imitation of the Greeks, and worn with the pallium, not with the toga—the *calceus* being the shoe used in walking. The proverb *Ne sutor ultra crepidam* is familiar to every one. It is said to have originated from an incident in the career of the celebrated painter Apelles. That artist used to expose his finished pictures in a public place, and take up his station behind the canvas to hear the remarks of the passers-by. On one occasion a cobbler criticized the defects in the shoes of a figure that was thus exposed. Apelles took the picture home, corrected the fault, and on the following day set up the painting as usual for public view. The cobbler finding the defect amended

Crepundia || Crescimbeni.

which he had discovered in the shoes was proceeding to criticize the leg, when Apelles, rushing out from behind the canvas, exclaimed, "*Ne sutor ultra crepidam.*"

CREPUNDIA, in *Roman Antiquity*, a child's rattle; and hence used to express such things as were found along with children who were exposed, as tokens by which they might be recognized.

CREPUSCULUM (*Latin*), in the *Old Astronomy*, twilight; the time from the setting of the sun till dark; what is known in Scotland as the gloaming. The correlative term is DILUCULUM, which signifies the dawning of the day; day-break.

CRESCENT (Lat. *crescens*, growing, increasing), the new moon; which, as it recedes from the sun, shows a curving rim of light, terminating in points or horns, which increase till it becomes full and round. The term is also applied to the moon in its wane or decrease, but less properly.

CRESCENT, in *Heraldry*, a bearing in the form of a half moon. The Ottomans bear sinople, a crescent montant, argent.

The crescent is frequently used as a difference in coat armour, to distinguish it as that of a second brother or junior family.

The figure of the crescent is the Turkish symbol; or rather it is that of the city of Byzantium, which bore this device from all antiquity, as appears from medals struck in honour of Augustus, Trajan, and others.

The crescent is sometimes montant, that is, its points look towards the top of the chief, which is its most ordinary representation; and hence some contend that the crescent, absolutely so called, implies that situation; though other authors blazon it montant when the horns are towards the dexter side of the escutcheon, in which position others call it *incroissant*.

Crescents are said to be *adossed*, when their backs or thickest parts are turned towards each other, and their points look towards the sides of the shield. *Crescent inverted*, is that whose points look towards the bottom; but *turned crescents* are placed like those adossed, the difference being, that all their points look to the dexter side of the shield: *conturned crescents*, on the contrary, look to the sinister side; and *affronted* or *appointed crescents* are contrary to the adossed, the points looking towards each other.

CRESCENT has also been applied to three orders of knighthood; the first of which was instituted by Charles I., king of Naples and Sicily, in 1268; the second in 1448 by René of Anjou; and the third by the Sultan Selim in 1801, two years after the battle of Aboukir.

CRESCENTINO, a town of Piedmont, kingdom of Sardinia, province of Vercelli, and 18 miles W.S.W. of the town of that name, at the junction of the Dora Baltea with the Po. It is supposed to have been a Roman station, from the remains found here. Pop. 4500.

CRESCIMBENI, GIOVANNI MARIO DE', an Italian poet, and literary historian, born in 1663 at Macerata, in the march of Ancona. His father, who was a jurist, designed him for the profession of law; but a residence in Rome having developed his poetical talents, he addressed himself to the task of effecting a reformation in the prevailing school of Italian poetry. With this view he projected the establishment of a new academy, under the name of *Arcadia*; the members of which used to meet in the open air, at a place which they were accustomed to call the Bosco Parrasio. They called themselves the shepherds of Arcadia, and each took the name of some shepherd and some place in that ancient kingdom. Of this society Crescimbeni was appointed chief director in 1690, and was re-elected at every *Olympiad* till his death, which took place in 1728.

In Niceron a list is given of his works, the principal of which are, *Istoria della volgar Poesia*, Rome, 1698. 4to; *I Commentarj intorno alla detta Istoria*, 5 vols. 4to; *Le Vite de più celebri poeti Provenzali tradotte dal Francese, e accresciuti di moltissimi poeti*, Rome, 1772, 4to; *Trattato della bellezza della volgar Poesia*, Rome, 1700, 4to; *Istoria d'Arcadia*, Rome, 1709, 4to; *Istoria della Basilica di S. Maria in Cosmedin col ristretto di molte altre chiese di Roma*, Rome, 1715, 1719, 4to; *Istoria della chiesa di S. Giovanni a porta Latina*, Rome, 1716, 4to; *Istoria della Basilica di S. Anastasia*, Rome, 1722, 4to; *Stato della sacrosanta chiesa papale Lateranese*, Rome, 1724, 4to; *Omelie e Orazioni di papa Clemente XI, volgarizzate*, Florence, 1704, 4to, Venice, 1714, 8vo; *Vita de Monsignore Gio. Maria Lancisi, medico di Papa Clemente XI.*, Rome, 1721, 4to; *Vita di Monsignore Gabriello Filipucci*, Rome, 1724. 4to; *Atti della coronazione del Cavalier Perfetti, fatta in Campidoglio*, Rome, 1725, 4to; *L'Elvio, favola pastorale*, Rome, 1695, 8vo; *Rime del Crescimbeni*, Rome, 1695, 12mo; *Gli Apologhi di Berardino Baldi tradotti in versi*, Rome, 1702, 12mo; *Compendio della vita della beatissima Vergine*, Rome, 1724, 16mo; besides a number of works edited by him.

Crespi || Crest.

CRESPI, GIUSEPPE MARIA, a Bolognese painter, born in 1665, was an artist of undoubted genius and great industry. He successfully imitated, at different periods, the Caracci, the Venetian school, and Baroccio, in endeavouring to strike out a novel style of art. In this he succeeded; but he is considered by Mengs as having tended to corrupt the school of Bologna by capriciously introducing in his historical, and even into his religious compositions, a species of caricature. His earlier pictures are painted in a firm and commendable tone of colouring; but many of his later pieces are negligently pencilled, and his colours, from carelessness in their preparation and haste in laying them on, are raw, and have utterly faded in their tints; while in his shadows and draperies, from his attempts at novelty, he has degenerated into mannerism. He was much employed by the nobility, and also by the pope, who conferred on him the title of *Cavaliere*. Crespi was considered in Italy as the first painter of his age. He died in 1747. Lanzi, *Stor. Pitt.*

CRESSET, a great light set on a beacon, lighthouse, or watch-tower. It also signifies a lamp or torch; a large light or lantern fixed on a pole. Minshen derives the word from the Dutch *keerse, candela*; but it is more probably from the French *croisset*, a little cross—that symbol having been usually placed upon beacons.

CRESSY. See CRECY.

CREST (Lat. *crista*; It. *cresta*;) in armoury, the plume or other ornament on the top of the casque or helmet.

In ancient times warriors wore crests composed of the spoils of animals they had killed, in order to strike terror into their enemies; or to render their mien the more formidable, by making them appear taller and fiercer.

At jousts and tournaments, the cavaliers wore plumes of feathers for their crests, especially those of the ostrich and the heron. These tufts were called *plumarts*, and were placed in tubes on the tops of their bonnets. Some had crests of leather; others of parchment, pasteboard, &c., painted or varnished; others of steel, wood, &c., on which was sometimes represented a member or ordinary of the coat, as an eagle, fleur-de-lis, &c.; but never any of those called *honourable ordinaries*, as pale, fesse, &c. The crests were changeable at pleasure; being reputed merely an arbitrary device or ornament.

Herodotus attributes the origin of crests to the Carians, who first bore feathers on their casques, and painted figures on their bucklers; whence the Persians called them *cocks*.

The crest is esteemed a greater criterion of gentility than the armour itself, as being borne at tournaments, to which none were admitted until they had given proof of their nobility. Sometimes it serves to distinguish the several branches of a family. It has also been employed, on occasion, as the distinguishing badge of factions. Sometimes the crest is taken from the device; but more usually it is formed of some piece of the arms.

In *Heraldry*, it denotes a figure placed upon a wreath, coronet, or cap of maintenance, above both helmet and shield,—being the highest part of the ornaments of a coat-of-arms. See HERALDRY.

Cretaceous || Crete.

CRETACEOUS, pertaining to chalk, in Latin *creta*; chalky.

CRETE, one of the largest islands in the Mediterranean, situated between the 35th and 36th degrees of east longitude, and between the 22d and 27th degrees of north latitude. The Cretan mythologists, quoted by Diodorus Siculus, relate that the first inhabitants of the island were the Dactyli Idæi, who dwelt around Mount Ida, and were regarded as magicians, because they possessed a variety of knowledge, and were particularly skilled in religious mysteries. Orpheus, who distinguished himself so highly in poetry and music, was their disciple. They discovered the use of fire, iron, and brass, and invented the art of working these metals in Berecynthius, a mountain near Aptera. Those invaluable discoveries procured them divine honours. One of them, named Hercules, rendered himself famous by his courage and exploits, and instituted the Olympic games; though posterity, by a mistake, have ascribed that institution to the son of Alcmena, who, indeed, trode in the footsteps of his predecessor, and also raised himself to immortality.

The Dactyli Idæi were the ancestors of the Curetes. The latter originally inhabited the forests and caves of the mountains; but they afterwards entered into domestic life, and by their institutions contributed to the civilization of mankind. They taught men to collect flocks of sheep, to tame wild animals for domestic purposes, and to entice bees into hives, that they might rifle them of the fruit of their labours; they first prompted men to the chase, and taught the use of the bow; and they were the inventors of swords and of military dances. The noise which they made, by dancing in armour, prevented Saturn from hearing the cries of Jupiter, whose education Rhea had intrusted to them, and whom, with the assistance of the nymphs, they brought up in a cave in Mount Ida, feeding him with the milk of the goat Amalthea, and with honey.

To this period mythology assigns the origin of the Titans; their abode near Gnossus, where stood the palace of Rhea; their travels over the whole earth; their war against Ammon, and his defence by Bacchus; the nuptials of Jupiter and Juno, celebrated near the river Therenus in Crete; and the gods, goddesses, and heroes who descended from them.

Of these heroes the most illustrious were Minos and Rhadamanthus. They are said to have been the sons of Jupiter and of Europa, who had been conveyed into the island on a bull. Minos having become king, built several cities; the most considerable of which were Gnossus, on that side of the island which faces Asia, Phœstus on the southern shore, and Cydon on the western side facing the Peloponnesus. He gave to his subjects a code of admirable laws, which he pretended to have received from his father Jupiter in the grotto of Mount Ida.

Rhadamanthus distinguished himself by the impartiality of his judgments, and by the inflexible severity with which he inflicted punishment on the impious and the wicked. His empire extended over the chief isles of the Archipelago; and the inhabitants of the adjacent coasts of Asia submitted to him on account of his high reputation for probity and justice. Mythologists have constituted him judge in the regions below, to determine the future state of the righteous and the wicked: they have conferred on him the same honours which were bestowed on Minos, the justest of kings.

Thus far have been followed the Cretan traditions as these are related by Diodorus; but historians differ as to the degree of truth or probability which they involve. There are a variety of opinions concerning the original inhabitants of Crete. Strabo, who has discussed the subject with great erudition, says, "I am not fond of fables; yet I have detailed these at some length, because they are connected with theology. Every discourse concerning the gods should examine the religious opinions of antiquity, and distinguish them from fable. The ancients were pleased to conceal their knowledge of nature under a veil. It is now impossible to unfold the meaning of their enigmas. But by exposing to light the numerous allegories which they have left us, and examining attentively their mutual relations and differences, genius may perhaps be able to unfold the truths which are couched under them." Crete.

But leaving mythology for the more certain records and monuments of history, we find that Crete received its name from Cres, the first of its monarchs, and the author of several useful inventions, which contributed to the happiness of his subjects. Prompted by gratitude, they endeavoured to perpetuate the memory of his favours, and to immortalize his name, by naming the island after him. In order to distinguish the true Cretans from strangers, they were named *Eteocretes*. A number of colonies, from different parts of Greece, settled in the island; the salubrity of the climate, and the fertility of the soil, having induced them to fix their habitation there. The Lacedæmonians, Argives, and Athenians, were the principal people who sent colonies into Crete. "Crete," says Homer, "is an extensive island in the midst of the stormy main. The soil is rich and fertile. It contains an immense number of inhabitants. It is adorned with a hundred cities. Its inhabitants speak in various languages. We find there Achæans, valiant Eteocretes, Cydonians, Dorians, and godlike Pelasgians." The Eteocretes inhabited the southern division of the island, where they built the city of Præsus, and erected a temple to the Dictæan Jove.

Cres was not the only monarch who reigned in the island of Crete. He had a series of successors; but history affords little information concerning them. The names of a few of them only are preserved, and a small number of events which happened under the reign of others are related, but the latter are disfigured with an intermixture of fable. Among these monarchs we find two of the name of Jupiter, and two of that of Minos. However, most writers confound them, and ascribe to one the transactions and exploits which should be shared between both.

This remark chiefly regards Minos, who was esteemed the wisest legislator of antiquity. The office assigned him in the regions below is a certain proof of his having gained an exalted reputation by his justice upon earth. Greece, says Plato, has with great propriety adopted the laws of Crete; for they are founded upon the solid basis of reason and equity, and have a natural tendency to render the people who live in subjection to them opulent and happy. One of these laws forbade the Cretans ever to carry their festivity so far as to intoxicate themselves with wine. Another contained the following eminently conservative provision: "Let young people not canvass the laws with an indiscreet curiosity; let them not examine whether the lawgiver has done right or wrong in promulgating them; but let them join unanimously in declaring them good, since they proceed from the gods. If any of the old men perceive something in them meriting amendment, let him mention it to the magistrate, or discuss it with his equals, but never in the presence of the young people." The Cretan code was engraven on tablets of brass; and Talos, chief minister to Minos, visited all the towns and cities in the island three times a year, to observe in what manner the laws were executed and obeyed. The king of Crete, aware that an infusion of the marvellous is useful in commanding the belief and enforcing the obedience of the multitude, pretended that he had received those laws from his father Jupiter, in the grotto of Mount Ida. In the same manner, Lycurgus, before promulgating his laws, repaired to Del-

Crete. phi, and gave out that they had received the sanction of Apollo. A like reason induced Numa to pretend to an intimacy with the nymph Egeria, and Mahommed to ascribe his doctrines and institutions to the revelation of the angel Gabriel.

In contradiction of this account, however, others of the ancients describe Minos as a prince abandoned to the fury of his passions, and a barbarous conqueror. Having fallen furiously in love with the nymph Dictynna, who refused to gratify his wishes, he pursued her to the brink of the shore, and forced her to plunge into the sea, where she was saved by some fishermen, who received her in their nets. He was the first of the Greeks who appeared in the Mediterranean at the head of a naval armament. He conquered the Cyclades, expelled the Carians, established Cretan colonies in those islands, and committed the government of them to his son.

Being informed, while he was at Paros, that his son Androgeus was slain at Athens, he declared war against Egeus, and imposed on him a disgraceful as well as cruel tribute, from the payment of which Theseus delivered his country. He took arms against Nisus, king of Megara, made him prisoner by the treachery of his daughter Scylla; and put him to death, together with Megarus, the son of Hippomanes, who had brought some forces to his assistance. Dædalus, who had by some means incurred his displeasure, despairing of pardon from so severe and inflexible a prince, employed the resources of his inventive genius in order to escape from his power. He fled to Sicily, gained the protection of King Cocalus, and obtained an asylum in his court. Valerius Flaccus has described his flight in a very lively and picturesque manner. "Thus Dædalus, with the wings of a bird, ascended from Mount Ida. Beside him soared the comrade of his flight, with shorter wings. They appeared like a cloud rising in the air. Minos, seeing his vengeance thus eluded, glowed with impotent rage. In vain he followed with his eyes the secure flight of his enemies through the wide expanse of heaven. His guards returned to Gortynia with their quivers filled with arrows." The Cretan monarch did not, however, give up his prey. He equipped a fleet, pursued the fugitive to Sicily, and fell before the walls of Camicum.

It is plain that these actions are unsuitable to the character of that just monarch, whose merits raised him to the office of determining, in the regions below, the unalterable fate of the righteous and the wicked. We may therefore reasonably conclude that Minos the legislator was a different person from Minos the conqueror; that it was the former who gained a lasting reputation by his wisdom and justice; that it was the latter who subdued most of the islands of the Archipelago, but, being enslaved by his passions, tarnished his glory by cruelty and a merciless thirst for vengeance.

The last king of Crete was Idomeneus. This prince, accompanied by Merion, conducted twenty-four ships to the assistance of Agamemnon. Homer informs us of the illustrious exploits by which he signalized himself before the walls of Troy. At his departure he committed the government of his kingdom to Leucus, his adopted son, promising him the hand of his daughter Clisithera if he governed wisely in his absence. But that ambitious young man forgot the favours which had been so lavishly bestowed on him; and having gained a number of partisans, he in a short time aspired to the immediate possession of the crown. His impatience would not wait till he should obtain it lawfully by marriage. Flattering himself, from the long absence of the king, that he had perhaps fallen before Troy, he determined to mount the throne. Mida, wife of Idomeneus, and the princess Clisithera, were however obstacles to the gratification of his wishes. But ambition knows no restraint, and tramples under foot the most sacred obligations. This base wretch having seduced the people from their allegiance, and captivated the affections of the nobles, sacrificed these unfortunate victims in the temple. When Idomeneus, crowned with laurels, landed on the coast of Crete, Leucus, who had now firmly established his power, attacked him with an armed force, and obliged him to reimbark. But a different account is given of the banishment of Idomeneus. Servius says that he had vowed, in a storm, to sacrifice to the gods the first person whom his eyes should behold on the Cretan shore; that his son having met him first after his arrival, he fulfilled his vow by sacrificing him; and that the island, being soon afterwards depopulated by pestilence, the inhabitants looked upon that affliction as the effect of divine vengeance, and expelled the murderer, who, having retired to Italy, founded Salentum, on the Messapian coast. But this opinion appears to be entirely groundless. History mentions no son of Idomeneus. If he had had a son of his own blood, why did he adopt Leucus? Why did he trust to the latter the government of the island, when he promised him his daughter in marriage? The more probable opinion is, that the plague was introduced into the island by his ships, when he returned from the siege of Troy; and that Leucus artfully made use of that pretext to expel his lawful sovereign. This is the statement of Herodotus. But it appears that the usurper did not long enjoy the fruit of his crimes. Soon after the departure of Idomeneus, monarchy was abolished, and the government of Crete became republican. Crete.

The Cretan government, soon after the expulsion of Idomeneus, became aristocratical. The power was divided between the nobles and the people; yet as the chief employments were occupied by the nobles, they directed the administration of affairs. Ten magistrates were annually elected, by a majority of voices, in the national assembly. They were named *cosmoi*, and their public office and character were nearly the same with those of the ephori at Sparta. They were the generals of the republic in time of war, and directed all affairs of importance. They had the right of choosing certain old men as counsellors. The latter, to the number of twenty-eight, composed the Cretan senate. They were chosen from among those who had discharged the office of cosmoi, or had distinguished themselves by extraordinary merit and blameless probity; and they continued in office during life, possessed a weighty influence, and were consulted in every affair of importance. This body formed a barrier which the wisdom of the legislator had opposed against the ambition of the ten chief rulers. Another restraint was imposed on their power, by limiting the period of their administration to one year; and as the suffrages of the people might be obtained by bribery or personal influence, and of consequence their choice might sometimes fall on a man unworthy of so honourable an office, it was provided that he who had been undeservedly advanced to the dignity of cosmos should be degraded, either in a national assembly, or simply by the voices of his colleagues. This, no doubt, is what Plato alludes to when he says, "Neither the commonwealth, which approaches too near to a monarchical constitution, nor that which affects a licentious liberty, is founded on the solid basis of a just medium between anarchy and despotism. The Cretans and Lacedæmonians, by establishing theirs on firmer foundations, avoided those fatal extremes."

Such were the distribution of power and the administration of public affairs in the Cretan government. Its simplicity was admirable. A people who were blessed with the sacred enjoyment of liberty, but who possessed not sufficient knowledge and discernment to direct them-

 selves, elected magistrates, to whom they delegated their authority. These magistrates, thus clothed with sovereign authority, chose senators to assist and direct their deliberations. But these counsellors could neither enact nor decide of themselves; they held their office for life, and that circumstance contributed to strengthen their influence and to increase their experience. The magistrates were animated by the most powerful motives to distinguish themselves, when in office, by unwearied activity in the public service. On one side they were restrained by the fear of degradation; and on the other, actuated by the hope of becoming one day members of the national council.

All the Cretans were subjected to the power of the magistrates, and divided into two classes, the adults and the youth. Men arrived at maturity were admitted into the first class. The second consisted of all the young men who were not below the age of seventeen. The society of adults ate together in public halls. There rulers, magistrates, poor and rich, seated together, partook, without distinction, of the same simple fare. A large bowl, filled with wine and water, which went round the company from one to another, was the only drink which they were allowed. None but the old men had a right to call for more wine. A woman was appointed to preside at each table; a circumstance which of itself indicates a great advance in civilization; and in this capacity she openly distributed the most exquisite meats to those who had distinguished themselves by their valour or wisdom. This preference was so far from exciting envy or jealousy, that it only prompted every person to deserve it by brave and prudent conduct. Near where the citizens sat, two tables were laid, which they named *Hospitable*, and where all strangers and travellers were entertained; and there was also a particular house set apart by the public, in which they might spend the night.

To supply the public expenses, every citizen was obliged to bring a tenth part of his annual income into the treasury; and it was the duty of the chief magistrates to take care that every person contributed his proportion. In Crete, says Aristotle, one part of the fruits of the earth, of the produce of the flocks, of the revenues of the state, and of the taxes and customs, is sacred to the gods, and the other is distributed among the members of the community; so that men, women, and children, all subsist at the public expense.

After dinner, the magistrates and senators usually spent some time in deliberating on the affairs of the state; they next recounted the noble deeds which had been done in war, celebrated the courage of their most distinguished warriors, and animated the youth to heroic valour. These assemblies were the first school of the youth. At the age of seven, the boy was permitted to handle the bow; and from that time he was admitted into the society of the adults, where he continued till the age of seventeen. There, sitting on the ground, and clothed in a plain and coarse dress, he served the old men, and listened, with respectful silence, to their admonitions. His young heart was inflamed by the recital of noble deeds in arms, and glowed with ardour to imitate them; he acquired habits of sobriety and temperance; and being constantly witness of illustrious examples of moderation, wisdom, and patriotism, the seeds of virtue were thus sown and fostered in his heart before he attained the full use of reason.

He was early accustomed to arms and to fatigue, that he might learn to endure excessive heat or cold, to clamber and leap among hills and precipices, and to bear manfully the blows and wounds which he might receive amid the gymnastic exercises or in battle. But his education was not confined to the gymnastic exercises; he was also taught to sing the laws, which were written in verse, with a certain species of melody, in order that the charms of music might dispose him to learn them with more pleasure, and might impress them more deeply on his heart, and that, if he should ever transgress them, he might not have the excuse of ignorance to offer. He next learned hymns in honour of the gods, and poems composed in praise of heroes. When he reached his seventeenth year, he retired from the society of the adults, and became a member of that of the young men.

But here his education was still carried on. He exercised himself in hunting, wrestling, and fighting with his companions. Martial music was played on the lyre; and he learned to follow exactly the sounds and measure of the musician. Those sports and exercises were attended with danger, because arms of steel were sometimes used in them. One dance, in which the youth aspired most ardently to excel, was the Pyrrhic, originally invented in Crete. The performers in that dance were arrayed in complete armour; they wore a light short coat, which did not fall below the knee, and was bound with a girdle round the waist; on their feet and legs were buskins; in their hands they bore their arms, and performed various military evolutions to the sound of musical instruments. "The Lacedæmonians and Cretans," says Libanius, "cultivated dancing with amazing ardour; they considered that their laws had directed them to practise it for the most important purposes; and it was scarcely less dishonourable for a Lacedæmonian or Cretan to neglect the military dance, than to desert his post in battle."

Those Cretans who were opulent and high born were permitted to form societies of young men of their own age; and they often strove with emulation who should form the most numerous ones. The father of the young man who formed one of those societies usually presided in it; and he had a right to educate the warlike youth, to exercise them in running and in hunting, and to confer rewards and inflict punishments.

Friendship was held in high estimation among the Cretans; but according to Strabo, the manner in which they conducted the intercourse of friendship was somewhat extraordinary. Instead of mild persuasion, they made use of violence to gain the objects of their affections. He who conceived an affection for a young man of his own age, and wished to attach him to himself by indissoluble bonds, formed a scheme for carrying him off by violence. Three days before putting it into execution he communicated it to his comrades. They could not then interfere to prevent it, because if they had, they would have appeared to think the young man unworthy of such an excessive attachment. At the appointed day they assembled to protect their companion. If the ravisher appeared to them not unworthy of the object of his affection, they made at first a faint resistance in obedience to the law, but at last joyfully favoured his enterprise; if, on the other hand, they thought him unworthy of the object of his choice, they made such resistance as to prevent him from executing his design. The feigned resistance continued till the ravisher had conducted his friend into the hall of that society to which he belonged. They did not regard him who possessed superior beauty and gracefulness of person as the most amiable, but him who had most distinguished himself by his modesty and valour.

When the youth had finished their exercises, and attained the legal age, they became members of the class of adults; being then considered as men, they were permitted to vote in the national assemblies, and were entitled to stand candidates for any public office. They were then obliged to marry, but did not take home their wives till such time as they were capable of managing their domestic concerns.

Crete. "The legislator," says Strabo, "had considered liberty as the greatest blessing that cities can enjoy. Liberty alone can secure the property of the citizens of any state. Slavery either robs them of it, or renders it precarious. The first care of nations should therefore be to preserve their liberty. Concord strengthens and supports her empire; she flourishes wherever the seeds of dissension are extinguished. Almost all those hostilities which prevail among nations or individuals spring either from an inordinate desire of wealth or the love of luxury. Introduce, instead of those baneful principles, frugality, moderation, and equality of conditions; you will thus banish envy, hatred, injustice, and haughty disdain." This was what the Cretan lawgiver happily effected; and the community which was regulated by his wise institutions rose to glory, opulence, and power, and was honoured with the panegyrics of the most celebrated philosophers of Greece; but the highest honour it ever obtained was that of serving Lycurgus as a model for the admirable form of government which he established at Sparta.

Nations are effaced from the earth like the monuments of their power, and after the revolution of ages we can scarcely trace in their posterity any remains of their ancient character. Some of them exist longer, others shorter; but we may almost always calculate the period of their duration by the excellence of their laws, and the fidelity with which they support and obey them. The republic of Crete, being established on a solid basis, knew no foreign master for a period of ten centuries, and bravely repelled the attacks of those princes who attempted to enslave it. At length the time arrived when the warlike and victorious Romans aspired to the empire of the world, and would suffer none but subjects or slaves to exist within the reach of their arms. Florus does not scruple to acknowledge that the Romans had no other motive for invading Crete but the ambitious desire of subduing the renowned native country of Jupiter. If any person wished to know the reason which induced us to attack Crete, says he, the true reason was our desire to subdue so celebrated an island. The Cretans had appeared to favour Mithridates, and the Romans thought proper to declare war against them on that pretext. Marc Antony, father of the triumvir, attacked them with strong hopes of success, but was severely punished for his presumption and imprudence. The Cretans took a great part of his fleet, hung up his soldiers and sailors on the masts amid the sails and cordage, and returned in triumph into their harbours. But their triumph was of short duration. Quintus Metellus was sent against them with a powerful armament, but met with an obstinate and vigorous resistance, which, however, he completely overcame in three years. His first care was to abolish the laws of Minos, and to substitute those of Numa.

The island of Crete, united with the small kingdom of Cyrene, on the Libyan coast, formed a Roman province, which was at first governed by a proconsol; but a questor and an assistant were afterwards sent there, and at last, as Suetonius informs us, it was put under the government of a consul. This island was one of the first places in the world which were favoured with the light of the gospel. St Paul introduced the Christian faith into Crete; and his disciple Titus, whom he left there to cherish and cultivate that precious plant, became the first bishop of the island. In the reign of the emperor Leo it had twelve bishops, who were all subject to the patriarch of Constantinople. Constantine separated Crete from Cyrene in the new division which he made of his empire; and, in the distribution of territory among his three sons, this island, together with Africa and Illyria, fell to the share of Constans.

When Michael Balbus sat on the throne of Constantinople, the rebellion of Thomas, which lasted three years, caused him to neglect the other parts of the empire. Crete soon passed into the hands of the Saracens, who retained it for 127 years, at the end of which period it was recovered by Nicephorus Phocas. Crete then remained under the dominion of the Romans until the time when Baldwin count of Flanders, being raised to the throne, liberally rewarded the service of Boniface, marquis of Montferrat, by making him king of Thessalonica, and adding this island to his dominions. But that lord, being more covetous of gold than of glory, sold it in the year 1194 to the Venetians, under whom it assumed the name of *Candia*. See Candia. Cretins.

CRETINS, the name applied to those persons in the valleys of the Alps who are affected by congenital idiotism. They almost all exhibit the *goitre*, a singular enlargement of the thyroid gland, though all goitrous persons are not Cretins. *Cretinism* is the term used to denote the state of a Cretin. (See Saussure's *Voyages dans les Alpes*, ii.)

The following account of these unfortunate beings is taken from Pinel's *Traité sur l'Aliénation Mentale*:—"Children who are to become Cretins are generally born with a small *goitre* or swelling of the throat, about the size of a nut. Those who have not this peculiarity are nevertheless marked by some other characteristics which foretell their degradation and fatuity. They have an inflated tumid appearance, especially about the head and hands. They are less sensible than other infants to the impressions of the atmosphere. They suck with difficulty, sleep a great deal, and have always a dull sleepy look. When children of the same age begin to pronounce words, they can only articulate the vowels, and they make no farther progress in speech during the rest of their lives. When other children begin to use their hands in feeding themselves, the young Cretins are incapable of it; and it is often necessary, after they are ten or twelve years of age, to feed them with a spoon like infants. They are equally slow in learning to walk: never cheerful: always cross and sullen: nothing but maternal tenderness could tolerate them. The head of a Cretin does not grow in proportion to the rest of his body; it is commonly small, and flat on the top; the temples are flattened also, with the tuberosity of the occiput projecting in a slight degree. The eyes are small, and sunk in the head, though sometimes on the contrary very protuberant. The look of a Cretin is dull and stupid; the chest broad and flat; the fingers long and slender, with the articulations ill marked; the sole of the foot broad, and sometimes bent, and the feet are generally turned either outwards or inwards. The age of puberty is later among the Cretins; but the organs of generation are large, and they are much disposed to sensual indulgences. It is not till this period that the Cretin begins to walk, and still his locomotion is very limited, only excited by the desire of food, or to bask by the fire-side, or in the rays of the sun. His small sorry bed is another termination of his difficult journeys, his step is unsteady, his body jolts on his legs, and his arms are pendulous by his side. In walking he goes straight forward, without avoiding any obstacles or dangers; and he always takes the route that he has once gone. When he has attained his greatest height of stature, which is from four to five feet, his skin becomes brown; his sensibility continues to be obtuse; he regards neither cold, nor heat, nor vermin, nor blows. He is commonly deaf and dumb, and is scarcely affected by the most pungent odours. The taste of Cretins is also very imperfect; and their organs of vision and of touch are probably impaired. Their moral faculties appear almost obliterated. They are hardly affectionate to their parents and friends, and betray neither pleasure nor pain at all the necessary wants of life. Such (says Fodéré) is the physical and moral state of the Cretins during a long course of years; for, reduced thus to a sort of vegetation and automatic existence, they live to a great old age."

Creusa ‖ Crewe.

CREUSA, the daughter of Priam and Hecuba, and wife of Æneas. She was left behind by Æneas when he fled from Troy, but appeared to him as a shade and foretold his high destiny.

CREUSE, a department of France, so called from the river of that name by which it is watered, is bounded north by the departments of Indre and Cher, west by that of Haute-Vienne, south by that of Corrèze, and east by those of Puy-de-Dôme and Allier. Area 2150 square miles. The surface is mostly mountainous, with a general inclination from south to north. Along its S. and S.E. boundaries is a range of mountains sending off branches to the interior of the department. The rivers are numerous, but none of them are navigable. The largest is the Creuse, which rises on the southern frontier, has a general north by west direction through the department, dividing it into two nearly equal parts, and falls into the Vienne after a course of about 150 miles. The climate is cold and moist, and the winter long and rigorous. The soil, except in the valleys, is sandy and of little fertility, so that the corn produced is not sufficient for home consumption. The rearing of cattle principally occupies the attention of the people. Among the mineral productions are iron, lead, copper, manganese, and antimony; coal mines are worked; granite and building stone are quarried; and potters' clay of good quality is raised. From 20,000 to 28,000 labourers annually emigrate to other parts of the kingdom in search of employment, during certain months of the year. The chief manufacture is that of carpets.

The department is divided into four arrondissements, as follows:—

Arrondissements.	Cantons.	Communes.	Pop in 1851
Aubusson	10	104	106,619
Bourganeuf	4	41	42,673
Boussac	4	46	39,497
Guéret	7	75	98,286
	25	266	287,075

The chief town of the department is Guéret.

CREUX (*French*), a term in sculpture. Creux originally signifies a *hollow* or *cavity* out of which something has been scooped: hence *en creux* is applied to that kind of sculpture where the lines and figures are formed by cutting in upon the surface to be ornamented; and thus it stands opposed to *relievo*.

CREVIER, Jean Baptiste Louis, a celebrated philologer, was born in 1693 at Paris, where his father was a printer. He studied under the celebrated Rollin, and held the professorship of rhetoric in the college of Beauvais for twenty years till his death in 1765. On the death of Rollin in 1741, he undertook to complete his Roman History, and published the last eight volumes of the work. He also published an excellent edition of *Livy*, with notes, in six vols. 4to, 1748, and afterwards another in six vols. smal 8vo; *L'Histoire des Empereurs des Romains, jusqu'à Constantin*, 1749, 12 vols. 12mo; *Histoire de l'Université de Paris*, 7 vols. 12mo; *Rhétorique Françoise; Observations sur l'Esprit des Loix; Remarques sur le Traité des études de Rollin*, Paris, 1780, 12mo.

CREWE, a town of Cheshire, and an important station on the London and North-Western railway, to which it is altogether indebted for its present importance. It is the centre of five lines of railway connecting it with Manchester, Chester, Birmingham, and other large towns; and is 21 miles east by south of Chester, and 54 miles N.W. of Birmingham. It is inhabited principally by persons in the employment of the railway companies, and is well laid out. The station is elegant and commodious, and the workshops for the making and repairing of railway carriages and engines are very extensive. It has also a fine hotel, church, mechanics' institute, library, baths, &c. Pop. (1851) 4491.

Crewkerne ‖ Crichton.

CREWKERNE, a market-town in the hundred of the same name, county of Somerset, 10 miles S S.W. of Ilchester, in a fertile valley watered by the rivers Axe and Parret. It has a fine Gothic church surmounted by an embattled tower, and a free grammar-school, with four exhibitions at Oxford. Pop. (1851) 3303.

CRICHTON, James, commonly known by the appellation of the Admirable Crichton, was born on the 19th of August 1560.[1] His father was Robert Crichton, who, in conjunction with John Spence, executed the office of lord advocate; his mother was Elizabeth, the only daughter of Sir James Stewart of Beath, by Margaret, the eldest daughter of Lord Lindsay of Byres. It appears highly probable, if not certain, that by the father's side he derived his lineage from Sir Robert Crichton of Sanquhar, ancestor of the earl of Dumfries; and his maternal grandfather, ancestor of the earl of Moray, was the son of Lord Avandale, who was descended from Murdac duke of Albany, and through him from Robert II. It is indeed to be recollected that the birth of the first Lord Avandale was illegitimate; but it is likewise to be recollected that he obtained letters of legitimation under the great seal.[2] His grand-uncle Lord Methven was the third husband of Margaret Tudor, the relict of James IV. It is therefore sufficiently obvious that he was entitled to speak of his high descent; but his extraordinary endowments of mind conferred upon him much higher distinction than he could derive from any accidental circumstances of birth. The place of his birth is somewhat doubtful. According to one tradition, he was born in the castle of Cluny, situated on a small lake bearing the same name; but as the father did not acquire his estate in Perthshire till two years after the birth of James, his eldest son, this may be considered as entitled to less attention than another tradition, which represents him as having been born at Elliock in Dumfriesshire, the more ancient seat of the family. The estate of Cluny, which belonged to the bishopric of Dunkeld, was conveyed to the king's advocate by Robert Crichton, the last popish bishop of that wealthy see.

In the year 1570, when he had only attained the age of ten, he was sent to the university of St Andrews, where he was entered at St Salvator's College. According to Aldus Manutius, his father placed him under the tuition of Buchanan, Hepburn, Robertson, and Rutherford, who are all mentioned as very eminent persons. John Rutherford, whose name is sufficiently known, was provost of the college to which Crichton belonged. Buchanan, who was principal of St Leonard's College, resigned his office about the time when he became a student; but, according to the statement of his Italian friend, he was partly educated along with the young king of Scotland; and Buchanan was appointed to the office of preceptor to the king when he quitted St Andrews, in the year 1570. On the 20th of March 1573, or, according to our present mode of computation, 1574, Crichton took the degree of A.B. He proceeded A.M. in the year 1575, and thus completed the regular course of study at the premature age of fifteen. In the university of St Andrews, the candidates for the higher degree were then distributed into

[1] An Italian broadside, printed at Venice in 1580, states that he had completed the twentieth year of his age on the 19th of August. This curious document, which was lately discovered, and which affords some confirmation of the account which Manutius and Imperiali have given of Crichton's character and attainments, may be found in the appendix to the second edition of Mr Tytler's *Life of the Admirable Crichton*, p. 289. Edinb. 1823, 12mo.

[2] Wood's Peerage of Scotland, vol. i. p. 158.

Crichton. circles, according to the comparative proficiency displayed in the course of their previous examinations. Each circle was likewise formed on the same principle. Of the thirty-six masters who took their degrees on this occasion, there were three circles; and the third name in the first circle is that of James Crichton. At the head of the list appears David Monypenny. It is highly probable that Crichton was the youngest of all those graduates; and as his proficiency was only exceeded by two out of thirty-five, it is evident that he had already begun to distinguish himself by his extraordinary aptitude in the acquisition of knowledge.

As the king was six years younger than Crichton, they could not well participate in the same studies, although they could receive instructions from the same tutors. Crichton must have continued to devote himself with intense ardour to the pursuits of science as well as literature; for to a knowledge of many languages he added a familiar acquaintance with the philosophy and even the theology of the age. The power of genius is shewn in the use of the materials which are placed within its reach; but there is no royal road to learning, which, if acquired to any extent, must be acquired by much labour and perseverance, although their particular degree must vary according to the quickness of apprehension and tenacity of memory belonging to various individuals.

Crichton may for some time have enjoyed the benefit of such able instruction; for he appears to have been still residing in Scotland towards the close of the year 1577. His subsequent movements are represented as being partly influenced by some domestic disagreements. As the father embraced the reformed doctrines, while the son adhered to the ancient superstition, disputes and reproaches could scarcely fail to intervene at a crisis of such high and general excitement. The young scholar repaired to France, where he is said to have distinguished himself equally by his skill in literature and in arms. Of a marvellous disputation which he held in the university of Paris, there is an account which passes very currently, although it is only stamped with the authority of Sir Thomas Urquhart. According to this account, he affixed a program in the most public places of the city, inviting all men of learning to meet him, after an interval of six weeks, at the College of Navarre, where he should "be ready to answer to what should be propounded to him concerning any science, liberal art, discipline, or faculty, practical or theoretick, not excluding the theological nor jurisprudential habits, though grounded but upon the testimonies of God and man, and that in any of these twelve languages, Hebrew, Syriack, Arabick, Greek, Latin, Spanish, French, Italian, English, Dutch, Flemish, and Sclavonian, in either verse or prose, at the discretion of the disputant:"[1] in the mean time, as we are duly instructed, "the admirable Scot (for so from thence forth he was called) minding more his hawking, hunting, tilting, vaulting, riding of well-managed horses, tossing of the pike, handling of the musket, flourishing of colours, Crichton. dancing, fencing, swimming, jumping, throwing of the bar, playing at the tennis, baloon, or long-catch, and sometimes at the house-games of dice, cards, playing at the chess, billiards, trou-madam, and other such like chamber-sports, singing, playing on the lute, and other musical instruments." But when the appointed hour arrived, he acquitted himself with stupendous learning and ability, having for the space of nine hours maintained his ground against the most eminent antagonists in all the faculties. The rector of the university concluded the ceremony by presenting him with a diamond ring and a purse full of gold. It would be a mere waste of criticism to enter into a minute examination of the narrative to which we have now referred. The details are sufficiently circumstantial, but they have much of the aspect of a downright romance; and such details from the knight of Cromarty would have required the strong confirmation of collateral evidence. It might perhaps be admitted with some degree of safety that Crichton was engaged in a public disputation at Paris, and that he acquitted himself with consummate ability; but as to his fluency in twelve languages, and his maintaining so long and powerful a contest, not merely with grammarians, rhetoricians, and philosophers, but even with theologians, canonists, and civilians, all these particulars must be received with extreme hesitation; and perhaps it may be considered as much more probable that such a disputation never took place at Paris, but was merely fabricated from another, which took place at Venice.

The intellectual endowments of Crichton seem to have been equalled by his personal accomplishments. He is highly celebrated for his martial prowess, and as a complete master in the use of the sword and spear. Some degree of military experience he must have acquired during his two years service in the civil wars of France: but this term of service was apparently sufficient to gratify his youthful inclination for the life of a soldier; and he next directed his steps towards Italy, where he must have arrived in the year 1580. According to Dr Mackenzie, he proceeded to Rome, and there gave another demonstration of his talents for public disputation;[2] but this account is evidently destitute of all foundation, and the only authority alleged by its author is that of Boccalini, whose meaning is either completely misrepresented or completely misunderstood.[3] Dempster has stated that he went to Genoa, attracted by the offer of a considerable salary; but in what capacity he appeared there, we are left to conjecture.[4] Whatever might be his first place of residence in Italy, it is at least ascertained that he arrived at Venice before the close of the year 1580. He now addressed a Latin poem to the younger Aldus Manutius, a name highly celebrated in the annals of typography; and this laid the foundation of a literary friendship, which was not without considerable influence in perpetuating his fame.[5] He

[1] Urquhart's Discovery of a most exquisite Jewel, p. 94. Lond. 1652, 8vo.—This writer is pleased to inform us, that about a fortnight before the appointed day of meeting, some person, less acquainted with Crichton himself than with his reputation, subjoined the following sarcastic inscription to his program on the gate of the Sorbonne: "If you would meet with this monster of perfection, to make search for him either in the taverne or bawdy-house, is the readyest way to finde him." The hint for this part of the story is to all appearance borrowed from a work of mere fancy, in which Boccalini relates that a similar *mordace facetia* was practised upon Crichton, not in Paris, but in Parnassus: "E chi lo vuol vedere, vada all' hosteria del Falcone, che li farà mostrato." 'Ragguagli di Parnaso, tom i. p. 181.)

[2] Mackenzie's Lives of Scots Writers, vol. iii. p. 200.—From the very loose and erroneous account of Crichton which occurs in this work, was fabricated a separate tract published under the title of *The Life of James Crichton of Clunie, commonly called the Admirable Crichton.* Aberdeen, 1760, 8vo. It was printed, and probably edited, by Francis Douglas, who was a person of some taste for literature. Dr Mackenzie's account, thus disguised, was inserted in an appendix to Mr Pennant's *Tour in Scotland*, vol. i. p. 315. edit. Lond. 1790, 3 vols. 4to.

[3] Boccalini, Ragguagli di Parnaso, tom. i. p. 180. ed. Amst. 1669, 2 tom. 12mo.

[4] Dempsteri Historia Ecclesiastica Gentis Scotorum, p. 188. Bononiæ, 1627, 4to.

[5] Jacobi Critonii in Appulsu ad celeberrimam Urbem Venetam Carmen ad Aldum Manutium. Venetiis, 1580, 4to. (Renouard, Annales de l'Imprimerie des Aldes, tom. ii. p. 125.)—Gabriel Naudé speaks of Crichton's orations being printed: "Tel negligera,

Crichton. likewise formed an intimate acquaintance with other men of letters, particularly with Sperone Speroni, Lorenzo Massa, and Giovanni Donati. An ode addressed to Massa, and another to Donati, are preserved among his literary reliques. But the friendship of Manutius was distinguished by a more than ordinary degree of zeal: he highly extolled Crichton when living, and deeply bewailed him when dead. To the notices which he has introduced into his edition of Cicero, we are in a great measure indebted for our knowledge of the young scholar's proceedings in the territory of Venice. His edition of the *Paradoxa* he inscribed "Nobilissimo juveni Jacobo Critonio Scoto;" and the dedication, dated on the first of June 1581, contains a recital of some of those literary exploits which astonished the Italians.[1]

An oration which Crichton pronounced before the Doge and the nobility of Venice excited the admiration of his audience, by the eloquence of the composition, as well as by the gracefulness of the elocution, insomuch that the young orator was regarded as a person of the most extraordinary endowments. He afterwards engaged in various disputations on subjects of divinity, philosophy, and the mathematical sciences; and such was the reputation which he now acquired, that, during the remainder of his short career, he seems to have been viewed as one of the wonders of Italy. It has been thought a circumstance worthy of being recorded in the life of Mazzoni, celebrated among his countrymen for his powers of literary debate, that he thrice encountered Crichton at Venice, and overwhelmed him by the astonishing copiousness and subtilty of his arguments. If it was reckoned an honour for a man of high reputation to sustain a contest with so youthful an antagonist, we cannot fail to perceive the singular estimation in which that antagonist must have been held.

These intellectual exertions were succeeded by an infirm state of health, which continued for upwards of four months; and before he had completely recovered, he made an excursion to Padua, the seat of a flourishing university. The professors in all the different faculties were invited to meet him in the house of a person of rank; and there, in the midst of a numerous assembly, he exhibited new and striking proofs of the versatility of his genius. He commenced his performances with the recitation of an extemporaneous poem in celebration of Padua; a subject which was only then proposed to him, and which he treated in a manner that is described as very elegant. With much acuteness and learning, he afterwards discussed various topics of science with the doctors who were there assembled; and it is particularly mentioned that he exposed many of the errors of Aristotle and his commentators. Having thus displayed his knowledge for the space of six hours, the final theme proposed to him was the praise of ignorance; and on this subject he pronounced an oration, which still further excited the admiration of his learned auditors. A similar exhibition was announced to be held in the bishop's palace, but, for some reason which is not plainly stated, it did not take place. The popular applause which attended such demonstrations of intellectual superiority, had too natural a tendency to excite envy, and to provoke detraction, nor did Crichton escape that lot which has been common to so many others. On his return to Venice, he was induced by the malignity of certain individuals, whom he does not mention by name, to publish a remarkable program, which has been preserved by his friend Manutius. In order to expose the futility of their cavils, he undertook to refute innumerable errors of Aristotle, and of all the Latin philosophers, that is, all the schoolmen, both in their expositions of his doctrines, and in their disquisitions on subjects of theology, together with the errors of certain professors of mathematics, and to answer such objections as might be urged against him. He further gave his antagonists the option of selecting their topics of disputation from any other branch of science, whether publicly taught in the schools, or privately investigated by the most profound philosophers; and he undertook to return his answers, as the proponents should themselves determine, either according to the usual figures of logic, according to the secret doctrine of numbers, or mathematical figures, or in any one out of a hundred different species of verse. The challenge may appear sufficiently bold, if not arrogant; but unless it came from a person who was conscious of possessing very extraordinary powers of intellect, and who had repeatedly applied to them a severe and unequivocal test, it could scarcely be viewed in any other light than as an indication of insanity. He appealed to a community which included many competent judges of such pretensions, and therefore could not hope to impose upon an unlearned multitude. The appointed place of meeting was the church of St John and St Paul; and there, for the space of three days, this young man sustained the arduous trial in a manner which fully justified his confidence in his own intellectual resources. His friend Aldus Manutius was a spectator of his triumphs upon this occasion; and though some allowances must doubtless be made for the warmth of friendship, and for an Italian taste in writing, it is still to be remembered that when he published his account, the event to which it referred was altogether recent, and he necessarily appealed to a cloud of living witnesses, who would have treated his panegyric with derision, if Crichton had obviously failed in supporting his own lofty pretensions.

Crichton.

After his departure from Venice, he betook himself to Mantua; and there, according to Urquhart's romantic narrative, he rendered himself very conspicuous by his valiant encounter with a fierce Italian gentleman, who had recently slain three antagonists. Crichton is said to have challenged this redoubtable champion, and, after many efforts of mutual skill, to have brought the matter to this conclusion: "His right foot did beat the cadence of the blow that pierced the belly of this Italian; whose heart and throat being hit with the two former stroaks, these three franch bouts given in upon the back of other: besides that, if lines were imagined drawn from the hand that liver-

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par exemple, les Oraisons de Jacques Criton, parce qu'elles ne se trouvent qu'imprimées separément, qui aura dans sa bibliotheque celles de Raymond, Gallutius, Nigronius, Bencius, Perpinian, et de beaucoup d'autres autheurs, non pas qu'elles soient meilleures ou plus disertes et esloquentes que celles de ce docte Escossois, mais parce qu'elles se trouvent reserrées et continues dans de certains volumes." (Advis pour dresser une Bibliotheque, p. 76. edit. Paris, 1644, 8vo.) Naudé apparently confounds him with George Crichton, doctor of the canon law, who was royal professor of Greek in the university of Paris, and the author of various orations published in a detached form. He married a daughter of his countryman Adam Blackwood. (Niceron, Memoires des Hommes illustres dans la Republique des Lettres, tom. xxxvii. p. 346.) The poems of the two Crichtons are mentioned in the following terms by Olaus Borrichius: "Jacobo Crittonio Scoto non ignotum fuisse Pegaseium melos docent heroica, quibus suum in urbem Venetam appulsum designat. Plus tamen vividi caloris cultusque in epicis Georgii Crittonii." (Dissertationes Academicæ de Poetis, p. 151. Francof. 1683, 4to.)

[1] The dedication of Aldus Manutius, together with the four Latin poems of Crichton, are reprinted in Grævius's edition of Cicero *De Officiis*, &c. Amst. 1688, 8vo. They may likewise be found in the *Biographia Britannica*, vol. iv. p. 452, and in the appendix to Mr Tytler's *Life of the Admirable Crichton*, p. 292. Only two of the poems, the hexameters on Venice and the ode to Manutius, occur in the *Deliciæ Poetarum Scotorum*, tom. i. p. 268.

Chrichton. ed them, to the places which were marked by them, they would represent a perfect isosceles triangle, with a perpendicular from the top-angle, cutting the basis in the middle."[1] The learned knight had studied mathematics, and he seems to have been fully resolved that his knowledge should be turned to some account. This combat he has described in a very circumstantial manner; but, viewing his unsupported authority with no small degree of suspicion, we feel no inclination to repeat his martial details, which however are not a little curious in themselves. But it is a fact confirmed by other evidence that Crichton was invited or attracted to the court of Mantua, and that the duke appointed him tutor to his son Vincenzo Gonzaga. Here, according to the knight of Cromarty, he displayed his dramatic talents as conspicuously as he had formerly displayed his learning and his prowess. In the space of five hours, he is said to have represented fifteen different characters, and to have supported each of them with marvellous effect. But his brilliant career was speedily to close. When he was one evening walking in the streets of Mantua with his lute in his hand, he was unexpectedly assailed by three individuals, and drawing his sword, he pressed upon them with so much skill and resolution, that the principal aggressor was impelled by his fears to discover himself as young Gonzaga. Crichton fell upon his knees, and entreated forgiveness for an act which evidently inferred no guilt, when the prince instantly pierced him through the body, and terminated the mortal existence of one of the most remarkable persons of the era to which he belonged.[2] This act of base ferocity was perpetrated on the third of July 1583, when Crichton had nearly completed the twenty-third year of his age.

The elegance of his person had procured him the admiration of those who were unable to estimate the powers of his mind. His countenance is described as beautiful; but his right eye was marked, if not somewhat disfigured, by a red spot, or, as Manutius describes it, a red rose by which it was surrounded. His reputation as a scholar did not render him indifferent to the more superficial accomplishments of a gentleman: his address was courteous, and he was a proficient in dancing, as well as in the gymnastic and martial exercises to which youths of his condition were then addicted.

The unrivalled fame of this young scholar is certainly allied to romance; but, on the other hand, it is very difficult to imagine that it was not originally founded on some qualities which eminently distinguished him from other forward and aspiring youths, who at that period were sufficiently numerous in the more learned countries of Europe. A reputation so splendid, and so uniformly maintained, cannot reasonably be ascribed to a mere concurrence of accidental circumstances. The specimens of his Latin poetry which have been preserved do not indeed contain any thing very remarkable; but they are few in Crichton. number, and were not published by himself; nor does his reputation depend upon one species of excellence. He is celebrated for the wonderful facility with which he composed verses, for his knowledge of ten or twelve different languages, for his acquaintance with the writings of the fathers, for his uncommon powers of memory, and for his promptitude and acuteness in public disputation. We must not therefore hastily conclude that he "was in Italy considered as one of those literary mountebanks who were numerous in that age;" or that his reputation chiefly depends on the romantic flights of Sir Thomas Urquhart, who wrote about seventy years after his death. Joseph Scaliger, who flourished at the same period with himself, who professes to have obtained his information in Italy, and who besides was not too prone to admiration, mentions Crichton as a prodigious genius, and indeed enumerates all the most essential qualifications that are commonly ascribed to him.[3] His testimony, which is entirely overlooked by the late Dr Black,[4] is certainly of considerable weight and importance. Crichton is likewise extolled in terms of the highest admiration, in a work published so early as the year 1609 by Dr Abernethy, a native of Edinburgh, and a member of the university of Montpellier.[5] The longer of the two poems which he wrote in celebration of his young countryman, commences with these verses:

O fœlix animi juvenis Chrichtone! vigore
Ingenii volitante supra qui vectus in astra
Humanam sortem, et mortalis culmen honoris,
Seu placuit Musas colere, aut glomeramine campum
Tundere cornipedis, pictisve ardescere in armis;
Grandia sublimis nuper miracula mentis
Monstrasti attonito, et rapuisti protinus orbi.[6]

To the early testimonies which we have already produced, many others, somewhat more recent, might easily be added; and we are fully prepared to acquiesce in the opinion of Dr Johnson, that of Crichton's history, "whatever we may suppress as surpassing credibility, yet we shall, upon incontestible authority, relate enough to rank him among prodigies."[7] Dr Kippis, who has written a copious account of this renowned youth, has legitimately applied the test of criticism to several of the early notices; and many of his strictures, particularly those on Urquhart and Mackenzie, every person of a sober judgment must admit to be too well founded. We have however placed no reliance on such authorities, but have derived all our materials from better sources. "He appears," says this biographer, "to have had a fine person, to have been adroit in his bodily exercises, to have possessed a peculiar facility in learning languages, to have enjoyed a remarkably quick and retentive memory, and to have excelled in a power of declamation, a fluency of speech, and a readiness of reply. His know-

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[1] Urquhart's Discovery of a most exquisite Jewel, p. 90.

[2] Imperialis Musæum Historicum, p. 242. Venetiis, 1640, 4to.—In mentioning their first encounter, he uses the expression, "consulto an casu, incertum;" nor are we in possession of any more specific information. With regard to the date, there is some degree of uncertainty. In the month of November 1583, Manutius bewailed his young friend as already dead, and pointedly referred to the fatal third of July. Imperiali likewise states that he died on the third of July 1583. On the other hand, Serassi, in his *Vita del Mazzoni*, p. 127, speaks of a poem written by James Crichton on the death of Cardinal Borromeo, which did not take place till the third of November 1584. But for such a fact as this, the authority of Manutius cannot well be called in question; and we must rather conclude that the poem was written by another James Crichton, or by some person who thought proper to adopt his name.

[3] "J'ay oüy parler d'un Critton Escossois en Italie, qui n'avoit que 21 ans, quand il a esté tué par le commandement du duc de Mantoue; et qui sçavoit 12 langues, avoit leu les peres, poëtes, disputoit de omni scibili, et respondoit en vers. C'estoit ingenium prodigiosum, admiratione magis quam amore dignum. Il estoit un peu fat. Ei judicium non tantum adfuit. Principes solent illa ingenia amare, non vero bene doctos. Manutius præfatione ad Paradoxa, quam dicat Crittonio, meminit illius ingenii." (Scaligerana, p. 58.)

[4] Black's Life of Tasso, vol. ii. p. 413. Edinb. 1810, 2 vols. 4to.

[5] Adam Abernethy took the degree of A. M. at Edinburgh on the 7th of August 1594. He afterwards took that of M. D. probably in some foreign university. He is described as "Monspeliensis academiæ moderator."

[6] Musa Campestris, &c. authore Adamo Abrenetheo ex Scoto-Britanna, Edinburgeno. Monspelii, 1609, 8vo.

[7] Adventurer, No. 81

Cricket.

ledge, likewise, was probably very uncommon for his years; and this, in conjunction with his other qualities, enabled him to shine in public disputation. But whether his knowledge and learning were accurate or profound, may justly be questioned; and it may equally be doubted whether he would have arisen to any extraordinary degree of eminence in the literary world. It will always be reflected upon with regret, that his early and untimely death prevented this matter from being brought to the test of experiment."[1] In all controversies, it is of the first importance to ascertain the real state of the question. In a youth of twenty-three, whatever superiority of intellect he may possess, we do not expect to find the erudition of Scaliger or Salmasius. Those who extol Crichton as a very extraordinary person do not necessarily suppose that his attainments exceeded the limits of human genius; but they may reasonably believe that in various departments of science and literature he arrived at a degree of proficiency wonderfully premature; that he evinced great energy of application, with unusual powers of memory; and that of the knowledge which he so rapidly acquired, he possessed so ready a command, together with so much promptitude and acuteness of mental exertion, that he appeared as a prodigy among men of the ordinary standard of intellectual excellence.[2] (D. I.)

CRICKET. See index to ENTOMOLOGY.

CRICKET, a well-known game with bats and ball. This favourite English pastime appears to be as old as the thirteenth century. It was not played at that early date in its present form, nor was the game then known under the name it now bears, but traces of its existence are found in various old English works. The game of single-wicket is known, from a MS. in the Bodleian Library, to have been played at least as early as 1344; and a kind of cricket called *handyn* and *handoute*, is mentioned in the statutes of Edward IV. as unlawful in consequence of the gambling to which it led. The double-wicket game, under the title of "Cat and Dog," was a popular recreation in certain counties of Scotland, at the beginning of the eighteenth century. The name of Cricket, however, which is derived from *Creag*, the Saxon word for a crooked stick, is not found in any English author till the year 1685, when it occurs in the *Mysteries of Love and Eloquence*, by Edward Phillips, the nephew of Milton. About the beginning of the eighteenth century, repeated allusions to the game under its present denomination are found in the writings of Tom D'Urfey, Pope, Duncome, and Soame Jenyns.

The south and south-eastern counties of England appear to have been the cradle of the game of cricket; Surrey, Sussex, Kent, and Hampshire, were the counties in which it was first systematically and successfully practised. Farnham in Surrey was the parish which produced the largest number of good players at the time when the game was slowly establishing itself throughout England as a national pastime towards the close of the last century. At this time the formation of the Hambledon Club contributed greatly to extend the game and elevate the standard of play. New clubs were formed in the centre and west of England, and the spirit of emulation, fostered and encouraged by the trials of skill to which these clubs challenged each other from time to time, gave rise to an astonishingly high standard of excellence. Of late years the propaganda of the metropolitan clubs has diffused throughout the whole of England, and the southern districts of Scotland, a taste for this manly pastime, which, however, has not yet become naturalized in any other country in the world.

Cricket.

There are two games of cricket, double-wicket and single-wicket. In both that side is victorious which obtains the greatest number of runs in two innings.

Double-wicket requires twenty-two players, eleven on each side. The two sides toss up for the first innings; and two players, belonging to the side that wins the toss go in, one at each wicket. The out-party place themselves in various situations on the field to catch or stop the ball when struck by the batsman. One of the bowlers begins bowling a round or "over" of six bowls, his object being to strike down the wicket; if he succeed, the batsman retires from the game, and another of his party takes the bat. If however the ball is struck by the batsman, he and his partner run, exchanging wickets till the ball is thrown up to the bowler. One notch is scored towards their game every time they change wickets. Should their bails be knocked off, however, either by the bowler or the wicket-keeper before they recover their ground, they are "out;" or, if the ball be caught by any of the fielders before it touches the ground, the batsman who struck it is out. After the bowler has bowled four or six times (as may have been agreed upon) the umpire calls out "over," and the fielders reverse their position, crossing over the field so as to assume proper positions for the new bowling which now begins from the other wicket. At the end of every four or six bowls this change in the position of the field takes place: and so on alternately. When all the players on the one side have been put out, their antagonists go in and play till their innings is over. When each side has had two innings, the notches are counted, and that party is victorious which has scored the highest number.

Single-wicket may be played by any number of persons, but four or six players a side is as large a number as can conveniently play. The distance of the wickets, and the object of batsmen and bowlers are the same as in double-wicket.

LAWS OF CRICKET, AS REVISED BY THE MARYLEBONE CLUB IN THE YEAR 1844.

I. The ball must weigh not less than five ounces and a half, nor more than five ounces and three quarters. It must measure not less than nine inches, nor more than nine inches and one quarter in circumference. At the beginning of each innings either party may call for a new ball.

II. The bat must not exceed four inches and one quarter in the widest part; it must not be more than thirty-eight inches in length.

III. The stumps must be three in number, twenty-seven inches out of the ground; the bails eight inches in length, the stumps of equal, and of sufficient thickness to prevent the ball from passing through.

IV. The bowling crease must be in a line with the stumps; six feet eight inches in length; the stumps in the centre, with a return crease at each end towards the bowler at right angles.

V The popping crease must be four feet from the wicket, and parallel to it; unlimited in length, but not shorter than the bowling crease.

VI. The wickets must be pitched opposite to each other, by the umpires, at the distance of twenty-two yards.

VII. It shall not be lawful for either party during a match, without the consent of the other, to alter the ground by rolling, watering, covering, mowing, or beating. This rule is not meant to prevent the striker from beating the ground with his bat, near to the spot where he stands during the innings, nor to prevent the bowler from filling up holes with saw-dust, &c., when the ground shall be wet.

VIII. After rain the wickets may be changed with the consent of both parties.

IX. The bowler shall deliver the ball with one foot on the ground behind the bowling crease, and within the return crease, and shall bowl four balls before he changes wickets, which he shall be permitted to do once only in the same innings.

[1] Biographia Britannica, vol. iv. p. 455.

[2] 'Ce fut," says Bayle, "l'un des plus extraordinaires prodiges d'esprit qu'on ait jamais vus." (Dictionnaire Historique et Critique, tom. i. p. 941.) This is scarcely exceeded by the panegyric of Imperialı: "Hic est Critonius ille Scotus, transacti duodum sæculi monstrum, prodigioso naturæ opificis conatu editum, quo Parnassi spacia stupendo et inusitato spectaculo illustrarentur. Hic est totius adhuc orbis judicio Phœnix habitus ingeniorum, divinæ mentis igniculis summi potius datoris referens majestatem, quam mortalem ad æmulandum lacessens industriam." (Musæum Historicum, p. 241.)

X The ball must be bowled; if it be thrown or jerked, or if the hand be above the shoulder in the delivery, the umpire must call "No ball"

XI. He may require the striker at the wicket from which he is bowling to stand on that side of it which he may direct.

XII. If the bowler toss the ball over the striker's head, or bowl it so wide that it shall be out of distance to be played at, the umpire (even although he attempt to hit it) shall adjudge one run to the parties receiving the innings, either with or without an appeal from them; which shall be put down to the score of wide balls; and such ball shall not be reckoned as any of the four balls.

XIII. If the bowler deliver a "no ball" or a "wide ball," the striker shall be allowed as many runs as he can get, and he shall not be out except by running out. In the event of no run being obtained by any other means, then one shall be added to the score of "no balls" or "wide balls," as the case may be. All runs obtained by "wide balls" to be scored to "wide balls." The names of the bowlers who bowl "wide balls" or "no ball" in future to be placed on the score, to show the parties by whom either score is made.

XIV. At the beginning of each innings the umpire shall call "Play." From that time to the end of each innings no trial ball shall be allowed to any bowler.

XV. The striker is out if either of the bails be bowled off, or if a stump be bowled out of the ground.

XVI. Or if the ball from the stroke of the bat, or hand, but not the wrist, be held before it touch the ground, although it be hugged to the body of the catcher.

XVII. Or if, in striking, or at any other time while the ball shall be in play, both his feet shall be over the popping crease, and his wicket put down, except his bat be grounded within it.

XVIII. Or if, in striking at the ball, he hit down his wicket.

XIX. Or if, under pretence of running or otherwise, either of the strikers prevent a ball from being caught, the striker of the ball is out.

XX. Or if the ball be struck, and he wilfully strike it again.

XXI. Or if, in running, the wicket be struck down by a throw, or by the hand or arm (with ball in hand) before his bat (in hand) or some part of his person be grounded over the popping crease. But if both the bails be off, a stump must be struck out of the ground.

XXII. Or if any part of the striker's dress knock down the wicket.

XXIII. Or if the striker touch or take up the ball while in play, unless at the request of the opposite party.

XXIV. Or if with any part of his person he stop the ball, which, in the opinion of the umpire at the bowler's wicket, shall have been pitched in a straight line from it to the striker's wicket, and would have hit it.

XXV. If the players have crossed each other, he that runs for the wicket which is put down is out.

XXVI. A ball being caught, no run shall be reckoned.

XXVII. A striker being run out, that run which he and his partner were attempting shall not be reckoned.

XXVIII. If a "lost ball" be called, the striker shall be allowed six runs; but if more than six shall have been run before "lost ball" shall have been called, then the striker shall have all which have been run.

XXIX. After the ball shall have been finally settled in the wicket-keeper's or bowler's hand, it shall be considered dead; but when the bowler is about to deliver the ball, if the striker at his wicket go outside the popping crease before such actual delivery, the said bowler may put him out, unless (with reference to Law XXI.) his bat in hand, or some part of his person, be within the popping crease.

XXX. If the striker be hurt, he may retire from his wicket, and return to it any time during that innings.

XXXI. If the striker be hurt, some other person may stand out for him, but not go in.

XXXII. No substitute in the field shall be allowed to bowl, keep wicket, stand at the point, cover the point, or stop behind in any case.

XXXIII. If any fieldsman stop the ball with his hat, the ball shall be considered dead, and the opposite party shall add five runs to their score; if any be run, they shall have five in all.

XXXIV. The ball having been hit, the striker may guard his wicket with his bat, or with any part of his body except his hands; that Law XXIII. may not be disobeyed.

XXXV. The wicket-keeper shall not take the ball for the purpose of stumping until it have passed the wicket; he shall not move till the ball be out of the bowler's hand; he shall not by any noise incommode the striker; and if any part of his person be over or before the wicket, although the ball hit it, the striker shall not be out.

XXXVI. The umpires are sole judges of fair or unfair play, and all disputes shall be determined by them, each at his own wicket; but in case of catch, which the umpire at the wicket bowled from cannot see sufficiently to decide upon, he may apply to the other umpire, whose opinion shall be conclusive.

XXXVII. The umpires in all matches shall pitch fair wickets, and the parties shall toss up for the choice of innings.

XXXVIII. They shall allow two minutes for each striker to come in, and ten minutes between each innings. When the umpires shall call "Play," the party refusing to play shall lose the match.

XXXIX. They are not to order a striker out unless appealed to by the adversaries.

XL. But if one of the bowler's feet be not on the ground behind the bowling crease, and within the return crease when he shall deliver the ball, the umpire of the wicket unasked shall call "No ball."

XLI. If either of the strikers run a short run, the umpire must call one short.

XLII. No umpire shall be allowed to bet.

XLIII. No umpire is to change during a match, unless with the consent of both parties, except in case of violation of Law XLII.; then either party may dismiss the transgressor.

XLIV. After the delivery of four balls, the umpire must call "Over;" but not until the ball be finally settled in the wicket-keeper's or bowler's hand; the ball shall then be considered dead; nevertheless, if an idea be entertained that either of the strikers is out, a question may be put previously to, but not after the delivery of the next ball.

XLV. The umpire must take especial care to call "No ball" instantly upon delivery; "Wide ball" as soon as ever it shall pass the striker.

XLVI. The players who go in second shall follow their innings, if they have obtained one hundred less runs than their antagonists.

XLVII. When one of the strikers shall have been put out, the use of the bat shall not be allowed to any person until the next striker shall come in.

LAWS FOR SINGLE-WICKET.

I. When there shall be less than five players on a side, bounds shall be placed twenty-two yards each in a line from the off and leg stump.

II. The ball must be hit before the bounds to entitle the striker to a run, which run cannot be obtained unless he touch the bowling stump, or crease, in a line with his bat, or some part of his person, or go beyond them, returning to the popping crease as at double-wicket, according to Law XXI.

III. When the striker shall hit the ball one of his feet must be on the ground and behind the popping crease; otherwise the umpire shall call "No hit."

IV. When there shall be less than five players on a side, neither byes nor overthrows shall be allowed, nor shall the striker be caught out behind the wicket, or stumped out.

V. The fieldsman must return the ball so that it shall cross the play between the wicket and the bowling stump, or between the bowling stump and the bounds; the striker may run till the ball be so returned

VI. After the striker shall have made one run, if he start again he must touch the bowling stump, and turn, before the ball shall cross the play, to entitle him to another.

VII. The striker shall be entitled to three runs for lost ball, and the same number for ball stopped with hat; with reference to Laws XXVIII. and XXXIII. of double-wicket.

VIII. When there shall be more than four players on a side, there shall be no bounds. All lists, byes, and overthrows, shall then be allowed.

IX. The bowler is subject to the same laws as at double-wicket.

X. Not more than one minute shall be allowed between each ball.

ADDENDA.

XI. The ball must be bowled, not thrown or jerked, and the hand must not be above the shoulder in delivery; and whenever the bowler shall so closely infringe on this rule, in either of the above particulars, as to make it difficult for the umpire at the bowler's wicket to judge whether the ball has been delivered within the true intent and meaning of this rule, or not, the umpire shall call "No ball."

XII. If the bowler shall toss the ball over the striker's head, or bowl it so wide, that, in the opinion of the umpire, it shall not be fairly within the reach of the batsman, he shall adjudge one run to the parties receiving the innings, either with or without an appeal, which shall be put down to the score of "wide balls;" such ball shall not be reckoned as one of the four balls; but if the batsman shall by any means bring himself within reach of the ball, the run shall not be adjudged.

XIII. The umpires in all matches shall pitch fair wickets, and the parties shall toss up for the choice of innings. The umpires shall change wickets after each party has had one innings.

Crickhowel ‖ Crimea.

CRICKHOWEL, a market-town of South Wales, county of Brecon, picturesquely situated on the Usk, 8 miles west by north of Abergavenny. It has remains of a castle, and is much resorted to by tourists and invalids. Pop. of parish (1851) 1403.

CRICKLADE, a parliamentary borough of England, county of Wilts, consisting of the hundreds and divisions of Highworth, Cricklade, Staple, Kingsbridge, and Malmsbury (except such part of the hundred of Malmsbury as is included within the borough of Malmsbury). Pop. (1851) 35,503. Cricklade returns two members to parliament. Registered electors (1851–52) 1647. The old market-town of this name consists of the parishes of St Mary and St Sampson, having in 1851, 431 and 1475 inhabitants respectively. It is situated on the right bank of the Thames, 9 miles S.E. of Cirencester, and 84 miles from London. The church of St Sampson is a spacious cruciform edifice, with a lofty and highly ornamented tower. The market formerly held on Saturday is now discontinued.

CRICOID (κρίκος, a ring), in the form of a ring; annular.

CRIEFF, a burgh of barony of Perthshire, Scotland, on the north bank of the Earn, a tributary of the Tay, 15 miles west of Perth. It is the second town in the county, and in 1851 had 3824 inhabitants. It stands near the foot of the Grampians, at the entrance of one of the important passes to the highlands, and the environs are noted for their beauty. The greatest cattle-market in Scotland was held here previous to 1770, when it was removed to Falkirk. The principal manufacture is that of cottons; but it has also manufactures of linen, worsted, and woollen stuffs; tanneries, corn and oil mills, distilleries, and a considerable trade in tambouring and flowering webs for Glasgow houses. It has several handsome churches, a town-house, assembly room, savings-bank, mechanics' institute, reading-room, and several libraries. An educational establishment called St Margaret's College, for young ladies of the Episcopal communion, has recently been organized here. There is a handsome bridge of four arches across the Earn; and in the middle of the central street is a curious old cross.

CRIMEA, a peninsula in the Black Sea, forming part of the Russian government of Taurida, with the mainland of which it is connected by the isthmus of Perekop. It is situate between 44. and 46. N. Lat., and 32. and 37. E. Long. It is of an irregular square, or rhomboid form, measuring diagonally about 190 miles from east to west, and 123 from north to south, and containing an area of about 8000 square miles. Its south-eastern, western, and north-western coasts are washed by the Black Sea, and the eastern by a shallow lagoon called the *Sivash*, or Putrid Sea, which is connected with the Sea of Azoff by a very narrow strait, and separated from it by a tongue of land, consisting of sand and broken shells, about 70 miles in length, and 1 to 1½ in breadth. The eastern part of the Crimea forms a minor peninsula, stretching eastward to the strait of Kertsh or Caffa, or Jenikaleh, the ancient Cimmerian Bosporus, which forms the communication between the Black Sea and the Sea of Azoff, but is not navigable by large or deeply-laden vessels.

General appearance.

The Crimea consists mostly of a continuation of the steppes that occupy so large a portion of the southern governments of Russia. From the isthmus of Perekop, southwards to the neighbourhood of Kara-su-bazar, the country is one continued flat; then it rises by an easy gradation to the summit of a chain of hills that occupy the southern part of the peninsula, extending along the shore of the Black Sea from the vicinity of Kaffa to Sebastopol, to the southward of which they form the celebrated promontory called by the Greeks *Kriou Metopon*, or the Ram's Face, and now by the Tatars *Ai Burun*, or the Holy Cape. These hills are composed mostly of calcareous rocks, and no primary rocks are to be found among them, nor in any other part of the peninsula. They rise abruptly from the sea to a considerable elevation; and the highest, called by the ancient Greeks *Trapezus*, or the table-mountain, from the flatness of its summit, and now called by the Tatars *Tchatir-dagh*, or the Tent Mountain, is 790 toises = 5051 feet above the level of the sea. The coast of this mountainous region is very picturesque, and numerous vineyards have been formed along its sunny slopes; but though they have the advantage of a fine exposure and a favourable climate, they have not been successful in the culture of the grape. The mountains produce likewise timber for shipbuilding, and abound with wild beasts. They are intersected by valleys of fine arable land, and are said to be rich in mineral produce of various kinds. From the northern foot of the mountains the country sinks into a boundless level steppe, mostly smooth as a bowling-green, with a soil of a dark coloured loam, with brackish water gathered in its hollows, but without either springs or rivers, though the beds of rivers that once existed may still be traced. The soil is generally impregnated with salt; but wherever it is capable of cultivation the surface is covered with plants, whose gaudy blossoms fill the air with fragrance. The most valuable product of this part of the country is salt, which is mostly derived, and in very large quantities, from lakes near Perekop, Kozlov, Kaffa, and Kertsh. Crimea.

Rivers.

The only rivers worth mentioning are the Salghir and the *Kara-su* or Blackwater. The former, which rises from a cavern near Simferopol, at the northern foot of the Tchatir-dagh, falls straight into the plain below, and then runs north-eastward into the Putrid Sea, watering in its course the central part of the peninsula. The Blackwater rises from the mountains a little farther east, and falls into the Salghir in the lower part of its course. Neither of them is navigable. The Alma is a small stream a little north of Sebastopol, with steep southern banks, celebrated for the defeat of the Russian army, September 20, 1854, by the allied forces of France and Britain.

Climate.

The climate from March to May is said to be most salubrious and delightful, the heat being moderate and refreshing, and the nights cool and serene. The summers are irregular and very hot, the thermometer rising to 100° in the steppe. Long droughts then frequently prevail, parching up the verdure; while thunderstorms, accompanied with hail and heavy rains, are frequent and destructive. The autumn is unhealthy, fevers and agues being then very prevalent and often fatal. In winter the mountains are covered with snow, which continues on the higher ones till June; and even in the plains the weather is sometimes extremely severe. Throughout the year the winds are very variable. They bring rain from the west, mild air and mists from the south, clear dry weather from the east, and cold from the north. Of late years the climate is believed to have changed materially for the worse; and fevers have become so prevalent in every part of the peninsula, that it is considered scarcely possible for a stranger to escape them.

Vegetable productions.

In ancient times the Crimea, then called the Tauric peninsula, produced a great quantity of corn, which was exported to Athens and other parts of Greece; and, with proper industry, it is believed to be still capable of maintaining its ancient productiveness. But the Tatars, who form the bulk of its present inhabitants, prefer the pastoral to the agricultural life; and so much do they neglect the cultivation of the soil, that even in the best years a large quantity of corn has to be imported. The sunny slopes of the mountains being supposed to be favourable to the cultivation of the vine, the Russian government has endeavoured to introduce it, and a large extent of the hill sides near Prince Woronzoff's palace of Marsanda has been covered with vineyards; but the produce has not been sufficient to remunerate the labour of the cultivators. The wine is not remarkable for either flavour or strength. The same part of the country likewise produces excellent garden fruits, particularly apples, which are so highly esteemed as to form an article of com-

Crimea.

merce as far as Moscow. Trees, if planted in the steppe, perish altogether, after a brief existence of a year to two. According to Pallas, the most prevalent trees and shrubs that naturally occur are mountain-pine, juniper, yew, and some other evergreens, oak, beech, elm, several kinds of poplar, linden, maple, and ash. Wild sage and thyme are the prevalent plants of the mountains, and many parts of the steppe yield a rich and luxuriant pasturage. Of cultivated plants, wheat, barley, rye, oats, maize, millet, peas, flax, and tobacco, are grown in the fields; and in the gardens, melons, water-melons, gourds, and cucumbers. The other principal fruits produced, besides apples, are quinces, plums, peaches, apricots, cherries, mulberries, walnuts, hazelnuts, and chestnuts.

Animals.

The wild animals consist of wolves, foxes, badgers, weasels, hares, and jerboas; the tame, or domesticated double-humped camels, buffaloes, and beeves; three kinds of sheep, one of which is distinguished from those of any other country by short curly wool of a bluish-gray colour; goats, dogs, and deer. The Tatars possess large herds and flocks of sheep, oxen, camels, and buffaloes, with small wiry horses more remarkable for activity and intelligence than for beauty. The variety of birds is not great, consisting mostly of crows, owls, thrushes, blackbirds, partridges, quails, kingfishers, pigeons and poultry, geese, swans, ducks, teal, and gulls of various species. Serpents, lizards, and frogs are abundant; and the *Rana variabilis*—a most disgusting like animal, swarms in the Sivash. Scorpions, tarantula-spiders, and scolopendras, are found in the dwellings of the Tatars, and are dangerous. Caterpillars and locusts are often very destructive. Bees are abundant, and produce excellent honey and a great deal of wax. The rivers are not prolific in fish; but great abundance and variety haunt the sea-coasts, among which are two kinds of sturgeon, mullet, herring, mackerel, oysters, and a variety of other shell-fish.

Commercial productions and exports.

The most valuable commercial production is salt, which, as already mentioned, is obtained in very large quantities from *tuzlas*, or salt lakes, near Perekop, Kozlov, Kaffa, and Kertsh. It is a government monopoly, and yields a considerable revenue. The other principal articles of commerce and export are wine, honey, wax, leather, hides, wool, and lambskins; of the last of which, called *shumski*, great quantities are exported yearly to Poland and other neighbouring countries. The only manufacture worth notice is what is called morocco leather, which is produced of good quality. The mountains contain masses of red and white marbles, full of cracks and fissures, which make them well adapted for quarrying, if there were a demand.

Ancient Inhabitants.

The oldest known inhabitants of the Crimea were the Cimmerians; but these were driven out by Scythians, only leaving a remnant in the mountains, where they acquired the name of *Tauri*. That these were a very savage people appears from the fact that every stranger that landed on their coast was sacrificed to a goddess whom the Greeks, from some supposed similarity of attribute, identified with the Artemis of their own mythology, distinguishing her however, as the Tauric Artemis. From these Tauri likewise were derived the name of *Tauric Peninsula*, bestowed upon the country by the ancient Greeks, and the modern Russian name of *Taurida*.

History.

About the year 550 B.C., the southern and eastern parts of the peninsula were colonized by Greeks. On the western side of the Bosporus the Milesians founded the city of *Panticapæum*, called also *Bosporos*, now represented by Kertsh. Being favourably situate for trade, it soon became a place of importance, and the capital of a kingdom which eventually included the whole of the peninsula. The last of its kings, being hard pressed by the Scythians, voluntarily ceded his dominions to Mithridates the Great, king of Pontus, on the opposite side of the Euxine. After his downfall his son Pharnaces was allowed to retain the kingdom of Bosporos; and a series of kings continued to rule it till a late period under the protection of the Roman empire. It was afterwards invaded and overrun successively by the Alans, the Goths and the Huns, and other barbarians, till about the year 1237, when it fell into the hands of the Mongols, under Genghis Khan, and became a province of their empire and peopled by their roaming tribes. Soon afterwards the Venetians established several commercial stations on the coasts, and carried on a lucrative trade till they were supplanted by the Genoese. These were allowed by the Mongols to take possession of Kaffa, which they rebuilt and fortified, and made the centre of an extensive trade, carried on overland, with Persia, India, and even China. In 1441, the Crimea came into the possession of a race of khans of the family of Genghis; but these were soon afterwards subjected by the Ottoman Turks, who ruined the foreign trade of the Crimea, and closed the navigation of the Black Sea to the western Europeans. So matters continued with unimportant changes till 1774, when, through the intervention of the Czarina, Catherine II. of Russia, the khans of the Crimea nominally recovered their independence, which continued however only for ten years more, when they were supplanted entirely, and the Crimea was annexed to the Russian empire. It now forms the southern or peninsular portion of the Russian government of Taurida.

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People.

The population consists mostly of Tatars, but there are also considerable numbers of Russians, Greeks, Germans, Jews, Armenians, and Gypsies. The Tatars consist of *Nogays*, who live in villages, and pique themselves on the purity of their lineage, as being the unmixed descendants of those who settled in the Crimea in the time of the Mongols; and of Tatars of the steppe, who are of less pure descent, but still consider themselves superior to the Tatars of the southern coast, who are a mixed race, largely alloyed with Greek, Italian, and Ottoman blood, and despised on that account by the two former races. The Tatars are all Mohammedans, and Simferopol is the seat of one of the two muftis of the Russian empire. They are classed into mirzas or nobles, mollahs or priests, and peasants. The noble families are now few in number, but there is a mollah for every parish or small district. The Tatars are simple in their manners and dress, and live principally on the produce of their flocks and herds, not being much disposed to the regular industry required for the cultivation of the soil. Their character has been highly eulogized for sobriety, chastity, cleanliness, and hospitality; but this will apply principally to those that live in the country, while those who live in towns are probably not unlike the townspeople of other countries similarly circumstanced. The houses in the towns, as well as in the villages, are built mostly of square timbers, having the interstices filled up with brickwork or turf, and the chinks and crannies made tight with clay, and then plastered both within and without, the roof consisting of bricks or turfs. Only the medscheds or mosques and the baths are of stone. The other inhabitants, Russian, German, Armenian, and Gypsy, are in no way distinguishable; but the Jews are all of the Karaite sect, and remarkably and honourably distinguished from their brethren in other countries by their probity, for which, according to Mr Oliphant, "the Karaite merchant enjoys everywhere so high a reputation, that throughout the Crimea his word is considered equal to his bond."

Popula-tion.

According to Pallas the population of the Crimea, before its annexation to Russia, amounted to half a million of souls; but it was subsequently much reduced, chiefly through emigration. The population of the government of Taurida, of which the Crimea forms the principal part, is stated to amount to 543,000.

Cities and towns.

The towns are mostly situate on the coasts, or in the valley of the Salghir. SIMFEROPOL, the provincial capital, situate on the banks of the Salghir, is a modern Russian

town, with wide streets and very white tall houses, and all the public establishments requisite to conduct the affairs of an extensive province. It has been built close by the old Tatar town of *Ak-metchet* (Whitechurch), which is still occupied by about 5000 Tatars. About 20 miles south-west of Simferopol is *Bagtchi-Serai* (Garden-palace), the old residence of the former Khans of the Crimea, still in good preservation, situate in a narrow and rocky but romantic valley. Adjoining, there is a large town, exclusively occupied by Tatars, who allow no Russians to settle in this valley. Near the town is *Juferd*, or *Tchoufut* or *Tchaiphut Kaleh* (Rogue's or Infidel's Castle), on a high rock, possessed by, and forming the headquarters and place of refuge of, the Karaite Jews, few of whom, however, live here, on account of its being so disadvantageously situated for trade. The streets are now silent, but the adjoining valley of Jehoshaphat is "fully garnished with tombstones; all the devout Karaites, when increasing infirmities warn them of approaching dissolution, being brought hither to die." *Ienikale*, pronounced *Yenekawleh* (New Castle), built by the Turks to command the entrance of the Bosporus from the sea of Azoff, looks, says Oliphant, "like some dilapidated town on the Red Sea." It is inhabited by a few hundred Greeks and Tatars. *Kertsh*, on the west side of the Bosporus, on the site of the ancient *Panticapæum*, is almost the only town in Russia that is built entirely of stone. The houses look handsome and substantial; and the population amounts to about 10,000 souls. For some Russian reason, incomprehensible to common sense, says Mr Oliphant, the tribune of commerce was transferred from Theodosia, a town advantageously situate at the head of a deep capacious harbour, which is never frozen, to the shores of these straits, which are closed for four months of the year, where the anchorage is dangerous, and the water shallow. Here every ship must remain, and perform a four days' quarantine. The larger ones wait until their cargoes arrive from Taganrog, or Rostof, in lighters, while those drawing less water cross the bar and proceed to load at Taganrog. Independently of the supply of shipping, the only trade of the town consists in exporting salt. *Theodosia*, or *Kaffa*, situate on a fine well-sheltered bay of the Black Sea, 45 miles west of the strait, was formerly a flourishing place of trade, but is now a decayed town with about 5000 inhabitants. *Ialta*, *Jalta*, or *Yalta*, 70 miles S.W. of Kaffa, is a small town with well-built houses, streets prettily laid out, and an air of commercial bustle, with a secure harbour. It is the commercial centre of the wine country, and a favourite watering-place for summer visitors. *Kozlov*, on the site of the ancient *Eupatoria*, founded by Mithridates Eupator, king of Pontus, on the west coast, is a considerable town, with a lazaretto, custom-house, several fine mosques, and a Tatar college. The great mosque of Kozlov, several centuries old, is the finest building in the Crimea, and much admired for its elegance, extent, and solidity. Although the bay is open and exposed, and the surrounding country only a series of steppes and marshes, Kozlov is considered the most thriving port in the Crimea. It owes its prosperity to the great number of Karaite Jews who have settled there. They form now the greater part of the population, and the handsomest synagogue of which the sect can boast in Russia adorns this town. Not far from Kozlov are the salt lake of *Guilan*, which produces a large quantity of salt, and the mud-baths of *Sack*, in which, during summer, invalids sit for hours up to the chin in mud. *Karasubazar* (Black-water-market), on a branch of the Salghir, to the N.E. of Simferopol, is one of the largest and most characteristic of the Crimean towns. It contains about 15,000 inhabitants, consisting of Tatars, Jews, and Armenians, who carry on extensive manufactures of Morocco leather, soap, candles, &c. The Kara-su runs past the town, through a fertile valley, which produces large quantities of grain and tobacco. But the most important place in the Crimea is *Sebastopol*, or *Sevastopol*, the Tatar *Akhtiar*, situated on the S.W. coast, about five miles east of Cape Chersonesus. The harbour consists of a fine bay of the Black Sea, about three miles and a half long, and from one to three quarters of a mile wide. The town stands on the south side of the bay, between two smaller bays, which extend southward, the eastern of these being the station of the imperial fleet, arsenal, and dockyard, and the other being the quarantine bay. The bay is so capacious, and the anchoring ground is so good, that the fleets of Europe might ride in it secure from every storm, and such is the depth of water that the largest ships may lie within a cable's length of the shore, and in the inner harbour, even close to the wharfs. It is the station of the Black Sea fleet, and no labour or expense has been spared to make the place impregnable by sea. The shores of the bay bristle with casemated batteries; and so many as 1200 guns, it is said, can be made to bear at once upon a vessel attempting to enter the harbour. It is, not, however, so well fortified on the land side, and possession of the adjoining heights would, it is believed, ensure the capture of the town and the destruction of the fleet. The fortifications were designed and executed by an English civil-engineer named Upton, who had been employed as a road-surveyor in Britain. The population of about 40,000 souls are mostly all naval or military, or in the employment of the government. The town is in fact an immense garrison, and looks imposing from so many of the buildings being barracks or government offices. Millions of money have been lavished on the object of making this place a fitting receptacle of the Russian navy, and the secure centre of Russian domination in and around the shores of the Black Sea. Westward of Sebastopol is the site of the ancient city of *Chersonesus*, founded by a colony from *Heraclea Pontica*, but now only to be traced by its ruins; and several miles to the southward, on the south coast, is the monastery of St George, which is believed by Pallas to occupy the site of the ancient *Parthenium*, and of the temple of the Tauric Artemis. *Balaklava*, ten miles S.E. of Sebastopol, is a small town deriving its name (*Bella Chiave*) from its fine harbour, which enters from the Black Sea by a strait only 30 yards wide, but then expands into a spacious basin, where large vessels may ride in safety during the severest storms. The bay is like a highland tarn, is about half a mile in length from the sea, and varies from 250 to 120 yards in breadth. The shores are so steep and precipitous that they shut out as it were the expanse of the harbour, and make it appear much smaller than it really is. Towards the sea, the cliffs close up and completely overlap the narrow channel which leads to the haven, so that it is quite invisible. On the S.E. of the poor village which struggles for existence between the base of the rocky hills and the margin of the sea, there are extensive ruins of a Genoese fort, built some 200 feet above the level of the sea. It must have once been a large and important position; and though its curtains, bastions, towers, and walls are all destroyed and crumbling in decay, they evince the spirit and enterprise of the hardy seamen who penetrated these classic recesses so long ago. There may be doubts whether the Genoese built it, but there can be none that it is very old, and superior in workmanship to the edifices of the Turks or Tatars. The town of Balaklava is approached in this direction through a narrow defile, leading from the more open country about Traktir. It is a formidable pass, and a few resolute men posted here might occasion great trouble even to a large army. The town is a poor fishing station, inhabited by a Greek colony. There are, however, one or two good houses of the usual character in the neighbourhood. All the hills around the town are barren rock; towards the land they become more fertile, and for a mile

Crimes ‖ Criticism.

towards Sebastopol and Simferopol they are studded with pleasant-looking white villas and farm-houses, principally inhabited by Russian officials from Sebastopol. About ten miles east of Sebastopol is *Mangoup kaleh*, one of the most remarkable objects to be found in any country. It is a castle situated on an inaccessibly precipitous mountain, perfectly isolated, and surmounted with extensive fortifications. The rock, moreover, has been cut into a variety of chambers and watch-towers, affording a secure retreat for a garrison of several thousand men. It was the work of the ancient Greeks and later Genoese, but is now deserted.

Isthmus.

The isthmus of Perekop, which joins the peninsula to the mainland, is, at its narrowest part, less than five miles across; and at that place it was formerly fortified by a wall and ditch, besides the small fort of Perekop; but all these seem to have been latterly neglected.

CRIMES AND PUNISHMENTS. See the articles JURISPRUDENCE and PUNISHMENT.

CRISPIN, and CRISPIANUS, two legendary saints whose festival, as marked in the calendar, is on the 25th of October. According to the legend, they were brethren, born at Rome, whence they travelled to Soissons, in France, about the year 303, to propagate the Christian religion; and that they might not be chargeable to others for their maintenance, they exercised the trade of shoemakers. But when it was known that they were Christians, the governor of the town ordered them to be beheaded. From that time they were regarded as the tutelary saints of shoemakers.

CRISSA, or CRISA, in *Ancient Geography*, one of the oldest cities of Greece, was situate in Phocis at the foot of one of the spurs of Mount Parnassus. Its name occurs both in the *Iliad* and in the Homeric hymns, where it is described as a powerful place, in the midst of a rich and fertile territory, reaching to the sea, and including within its limits the sanctuary of Pytho. In course of time the town of Delphi sprang up around the shrine, and Crissa began to decline in importance. Its decay was still further accelerated by the rise of its seaport, Cirrha, on the Crissean gulf. By the ancients themselves the name of Cirrha was so often substituted for that of Crissa, that it soon became doubtful whether these names indicated the same city or two different cities. The question has only recently been settled by the investigations of Ulrichs, who has eliminated with much care the history of the towns. From its position, Cirrha commanded the approach to Delphi, and its inhabitants soon became obnoxious to the Greeks from the heavy tolls which they exacted from the devotees who thronged to the shrine. The Amphictyonic council declared war against the Cirrheans in 595 B.C., and having taken the town, razed it to the ground, and consecrated its rich territory to the service of the temple at Delphi. The plunder of the town was sold to defray the expenses of the Pythian games. In 339 the people of Amphissa began to rebuild the city, and cultivate the adjoining plain. This act brought on the second sacred war, the conduct of which was intrusted by the Amphictyons to Philip of Macedon, who took Amphissa in the following year. Cirrha was afterwards rebuilt, but never regained its former importance.

CRITHOMANCY (*κριθη, barley*, and *μαντεια, divination*), in *Antiquity*, a kind of divination by means of the dough of cakes offered in sacrifice, and the meal strewed over the victims.

CRITIAS, one of the thirty tyrants set over Athens by the Spartans, B.C. 404, conspicuous for cruelty and rapacity above all his colleagues. He had been among the disciples of Socrates, and was distinguished as an orator. He also wrote poems, dramas, &c., and some fragments of his elegies are still extant. See ATTICA, vol. iv., p. 209.

CRITICISM (*κρινω, to judge*), the art or act of judging with propriety of the beauties and faults of a literary performance, or of any production in the fine arts. Also the act of judging on the merit of any performance; critical observation, &c. Criticism ‖ Crocodile.

CRITICISM, *Biblical*. See SCRIPTURE, and BIBLE.

CRITO, an Athenian philosopher, who attended Socrates in prison, and closed the eyes of the dying sage. He is principally known on account of these acts of friendship to his master,—his seventeen dialogues on philosophy having long since perished. Their titles are preserved in Diogenes Laërtius.

CRITOLAUS, a celebrated Achæan demagogue, who roused his countrymen to resist the aggression of the Romans. He headed the Achæan army, and having been defeated by Metellus near the town of Scarphæa in Locris (B.C. 146), he either poisoned himself or perished in the marshes of the coast.

CROATIA. See HUNGARY.

CROCUS, a genus of plants of the natural order *Iridaceæ*. The best known are *C. vernus*, or common crocus; and *C. sativus*, the flowers of which afford saffron. See BOTANY, vol. v., p. 211.

CROCKET. See glossary to ARCHITECTURE.

CROCODILE, a formidable reptile, giving name to the family of the Crocodilidæ, and which from its size and strength is usually assigned the first place in the saurian order. The Crocodilidæ are indigenous to all quarters of the world except Europe; and the members of the family are associated by many and well-defined characteristics, of which the following are the most marked. They all attain a great size; sometimes, though not very frequently, they are found 30 feet in length. Their tail is compressed laterally. Their fore-feet have five toes; their hind-feet four, which are united by membranes more or less strongly marked. Each jaw is furnished with a single row of teeth. The tongue is flat, and attached nearly the whole length of its margin. The back and tail are protected by great scales which are strong enough to resist a leaden musket ball. The nostrils open at the end of the snout by two small apertures, which shut with valves. The lower jaw reaches behind the cranium, which gives the animal the appearance of being able to move its upper as well as its under jaw. The external ears shut at will by two fleshy lips. The eye has three eye-lids, two of them horizontal, like those of the human being, and the third a *membrana nictitans*. Of all the saurians the Crocodilidæ are the only family that are destitute of clavicles. The gullet of the crocodile is extremely wide. That variety of the animal which abounds in the Nile is, next to the gavial, the most active on land, and of all the species the one that most readily frequents the open sea. The organs of excretion are small, and their digestion is accordingly found to possess an immense biliary apparatus. They are oviparous, and bury their eggs in the sand; and the female remains in the vicinity to dig them out on the day that the young ones break the shell. The invulnerability of the crocodiles may be imagined from the following incident. One being brought well bound to the bazaar of Cawnpore on the Ganges, it was purchased by British officers on the spot and carried further inland for the purpose of being baited. Accordingly, the ligatures, except those which secured the muzzle, being cut asunder, the monster, though it had been many hours exposed to the heat, and was almost suffocated with dust, fought its way through an immense crowd of assailants, soldiers and natives, armed with staves, lances, swords, and stones, and worried by numerous terriers, hounds, and curs. It overturned all in its way, till, scenting the water at a distance of two miles, it reached the river in spite of the most strenuous opposition.

Of all the animals deemed sacred by the Egyptians, none were held in higher veneration than the crocodile. Proof of this is to be found not only in the accounts we have of the temples and priests consecrated to its worship, but even in the floating traditions of the country. In Brown's

Crœsus. Travels we find the following story:—"The people of Isna in Upper Egypt have a tradition concerning crocodiles similar to that entertained in the West Indies. They say there is a king of them, who resides near Isna, who has ears but no tail; and he possesses an uncommon regal quality, that of doing no harm. Some are bold enough to assert that they have seen him." It is upon this tradition that Southey has founded his humorous pathetic ballad of the "King of the Crocodiles." See index to REPTILIA.

CRŒSUS, the last king of Lydia, was remarkable for his riches and conquests, his temporary prosperity, and sad reverse of fortune. He subdued the Phrygians, Mysians, Paphlagonians, Thracians, and Carians, amassed immense treasures, and became one of the most powerful and magnificent of princes. He invited the learned to his court, and took great pleasure in conversing with them. Thales of Miletus, Pittacus of Mitylene, Bias of Priene, Cleobulus of Lindus, and other sages who lived in that age, as well as Æsop the fabulist, and the most elegant Greek poets of the time, were welcomed at the court of Crœsus. There is still on record a memorable conversation which took place between that prince and Solon, which seemed to predict the subsequent events of his reign, and which had a late but important influence on the character and fortune of the Lydian king. Crœsus having entertained his Athenian guest for several days, ostentatiously showed him the magnificence of his palace, and the riches of his treasury. After all had been displayed, the king complimented Solon on his curiosity and love of knowledge; and asked him, as a man who had visited many countries, and reflected deeply on what he had seen, whom of all men he accounted most happy. From the particular occasion, as well as the air with which the question was proposed, it was evident that the king expected a flattering rather than an honest answer. But Solon's character had not been enervated by the vices of a court, and he replied with a manly freedom—Tellus the Athenian. Crœsus, who had scarcely learned to distinguish, even in imagination, between wealth and happiness, inquired, with a tone of surprise, why this preference was given to Tellus. Tellus, rejoined Solon, was not conspicuous for his riches or his grandeur, being only a simple citizen of Athens; but he was descended from parents who had deserved the first honours of the republic. He was equally fortunate in his children, who had obtained universal esteem by their probity, patriotism, and every useful quality of mind and body; and as to himself, he died fighting gallantly in the service of his country, which his valour rendered victorious in a doubtful combat; on which account the Athenians buried him on the spot where he fell, and distinguished his memory by every honour which public gratitude can confer on illustrious merit. After this answer, Crœsus had but little encouragement to ask Solon, in the second place, whom, next to Tellus, he considered as most happy. Such, however, is the illusion of vanity, that he yet ventured to put this question, no doubt entertaining hopes of being favourably answered. But Solon replied with the same freedom as before—the brothers Cleobis and Biton, two youths of Argos, whose strength and address were crowned with repeated victory at the Olympic games; who deserved the affection of their parents, the gratitude of their country, and the admiration of Greece; and who, having ended their lives with peculiar honour, were commemorated by the most signal monuments of immortal fame. "And is the happiness of a king, then," said Crœsus, "so little regarded, that you, Grecian stranger, prefer to it the mean condition of an Athenian or Argive citizen?" The reply of Solon justified his reputation for wisdom. "The life of man," said he, "consists of seventy years, which make 25,550 days; an immense number, yet, in the longest life, the events of any one day will not be found exactly alike to those of another. The affairs of men are liable to perpetual vicissitudes; the divinity who presides over our fate is envious of too much prosperity; and all human life, if not condemned to calamity, is at least liable to accident. Whoever has uninterruptedly enjoyed a prosperous tide of success may justly be called *fortunate;* but he cannot before his death be entitled to the epithet of *happy.*" Crœsus.

The events which soon followed this conversation prove how little satisfaction is derived from the possession of a throne. Victorious in war, unrivalled in wealth, supreme in power, Crœsus felt and acknowledged that he was unhappy. The warmest affections of his soul centred in his son Atys, a youth of the most promising hopes, who had often fought and conquered by his side. The strength of his attachment was accompanied with an excess of paternal care, and the anxiety of his waking hours disturbed the tranquillity of his rest. He dreamed that his beloved son had been slain by a dart; and the solicitude with which the father watched over his safety having prevented the youth from indulging in his usual occupations and amusements, and thereby rendered him too eager to enjoy them, most probably exposed him to the very misfortune which his parent had dreaded the most. Having reluctantly permitted him to engage in a hunting party, the juvenile ardour of Atys, increased by the impatience of long restraint, made him neglect the precautions necessary in that manly amusement; and he was slain by a dart aimed at a wild boar of monstrous size, which had long spread terror over the whole country of the Mysians. The fatal weapon proceeded from the hand of Adrastus, a Phrygian prince and fugitive, whom Crœsus had purified from the involuntary guilt of a brother's blood, and had long distinguished by peculiar marks of bounty. To the grateful protection of this Phrygian Crœsus had recommended, at parting, the safety of his beloved son. A mournful procession of Lydians brought the dead body of Atys to Sardis, and the ill-fated slayer followed behind. When they approached the royal presence, Adrastus stepped forward and entreated Crœsus to put him to death; thinking life no longer to be endured, after killing, first his own brother, and then the son of his benefactor. But the Lydian king, notwithstanding the excess of his affliction, acknowledged the innocence of Adrastus, and the power of fate. "Stranger," said he, "your action is blameless, being committed without design. I know that my son was destined to a premature death." But Adrastus, though pardoned by Crœsus, could not pardon himself. When the mourners were removed, he privately returned, and perished by his own hand upon the tomb of Atys.

During two years Crœsus remained disconsolate for the loss of his son; and might have continued to indulge his unavailing affliction during the remainder of life, had not the growing greatness of Persia, which threatened the safety of his dominions, roused him from his dream of misery. He marched against Cyrus with a great army, but was defeated; and retreating to his capital, Sardis, was there besieged. The city was taken by assault; and as a Persian soldier was about to kill Crœsus, that prince's only surviving son, who had hitherto been dumb, terrified at his father's danger, cried, "Stop, soldier, and touch not Crœsus." But though delivered by this extraordinary accident from the blind rage of the soldier, he seemed to be reserved for a harder fate. Dragged into the presence of his conqueror, he was loaded with irons; and the stern, unrelenting Cyrus, of whom so flattering a picture is drawn in the philosophical romance of Xenophon, ordered him, with his Lydian attendants, to be committed to the flames. An immense pile of wood and other combustibles was accordingly erected in the most spacious part of the city;

Croft ‖ Croisers.

and the miserable victims, bound hand and foot, were placed on the top of the pyre. Cyrus, surrounded with his generals, witnessed the dreadful spectacle, having, either from an abominable superstition, or from a motive of curiosity equally detestable, bound himself by a vow to sacrifice Crœsus as the first fruits of his Lydian victory. Meanwhile the unfortunate Lydian, oppressed by the intolerable weight of his present calamity, compared with the security and splendour of his former state, recollected the memorable conversation he had held with the Athenian sage, and uttered with a deep groan the name of Solon. Cyrus asked by an interpreter whose name he invoked. "His," replied Crœsus, "whose words ought ever to speak to the hearts of kings."

The words of a dying man are fitted to make a strong impression; and those of Crœsus deeply affected the mind of Cyrus. Considering the speech of Solon as addressed to himself, the Persian repented of his intended cruelty towards the unfortunate prince, who had formerly enjoyed all the pomp of prosperity; and dreading the vengeance which might lurk concealed in the bosom of fate, gave orders that the pyre should be extinguished. This event, which saved the life of Crœsus, recommended him to the favour of his conqueror; and Cyrus gave orders that he should be henceforth seated by his side, and treated as a king. But the mind of Crœsus had undergone a still more important revolution; for, tutored in the useful school of adversity, he had learned to think with patience and to act with prudence, to govern his passions by the dictates of reason, and to repay by wholesome advice the generous behaviour of his Persian master. This fallen monarch survived his conqueror; but the circumstances of his death are not known.

CROFT, William, doctor of music, was born in 1677, at Nether Eatington, in Warwickshire. He received his musical education in the Chapel Royal, under Dr Blow. He early obtained the place of organist of St Anne's, Westminster; and in 1700 was admitted a gentleman extraordinary of the Chapel Royal. In 1707 he was appointed joint organist with Dr Blow; upon whose death, in 1708, Croft became sole organist, and also master of the children and composer of the Chapel Royal, besides being made organist of Westminster Abbey. In 1715 he obtained his degree of doctor of music in the university of Oxford. In 1724 he published an edition of his choral music, in 2 vols. folio, under the name of "Musica Sacra," or "Select Anthems in score, for two, three, four, five, six, seven, and eight voices, to which is added the Burial Service, as it is occasionally performed in Westminster Abbey." John Page, in his *Harmonia Sacra*, published in 1800, in 3 vols. folio, gives seven of Dr Croft's anthems. This handsome work was the first of the kind executed on pewter plates and in score. Of instrumental music, Dr Croft published six sets of airs for two violins and a bass, six sonatas for two flutes, six solos for a flute and bass. These works are not mentioned by Dr Burney. Dr Croft died in August 1727, and was buried in the north aisle of Westminster Abbey, where a monument was erected to his memory by his friend and admirer Humphrey Wyrley Birch, Esq. Dr Charles Burney, in his *History of Music*, devotes several pages of his third volume (pp. 603–612) to Dr Croft's life, and criticisms upon some of his anthems. He speaks highly of Dr Croft's amiable character and dignified professional conduct. (G. F. G.)

CROISERS, a religious order founded in honour of the invention or discovery of the cross by the Empress Helena at Jerusalem. They were dispersed in several parts of Europe, particularly in the Low Countries, France, Bohemia, and Italy, and followed the rule of St Augustin. In England they were called crouched or crutched, *i. e. crossed* friars. See Cross, *Invention of the.*

Croises ‖ Cromlech.

CROISES, or Croizes, in English antiquity, pilgrims bound for the Holy Land, or such as had been there; so called from a badge they wore in imitation of a cross. The knights of St John of Jerusalem, created for the defence and protection of pilgrims, were particularly called *Croisés.*

CROMARTY County. See Ross and Cromarty.

Cromarty, a parliamentary burgh in the united counties of Ross and Cromarty, situated on a low promontory projecting into the narrow strait which communicates between the Moray and Cromarty Firths. It is about 16 miles N.E. from Dingwall, the county town, and 185 miles N.N.E. from Edinburgh. Cromarty continued to be a royal burgh till 1672, when it was disfranchised. It is now a contributary burgh to Wick, Dingwall, Dornoch, and Tain, and its municipal government is vested in a provost and six councillors. The principal buildings are the town-house and churches, which latter belong to the Establishment, the Free Church, and the United Presbyterians, respectively. The principal manufacture is that of hempen bagging; but there is also an establishment for some branches of woollen manufacture. Brewing and ship-building are also carried on. The staple trade of the place, however, is connected with the herring and white fisheries. The harbour, formed by a pier, is safe and capacious, admitting vessels of 400 tons burden. There are in the parish remains of several ancient chapels and camps believed to be Danish. Pop. of burgh (1851) 1988.

CROMER, a small seaport-town and parish of England, county of Norfolk, 21 miles N. of Norwich. It stands on the top of the cliffs, and many of the houses are ill-built; but having lately become a favourite resort for sea-bathing, it has undergone considerable improvements. It has several good inns, a public library, news-room, baths, &c. There are some remains of an ancient abbey and of the walls which formerly surrounded the town. About three-fourths of a mile east of the town is Foulness lighthouse, with a revolving light 274 feet above high water. The sea is here continually gaining upon the land, and in the winter of 1825 some cliffs, 250 feet in height, contiguous to the lighthouse, were precipitated into the sea. The bay is very dangerous, and has hence obtained from sailors the name of the "Devil's Throat;" yet it has some trade in coals, timber, tiles, oil-cake, &c. From the want of a proper landing-place, vessels have to load and unload on the open beach. Pop. of parish (1851) 1366.

CROMFORD, a market-town of Derbyshire, 15 miles north of Derby, in the picturesque valley of Matlockdale, situated chiefly on the right bank of the Derwent, and surrounded on the N., S., and W. by lofty limestone rocks. Pop. (1851) 1190, chiefly employed in the cotton factories of the Messrs Arkwright. The celebrated Sir R. Arkwright established two large cotton mills here, the first in 1771, and the other a few years subsequently. Lead mines are worked in the vicinity. The Cromford Canal extends from the Erewash Canal at Langley Bridge to this town, and the Cromford and High Peak railway joins the canal at a short distance south of the town.

CROMLECH, or Cromleh, in *Antiquity*, a rude kind of monument consisting of a large flat stone raised upon other stones set upright for the purpose. These monuments are spoken of by Rowland, by Borlase, and by Wormius, under the appellation of *Aræ*, or altars. It is generally supposed that they may have served a double purpose; namely that they were originally tombs, upon which, in after times, sacrifices were performed to the heroes deposited within. An account of King Harold having been interred beneath a tomb of this kind in Denmark is still preserved: and a skeleton deposited under a cromlech was discovered in Ireland. The very great similarity of the monuments throughout the north evinces that the same religion had with some slight variations been spread in

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every part. Many of these monuments are both British and Danish, for they are found in Britain in places where the Danes never penetrated.

The cromlech, or cromleh, differs from the *kist-vaen*, in not being closed up at the end and sides, that is, in not partaking so much of the chest-like figure; it is also generally of larger dimensions, and sometimes consists of a greater number of stones. The terms *cromlech* and *kist-vaen* have been, however, indiscriminately used for the same monument. The word *cromlech* is by some derived from the Armoric *crun*, crooked or bowing, and *leh*, stone; alluding to the reverence which persons paid to them by bowing. Rowland derives it from the Hebrew words *carem-luach*, signifying a devoted or consecrated stone. They are called by the vulgar *coetne Arthor*, or *Arthur's quoits*, it being a custom in Wales as well as in Cornwall to ascribe all great or wonderful objects to Prince Arthur, the hero of those countries.—(See Worsae's *Scandinavian Antiquities.*)

CROMWELL, Oliver, Lord Protector of the English Commonwealth, was born at Huntingdon on the 25th of April 1599. His father, Robert Cromwell, was the second son of Sir Henry Cromwell of Hinchinbrook, surnamed, for his munificence, *The Golden Knight.* His mother,[1] Elizabeth Steward, was the daughter of a gentleman of some property in the city of Ely. The connection of the Cromwell family with that of the celebrated Thomas Cromwell, Earl of Essex, and of the Stewards with the royal line of Scotland, are facts which, though in reality unimportant, are not altogether without interest.[2] The stories of Cromwell's youthful visions and adventures, his tyranny and violence, his distaste for learning, and his love of coarse and vicious amusements, resting as they do chiefly on the disreputable testimony of Heath, are little worthy of serious notice. The authentic facts of his early history seem to be confined to these:—that he was educated at Huntingdon grammar-school, under a rigid and pious instructor, by name Dr Thomas Beard; that on the 22d April 1616 he was admitted a fellow-commoner of Sidney Sussex College, Cambridge; that on his father's death in June 1617, he left the University (returning no more), carrying away at least as much Latin as enabled him in after years to speak that language with ease; and that soon after he proceeded to London to gain some knowledge of law. There is no proof that he ever attended any of the inns of Court; and regarding his life in London, and the limits of his residence there, we are equally destitute of information. The accounts of his extreme profligacy during this period have come to us on the most questionable authority. If founded in any measure on the fact that Cromwell afterwards, looking back on these youthful days, reproached himself as one who "hated the light," and was "the chief of sinners," we may leave them to rest much on the same footing with the similar and even more fearful self-accusations of the pure-hearted Bunyan. On the 22d August 1620, Cromwell, then 21 years of age, was married at St Giles's church, Cripplegate, to Elizabeth, daughter of Sir James Bourchier, or Felsted, in Essex, a woman of very amiable and prudent character, whose gentle virtues sweetened his domestic life to its close, amid all outward vicissitudes of trouble or glory.[3] He now returned to Huntingdon, and assumed the management of his patrimonial estate; and in the quiet routine of a farmer's life, fulfilled for nearly ten years, without any incident chronicled in history, the ordinary duties of a country gentleman. We are left to imagine, so far as we can, the silent and unnoticed growth of a great soul, limited as yet in its outgoings to the cares of a farm,—the thoughts that struggled and sank to rest in the stillness of home,—the powerful religious convictions, the "splenetic fancies," the deep fits of melancholy, that ultimately resulted in an open profession of Christianity, and a steady adherence thenceforward to that strict and earnest form of it which had received from its enemies the derisive name of Puritanism. The house of Oliver Cromwell became from this time a resort of "godly men;" and in their prayers and preachings, their interests and their grievances, he took a zealous and active part. On the 17th March 1628, he took his seat in the House of Commons as member for Huntingdon. The increasing influence of Puritanism, reacting against the arbitrary and ceremonious tendencies of the king, was powerfully exhibited in the transactions of this brief but memorable parliament. On the 11th February 1629, a few weeks before the close of its second session, Cromwell made his first recorded speech; calling the attention of the House to the scandalous fact "that Dr Alablaster had preached flat popery at Paul's Cross," and even been encouraged therein by his diocesan; while "Mainwaring, so justly censured by this House for his sermons, was, by the same bishop's means preferred to a rich living." "If these," he said, "are the steps to church preferment, what are we to expect?" "It is amusing," remarks Mr Hume, "to observe the first words of this fanatical hypocrite corresponding so exactly to his character." The correspondence is remarkable enough; but those who have formed a different estimate of Cromwell from that of the sceptical historian, may find instruction rather than amusement in this first sound of "the imperial voice," which in after days "arrested the sails of the Libyan pirates, and the persecuting fires of Rome."[4]

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About two years after this, Cromwell sold his lands in Huntingdon, stocked a grazing farm at St Ives, and there resided for five years. In 1636 he removed to Ely, where he had succeeded to the property of his uncle, Sir Thomas Steward. Events meantime were tending to a great crisis. His first cousin, John Hampden, had on the 11th January in this year refused to pay his "ship-money;" in the streets of London, in the midst of pale crowds, good men were being mutilated, branded, and pilloried; Scotland had risen in a flame against a forced episcopacy, and the patience of England was drawing near exhaustion. In April 1638 sentence was delivered against Hampden. The spirit of resistance rose with each new check. In his own district Cromwell had now some opportunity for its exercise, and that victoriously. The great

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[1] The character of Cromwell, in some of its noblest aspects, seems, as in the case of many great men, to have been inherited from his mother. She died at Whitehall, November 16, 1654, at the age of 94. Her affection for her son is touchingly expressed in her last words. "A little before her death," says Thurloe, "she gave my lord her blessing in these words: 'The Lord cause his face to shine upon you, and comfort you in all your adversities, and enable you to do great things for the glory of your Most High God, and to be a relief unto His people. My dear son, I leave my heart with thee. A good night!'"

[2] See the proofs adduced in Forster's *British Statesmen*, vi., 2; Carlyle's *Letters and Speeches of Cromwell*, I. 40.

[3] She died in the house of her son-in-law Claypole, October 8, 1672. The following letter to her from her husband, penned the day after the great battle of Dunbar, may be taken as an interesting specimen of his private correspondence: "For my beloved wife, Elizabeth Cromwell, at the Cockpit; these. Dunbar, 4th September 1650. My Dearest,—I have not leisure to write much. But I could chide thee that in many of thy letters thou writest to me, That I should not be unmindful of thee and thy little ones. Truly, if I love you not too well, I think I err not on the other hand much. Thou art dearer to me than any creature; let that suffice. The Lord hath showed us an exceeding mercy; who can tell how great it is? My weak faith hath been marvellously upheld. I have been in my inward man marvellously supported; though, I assure thee, I grow an old man, and feel infirmities of age stealing upon me. Would my corruptions did as fast decrease! The particulars of our late success Harry Vane or Gilbert Pickering will impart to thee. My love to all dear friends. I rest thine, Oliver Cromwell." (*Letters and Speeches*, iii, 67.)

[4] Macaulay, Essay on Hallam's Constitutional History.

Cromwell. work of draining the fens and completing the *Bedford Level* had proceeded successfully till the interference of royal commissioners excited a general outcry of dissatisfaction. Cromwell took an active part in the opposition; and his successful zeal in the business procured him the popular title of "Lord of the Fens." On the 13th April 1640, a new parliament met, in which he took his seat as member for Cambridge. In three weeks it was dissolved. Another was summoned for the 3d November, which became ever memorable in history as the *Long Parliament*. Cromwell again sat for Cambridge. Of his share in its proceedings for about two years there is little record. That he was an active member there can be no question. One interesting glimpse we obtain from the graphic narrative of Sir Philip Warwick. It brings before us a Monday morning, early in November 1640, when the writer, then "a courtly young gentleman," came into the house, "well clad," and found a remarkable figure in possession of the house, "a gentleman whom I knew not, very ordinarily apparelled," his linen "plain and not very clean," his stature "of a good size, his sword stuck close to his side, his countenance swoln and reddish, his voice sharp and untuneable, and his eloquence full of fervour." This personage was pleading, amid considerable attention, on behalf of a troublesome young man of the name of Lilburn, amanuensis to Mr Prynne, "who had disperst libels against the queen for her dancing and such like innocent and courtly sports" The impression made on the gay young courtier was anything but favourable. "I sincerely profess," he says, "it lessened much my reverence unto that great council, for this gentleman was very much hearkened unto."

The inevitable rupture at length took place, and the king and parliament made their appeal to the sword. On the 12th January 1642, Charles left Whitehall, to return no more till the day of his execution. Military preparations on both sides began; "voting henceforth by pike and bullet." And now, at the mature age of forty-three, already well beyond the "mid-way of life's journey," Oliver Cromwell girded on his armour, and, with his eldest son Oliver[1] by his side, left his quiet home and farm to fight for England's liberty. With no knowledge of the art of war, but much of himself, of men, and of the Bible, less even a politician than a man of prayer, this stout English squire had made up his mind, in no hasty or factious spirit, to draw the sword against his king, and venture his life for what he believed with his whole heart and soul to be the cause of "freedom and the truth in Christ." Out of his moderate fortune he subscribed L.500 "for the service of the commonwealth;" L.100 more he expended on arms; and during the summer he was actively engaged in raising volunteers. His first exploit, while as yet without a regular commission, was to seize the magazine in the castle at Cambridge, and prevent the carrying away of the university plate to help the royal exchequer. In September he received his commission as captain of a troop of horse. In the first campaign the royal troops generally had the advantage. Cromwell already knew in his own person wherein lay the strength of Puritanism, and the secret of its success. He spoke on the subject to his cousin Hampden. "Old decayed serving men and tapsters," and such Cromwell. "base mean fellows," he said, "could never encounter gentlemen and persons of quality." To match "men of honour," they must have "men who had the fear of God before them," and would "make some conscience of what they did." "A few honest men," he elsewhere said, "are better than numbers." Mr Hampden thought his cousin "talked a good notion, but an impracticable one." To turn "good notions" into facts, however, was the characteristic work of Cromwell; *impracticable* being a word with which we may suppose him to have had as little tolerance as Napoleon. On this principle of selection accordingly he gradually enlisted around him a regiment of a thousand men, whose title of *Ironsides* has become famous in history. "They never were beaten." "Had his history," says Mr Forster, "closed with the raising and disciplining of these men, it would have left a sufficient warrant of his greatness to posterity."

During the winter, associations for mutual defence were formed among the counties. Of these the "Eastern Association" alone, through the prompt and indefatigable activity of Cromwell, proved really efficient. During the spring of 1643, having now attained the rank of a colonel, he employed himself in quelling all royalist attempts throughout the association, giving them the final blow by the capture of Lowestoff, with a considerable body of influential royalists, and a large supply of warlike stores. His services were next devoted to Lincolnshire, and with similar success. Towards the end of July the Marquis of Newcastle, after his victory at Atherton Moor, advanced with a large army against Gainsborough, which was garrisoned by a small parliamentary force under Lord Willoughby. Cromwell threw himself between the town and the enemy's van, under General Cavendish; forced his way up a sandy eminence, in the face of a body three times superior in number to his own, and drove them in total rout down the other side. Their commander, an accomplished young nobleman, was killed on the spot. "This victory," says Whitelocke, "was the beginning of Cromwell's great fortunes. and now he began to appear in the world." The other parliamentary leaders, meantime, had met with a series of humiliating reverses, and at the close of the summer the popular cause seemed in imminent peril. In August, the Earl of Manchester took the command of the Eastern Association, with Cromwell as one of his colonels. On the 9th October they effected a junction with Fairfax at Boston, and on the 11th, Cromwell and Fairfax encountered the royal force under Sir John Henderson on the field of Winceby, near Horncastle. Cromwell led the van, which advanced to the battle singing psalms. His horse was killed in the first charge, and fell upon him. As he rose he was again struck down, but recovering himself he mounted a "sorry horse" belonging to a trooper, and mingled in the fight. The enemy gave way at the first onset, and were pursued with terrible slaughter for many miles. During the remainder of this season Cromwell was occupied in attending to the security of the Eastern Association, in raising funds, and settling public affairs in Ely, of

[1] We may here subjoin a brief notice of Cromwell's family, gathered from a note by Mr Carlyle. Oliver (born in 1623) entered as a cornet in the same division of cavalry with his father, who seems to have regarded him with deep affection and hope. He was killed shortly before the battle of Marston Moor (according to the author of the *Squire Papers*). "The Protector, on his death-bed, alludes to this Oliver's death: 'It went to my heart like a dagger, indeed it did.' Richard was born in 1626, and died in 1712, a man of mild and indolent character, unfit for any office requiring strong powers of mind. Henry, born in 1628, died in 1674. He entered the army at sixteen, and greatly distinguished himself by his courage, prudence, and resolution. He accompanied his father to Ireland in 1649, and in 1657 was appointed Lord Deputy there. He governed with great ability. "He is a governor," said Cromwell, "of whom I myself might learn." Of the daughters, the eldest, Bridget, born 1624, died 1681, was married first to Ireton, afterwards to Fleetwood. Elizabeth, born 1629, died 1658, was married to Mr Claypole, who became Master of the Horse to the Protecter. Mr Carlyle calls her "a graceful, brave, and amiable women," adding that "the lamentation about Dr Hewit and 'bloodshed' (in Clarendon and others) is fudge." Mary. born 1637, died 1712, was married to Lord Fauconberg. Dean Swift called her "handsome and like her father." Frances, born 1638, died 1721, was married first to Mr Rich, again to Sir John Russel. Charles II. at one time entertained the idea of allying himself with Cromwell by marrying her.

Cromwell. which he had some months previously been appointed governor

On the 10th April 1644, the Scotch Covenanted army of 21,000 men under Lesley, Earl of Leven, united with Fairfax at Wetherby, and proceeded to invest York. They were presently joined by Manchester and Cromwell, now lieutenant-general and second in command. On hearing of this, Prince Rupert hurried from Lancashire at the head of 20,000 men, and relieved York. The parliamentary army raised the siege, drew out to meet the enemy on Marston Moor, and on the evening of the 2d July, gave a death-blow to the royal cause in the north of England. To Cromwell belonged the chief glory of the victory. While the right wing under Fairfax was overpowered by the furious onset of Prince Rupert, Cromwell carried all before him on the left, and suddenly wheeling round, charged the victorious cavalry of Rupert with such overwhelming force that they were "swept off the field,"—"God made them as stubble to our swords." In the west on the other hand, Essex and Waller succeeded only in losing their armies. The parliament, still confiding in these generals, granted them fresh forces, and summoned Manchester and Cromwell to join them. On the 27th October they met the king at Newbury, and a sanguinary conflict ensued, with dubious success. During the night the king effected a safe retreat. Cromwell urged Manchester to pursue him, but in vain. Twelve days after the king and Prince Rupert returned, revictualled Dennington Castle, and carried off their artillery. Cromwell again pressed Manchester to attack them, but the timid earl was immovable. The fruit of these disagreements was a rupture, ending in important results. On the 25th November Cromwell, having been called upon to give an account of the affair at Newbury, charged Manchester in the House of Commons with neglect of the parliamentary interests; and on the 9th December openly urged the necessity of remodelling the army. The "self-denying ordinance," discharging members of parliament from military offices, and permitting enlistment without the signing of the covenant, was finally passed on the 3d April. Meantime Fairfax had been nominated general, the "new model" was passed, and the raising of troops, and remodelling of the old army, proceeded with activity.

The wisdom of these changes was proved by the triumphant result of the next campaign. Cromwell's services were by this time felt to be indispensable. He accordingly received a dispensation from the self-denying ordinance, and was hastily despatched (April 23d) to intercept a force of 2000 men sent by Rupert to convoy the king from Oxford to Worcester. On the second day he attacked and routed them at Islip Bridge, took Bletchington House on the same day, and on the 26th gained another victory at Radcot Bridge. On the 31st of May the king suddenly stormed Leicester; the southward movement of his army exposed the eastern counties to imminent danger; Fairfax, appealed to for help, immediately solicited the appointment of Cromwell as his lieutenant-general; the request was granted; and Cromwell, collecting 6000 chosen horse, joined the camp at Northampton without the loss of an hour, amid the acclamations of the whole army. Decisive action attended his presence; on the very day following, June 14, 1645, the royal army was beaten to pieces on the field of Naseby, and the first civil war virtually brought to an end. Cromwell and his Ironsides decided as usual the fate of the day. Proceeding victoriously south-westward, the parliamentary army encountered the *Clubmen*, a new and somewhat formidable party in the royal interest. At Shaftesbury Cromwell dispersed a large body of them, after which they appeared no more. On the 11th September Bristol was stormed; and again turning southward the army took every town and stronghold in its way. Cromwell particularly distinguished himself by his sieges. Basing House, the residence of the Marquis of Winchester, had for four years defied all besiegers, and was regarded by the royalists as impregnable. Cromwell. On the 14th October Cromwell wrote to the speaker—"I thank God I can give you a good account of Basing." He had stormed it that morning at 6 o'clock, having, says Hugh Peters, "spent much time with God in prayer the night before." A few more such successes ended the campaign and the war. On the 22d April 1646 Cromwell returned to his place in parliament, and was received with the most distinguished honours.

During the next two years he resided for the most part in London, taking a due share in the negotiations with the king, and in the important contest between the Presbyterians and Independents, represented respectively by the city and army, which ended in the triumph of the latter. On the one side the support of the army was felt to be now an unnecessary burden, while the fact that so many of the soldiers had never taken the covenant was displeasing to the strict Presbyterians, especially to those who had held commands in the old army. On the other side it was regarded as a most hazardous policy to disband the army without any surer guarantee for the nation's peace than the promises of the king. The formal claims of the soldiers however were 43 weeks' arrears of pay, indemnity for acts done in the war, and discharge according to contract. After much unsatisfactory negotiation, the celebrated rendezvous or army convocation took place (June 10, 1647) on Triploe Heath near Cambridge. The parliamentary commissioners were saluted in every regiment with the cry "Justice! Justice!" On the same day a letter signed by the general (Fairfax) and chief officers was despatched to the mayor and corporation of London. It expressed in moderate language their desires, containing at the same time the significant intimation that "for the obtaining of these things we are drawing near your city." The events that followed can here be merely indicated—the accusation of the 11 members by the army—their withdrawal—the advance and retreat of the army as the parliament resisted or yielded—the apprentice riot of July 26, forced repeal of the militia ordinance, and recall of the expelled eleven—the withdrawal of a large body from both houses of parliament with the two speakers to the camp at Hounslow—and finally, the entry of the army into London, August 6, after having received full satisfaction of all its demands. On the 12th November the king escaped from Hampton Court, leaving the parliamentary leaders convinced, after months of fruitless negotiation, of the hopelessness of further treating with him. On the 3d January 1648, it was decided that there should be no more addresses to his Majesty. In March news came from Scotland that a royalist army under the Duke of Hamilton was preparing to invade England. The smouldering elements of insurrection now broke out. In London an alarming riot was only crushed by "a desperate charge of cavalry." Similar risings in Norwich, Canterbury, Exeter, &c., were put down by Fairfax. A more formidable revolt took place in Wales, and thither Cromwell was ordered to hasten. On the 11th May he took the town of Chepstow, and leaving Colonel Ewer to besiege the castle, advanced towards Pembroke. The castle was held by Colonel Poyer, a renegade officer of the parliament; who surrendered, after a protracted siege, on the 11th July. Having settled Wales, Cromwell now hastened northward and joined Lambert in Yorkshire. Hamilton, with 17,000 Scots, and Sir Marmaduke Langdale with 4000 Yorkshiremen, were advancing in loose combination into Lancashire. Cromwell, marching westward at the head of 8600 men, attacked them at Preston on the 17th August. The rout and chase extended over three days, at the end of which Hamilton's army was a total wreck. 2000 men were slain, and 10,000 (the duke himself in the number) made prisoners. So rapid and unexpected had been the movement of Cromwell, that Hamilton did not

Cromwell. know till the close of the first day with what enemy he had been engaged. Following up this amazing success Cromwell proceeded northward, by Durham and Berwick across the border. On the 4th October he entered Edinburgh, where he was welcomed with enthusiasm. During two days he lodged in "the Earl of Murrie's house, in the Cannigate," receiving visits from persons of distinction; and on the day of his departure was entertained to a sumptuous banquet in the castle. Having received satisfactory guarantees of future amity, he took his departure on the 7th October, leaving Scotland "in a thriving posture," and "like to be a better neighbour than when the great pretenders to the covenant, and religion, and treaties, had the power in their hands." Returning by Carlisle, which was delivered up according to agreement with the Scots, he laid siege to Pontefract Castle. It held out stubbornly. On the 6th December, the day of "Pride's Purge," having left Lambert to conduct the siege, Cromwell arrived in London, and on the morrow received the thanks of the house for his services. During the following month he sat assiduously in the High Court of Justice for trying the king; and after the execution was nominated to the new council of state.

The critical state of Ireland now demanded the most vigorous measures; the whole country, with the exception of Dublin and Derry, having, through the exertions of Ormonde, been roused into open war against the Commonwealth. On the 15th March Cromwell was nominated lord-lieutenant for Ireland. Some work, however, still remained to be done at home. The wild doctrines of the Levellers—propagated mainly through the restless activity of John Lilburne—had made dangerous way in the army. The flame of discontent soon broke out into open mutiny at the various headquarters. By prompt activity, and a just exercise of "vigour and clemency," Cromwell and Fairfax succeeded in quelling this alarming insurrection; the ringleaders were shot, the rest were admonished and submitted. On the 10th July Cromwell left London in great state, and after some weeks spent in preparations at Bristol, embarked at Milford Haven, Aug. 13,—"followed," as Milton tells us, "by the well-wishes of the people, and the prayers of all good men." He landed in Dublin on the 18th, and was received with the most lively demonstrations of joy. On the 3d Sept. he appeared before Tredah (Drogheda), which Ormonde had garrisoned with 3000 of his best troops. On the 10th Cromwell's batteries began to play, and the governor received a summons to surrender. It was rejected, and the bombardment proceeded. Next day a breach was made, and the storming party entered, but met with a vigorous repulse. Cromwell, witnessing this from the batteries, hastily headed a second assault, drove in the enemy, and, "being in the heat of the action," put the whole garrison without mercy to the sword. In this terrible severity, Cromwell doubtless believed he was at once executing just judgment on obstinate rebels, and taking the surest method to hasten the termination of what threatened to be a long and bloody struggle. "I am persuaded," he wrote in his despatch, "that this is a righteous judgment of God upon these barbarous wretches, who have imbrued their hands in so much innocent blood; and that it will tend to prevent the effusion of blood in the future. Which are the satisfactory grounds to such actions, which otherwise cannot but work regret and remorse." His anticipations were correct. "The execrable policy of that regicide," says Carte, "had the effect he proposed." Towns and garrisons were yielded up in rapid succession; and, with the exception of Wexford, where a similar slaughter took place (Oct. 11), Cromwell "intending better to the place than so great a ruin," the subsequent "effusion of blood" in Ireland was comparatively small. The arm of resistance had been paralysed. On the 2d Dec. Cromwell retired to winter quarters. Before resuming the campaign, he issued, in answer to a manifesto from an assembly of the Popish hierarchy at Clonmacnoise, a "Declaration for the Undeceiving of Deluded and Seduced People." Cromwell. In this remarkable document ("probably," says Mr Carlyle, "the remarkablest state paper ever published in Ireland since Strongbow, or even since St Patrick, first appeared there") Cromwell, with rude but masterly hand, tears up the sounding pretences of the hierarchy, points to the true causes of Ireland's miseries, rebuts the charges of "massacre" and "extirpation," and invites the inhabitants of Ireland to submit peaceably to the Commonwealth, with assurance of inviolate protection in their just rights and liberties. These promises were no empty words; the results of Cromwell's conquest and government in Ireland were a general peace and prosperity, admitted, even by his bitterest enemies, to be without example in the previous history of that misgoverned country. On the 29th Jan. 1650 he again took the field. Success everywhere attended him and his lieutenants. At Clonmel 2000 men of Ulster made a last desperate effort in the royal cause. After a fierce and gallant resistance the place was stormed, and surrendered on the 9th of May. Cromwell had some time previously received orders to return to England; and having thus, within the brief space of nine months, reduced a hostile kingdom to comparative obedience, he sailed for England, leaving Ireton as his deputy, and entered London in triumph on the 31st of May.

The threatening aspect of affairs in Scotland had hastened his recall. Charles, willing "to sign anything," had taken the covenant, and forces were being raised against the Commonwealth. The command of the northern expedition was offered to Fairfax, but he declined to act against the Presbyterians; and on the 26th June Cromwell was nominated captain-general of all the forces of the Commonwealth. He made his preparations with his usual promptitude, and on the 29th marched from London; Lambert, Fleetwood, Whalley, Monk, Pride, and Overton, commanding under him. On the 23d July he crossed the border at Berwick. The inhabitants everywhere fled at his approach, the clergy having represented the English invaders as "sectaries and blasphemers," "monsters of the world," who would "put all the men to the sword, and thrust hot irons through the women's breasts." By dint, however, of encouraging proclamations, combined with the extreme discipline preserved in the army, the confidence of the people was gradually restored. On the 28th July, Cromwell encamped at Musselburgh. The Scotch army, commanded by David Lesley, as superior to the English in numbers as it was inferior in discipline, lay strongly fortified between Edinburgh and Leith. On the second day after the arrival of Cromwell, the enemy made a vigorous sally, but were repulsed with loss. "This," wrote Cromwell to the president of the council, "is a sweet beginning of your business, or rather the Lord's." Lesley, however, was not to be drawn into an open encounter. Fabius himself was not more skilful in wearing out by cautious manœuvring the patience of an enemy. During a whole month Cromwell marched and countermarched round Edinburgh, in vain attempting to provoke a battle, his supplies failing, the season advancing, and sickness reducing his men "beyond imagination." Declarations and responses, with no satisfaction on either side, had meanwhile passed between him and the Scotch commissioners. On the 31st August he left Musselburgh, and fell back upon Dunbar, where his ships lay. Lesley immediately hastened to cut off his retreat, and pressing closely in the rear, took possession of the heights above Dunbar, and the only pass that left a southward opening to the enemy. Thus hemmed in, the sea behind, the enemy encircling him on the hills, 23,000 strong, his own men reduced by sickness from 14,000 to 11,000, Cromwell's good fortune seemed, on the 2d of September 1650, to have at length forsaken him. "Before the fight," he

Cromwell. afterwards wrote to Ireton, "our condition was made very sad, the enemy greatly insulted and menaced us." Not even then, however, did his strong trust in God and in himself for a moment desert him. "He was a strong man," said one who knew him, "in the dark perils of war, in the high places of the field, hope shone in him like a pillar of fire, when it had gone out in all the others." "In the mount the Lord would be seen; He would find out a way of deliverance and salvation."[1] On the afternoon of that gloomy day, Cromwell, reconnoitring the enemy's position, saw that Lesley was moving his forces to the right, and "shogging" down his right wing to more open ground. At once recognising the advantage this offered for "attempting upon the enemy," he decided, after consulting his officers, to begin the attack on the morrow before dawn. The battle, however, did not begin till six. The "dispute" was hot on the right for about an hour, when Cromwell's "own regiment" came to the charge, and "at the push of pike" drove in "the stoutest regiment" of the enemy. At that moment the sun's beams broke out through the morning mist, over the hills and the sea, and the flashing lines of steel. Then was Oliver heard to say, in the words of the Psalmist, "Let God arise, let his enemies be scattered!" Horse and foot now charged resistlessly on every side; the Scottish ranks fell back in wild confusion, wrecked and scattered in tumultuous flight. Before nine o'clock 3000 of them were slain, and 10,000 prisoners, with all their baggage, train, and artillery, were in the hands of the English, who "lost not thirty men," "a mercy," Cromwell might well say, "far above all praise."

He now took possession of Edinburgh, where he spent the most of the winter and spring. The city clergy had shut themselves up in the castle, and refused on his invitation to return to their flocks. Some correspondence ensued, in the course of which the general showed himself rather more than a match for the theologians even on their own ground. In February a deputation from Oxford came to inform him of his election as chancellor of the university. Shortly after, we find him pleading in behalf of a "pious and laudable scheme" for establishing a college at Durham. About this time he was seized with a dangerous illness, brought on by exposure to wet and cold, which, after a temporary convalescence, broke out in several severe relapses. The council of state expressed their consideration by sending two physicians from London to attend him. In the interval, he spent ten days in Glasgow, where he held a friendly conference with some of the leading Presbyterian ministers. The Scotch army meantime lay entrenched at Torwood, near Stirling. Towards the end of June, Cromwell, having recovered from his illness, moved westward. Finding the enemy too strong to be dislodged, he sent a portion of his army under Lambert across the Firth. At Inverkeithing they defeated a large body of the enemy, killing about 2000 men. Inchgarvie and Burntisland soon after surrendered to Monk; and Cromwell, crossing with his army to Fife, marched upon Perth, which surrendered on the second day. Charles, finding his supplies thus cut off, determined on a bold stroke, and, breaking up his camp, marched into England. Cromwell, leaving Monk behind him, and sending Lambert and Harrison with his light horse in advance, followed at some distance. The tidings of the royal movement excited great alarm in London, and it was even suspected that the general had betrayed the Commonwealth. Cromwell, not unaware that such fears would arise, wrote to the Parliament simply relating the facts, and expressing full confidence of success. The militia flocked to his standard all along his march; and by the time he reached Worcester, he found himself at the head of upwards of 30,000 men. There, on the 3d of September 1654, the anniversary of Dunbar, after a fierce and unequal contest, the Scotch army was shivered into ruin, and the last hope of royalism buried. "The dimensions of this mercy," said Cromwell in his despatch, "are above my thoughts. It is, for aught I know, a crowning mercy." Such indeed it proved. On the 12th September the victorious general entered London amid the joyous congratulations of all persons, high and low. Cromwell.

At this point Cromwell's career as a general ends, and the events of his subsequent life become identified with the history of Britain. To give completeness to this sketch, however, it will be necessary briefly to notice the chief points in his history as a ruler. After the battle of Worcester, the management of Scotland, where his deputy Monk had been completely successful in crushing royalism, naturally fell under the chief direction of Cromwell. That country was now united to the Commonwealth by act of parliament, a small army distributed in garrisons preserved the peace of the country, justice was strictly administered, the affairs of the church were committed to a commission of pious and judicious ministers; and during the whole period of Cromwell's government, Scotland prospered under a strict but beneficent rule. During the interval between the battle of Worcester and the dismissal of the "Rump" Parliament, Cromwell took no prominent part in public affairs. The general opinion among historians seems to be, that during these nineteen months the ambitious general was busily occupied in that course of profound "dissimulation" and "intrigue" which had marked his whole career, and that as the premeditated result of the selfish scheme of usurpation, which had lurked darkly in his bosom even on the banks of the Ouse, he entered the House of Commons on the 20th April 1653, expelled the parliament, and assumed the reins of power. Without occupying time in the discussion of this view, it is sufficient here to remark that the great assembly that had moulded the Commonwealth had now, at the end of twelve years, exhausted its vitality, and dwindled into a mere mockery of representative government. It had become in fact an oligarchy, which had absorbed to itself not merely the whole administration of public affairs, but the control of many private interests. Their "only serious occupation to maintain themselves in power and defend themselves against their enemies;"[2] these men wasted months in debating questions of mere technicality, and prolonged time after time the duration of their power, after the voice of the nation, so far as it was capable of being interpreted, had pronounced it intolerable. After months of discussion and delay, they had completed their measure for electing a new parliament, professedly with the view of laying down their power into the hands of their successors, when it was found that by this act the members of the existing parliament were to be *de jure* members of the new, and to constitute a committee for deciding on the admission of their successors! On the morning of the 20th April, Cromwell, informed that this shameless measure was being hurried through the House, entered with his troopers and dissolved the parliament. By that daring act he became the sole head of power in the nation, and nothing was left him but to use it as wisely and firmly as he could. The consequences of that act left him thenceforth no honourable retreat had he desired it. *One* strong hand was needed to give consistency and unity to the action of the state, alike in its internal and its foreign relations; and, from the hour that Cromwell seized the helm, the ship of the Commonwealth rode the waves, if not without straining or accident, yet with a proud and steady

[1] *Letters and Speeches*, iii., 56. It is impossible here to omit reference to Mr Carlyle's chapter on "Dunbar." Another such battle-piece never was painted.

[2] Guizot, *History of Cromwell and the English Commonwealth.*

Cromwell. march. Few tears were shed for the departed "statesmen;" the nation quietly submitted, if it did not positively approve; the business of the state went on without interruption; the leaders of the army and navy, many of them ardent republicans, continued at their posts, sinking their private opinions in their concern for the country's good. As soon as possible, summonses were issued in Cromwell's name to 140 "persons of approved fidelity and honesty," selected from the nation by himself and his council to act as a parliament in the existing emergency. This extraordinary assembly met on the 4th of July. The old and vulgar charge against them, as a herd of mean and contemptible fanatics, is of a piece with the general run of historic portraitures of Cromwell himself, and has been sufficiently answered even by writers who have little favour for him. They were indeed a body of most sincere and earnest men, only too eager and comprehensive in their efforts to accomplish a national reformation. They attempted too much; they aroused a storm of hostility from the classes whose interests they threatened; they bowed before it; internal dissensions and intrigue hastened their fall, and on the 12th December they resigned their power into the hands of Cromwell, who now found himself in the solemn position of being the uncontrolled arbiter of the peace and safety of Britain. Earnestly desirous, as he throughout evinced himself, of giving his country a stable and constitutional government, he was willing now, rather than that England should sink into the abyss of anarchy, to brave the dangers and the odium that attach to the name of a usurper. Called, as he might well believe himself, "by a good right from God and men" to the great task of settling a distracted state, and carrying into full effect the earnest beliefs for which the nation had shed its blood and sacrificed its king, we give a poor judgment on all that is highest in human motive if we attribute to any mean and selfish ambition the act that now put visibly into the hand that alone was fit to wield it the sceptre of the British realms. Four days after the resignation of the "Little Parliament" it was openly proclaimed that Oliver Cromwell had been invested with the office of supreme governor of the British Commonwealth under the title of Lord Protector; and on the 16th December 1653 he was solemnly installed in Westminster Hall.

All the chief courts of Europe sent their congratulations to the new sovereign, and soon they were made to feel and bow to his power. A parliament was summoned for the 3d of September 1654; and in the meantime, Oliver and his council proceeded with vigour in the settlement of domestic and foreign affairs. "In less than nine months," says M. Guizot, "eighty-two ordinances, bearing upon almost every part of the social organization of the country, bore witness to the intelligent activity and to the character, at once conservative and reformatory, of the government." Of these it is sufficient to mention the partial reform of the court of chancery, and the settlement of ecclesiastical affairs by the commission of *Triers*, a body of able and pious men who, by the impartial testimony of Baxter, "did abundance of good to the church." A plot, the first of many, to assassinate the Protector, was discovered in the month of July. The principal conspirators, Gerard and Vowel, were executed; and on the same day, as a terrible example to Europe of English justice, Don Pantaleon Sa, brother to the Portuguese ambassador, was publicly beheaded for his share in the murder of an English citizen. On the 3d September the parliament met. The Protector had already concluded peace with the Netherlands, Sweden, Denmark, and Portugal; and a treaty with France was proceeding hopefully towards settlement. The parliament began business by deliberating whether they should approve the newly established frame of government—in other words, by calling in question the authority which had called them together. Oliver at once hastened to set them right. "I told you," he said, "that you were a 'free parliament,' but I thought it was understood withal that I was the Protector, and the authority that called you!" He concluded an Cromwell. earnest and powerful address by requiring of them to sign a document pledging themselves to acknowledge the existing government. One hundred and fifty of the republican members refused to sign, and withdrew. The rest resumed their sitting; but their subsequent proceedings were scarcely more satisfactory than their inauspicious commencement. Instead of accepting cordially as a fact the power of the Protector, and aiding him in the work of government, their sole business was to interpose as many checks as they could to his influence. Deeply grieved at the failure of each successive attempt to govern by constitutional means, Cromwell was not therefore discouraged. If parliaments would not help him, he was determined to govern without them. His scheme of *Major-generals* followed; "a little poor invention," as he called it, for preserving order in the country, and crushing the now imminent attempt at a combination between the Royalists and the Levellers. Though arbitrary, and in many instances oppressive, this scheme accomplished the great end of its establishment—the preservation of the country's peace.

But while the enemies of peace and order at home were made to feel the invincible power of his government, it was in his relations with foreign states that the commanding genius of Oliver was most conspicuously displayed. No monarch ever so sustained in the eyes of Europe the majesty of the British power. The grand object of his foreign policy was to unite the Protestant states, with Britain at their head, in a defensive league against Popery, then as now the enemy of civil and religious liberty. Spain, "the great underpropper of the Roman Babylon," the "natural enemy of the honest interest," he determined to humble, and in due time he did. With France, less subject to the yoke of Rome, he allied himself, making such terms as he pleased, extorting from the crafty Mazarin (who was said to "fear Oliver more than the devil," and to change colour at the mention of his name), a cardinal and prince of the Church of Rome, protection for Rome's enemies, and full pardon for offences committed against her in the heart of France itself! In the summer of 1655 the persecution of the Protestants in the valleys of Piedmont afforded an occasion for displaying in the noblest light the greatness of the Protector and of the nation which he represented. The tidings of these cruel oppressions affected the stern conqueror to tears. The treaty with France was ready to be signed that day. He refused to put his name to it until he received assurance of protection for the persecuted Piedmontese; and immediately wrote, not only to the Duke of Savoy himself, but to Louis XIV., to Cardinal Mazarin, the Kings of Sweden and Denmark, the States-General, the Swiss Cantons, and even to Rakozy, Prince of Transylvania, pleading for their interposition. Had his remonstrances proved unsuccessful, he had fully prepared to exact compliance at the point of the sword. A Protector not of England only, but of the Protestantism of Europe, this Usurper might claim, without any fiction, the royal title "Defender of the Faith." Meantime the supremacy of England on the seas was upheld by Blake, whose guns thundered along the shores of the Mediterranean, exacting justice and submission from every hostile power. The Duke of Tuscany, the Pope, the Deys of Tunis, Tripoli, and Algiers, each in succession, were forced to make reparation for injuries to English commerce and liberty. The Mediterranean was cleared of pirates, and the confidence of peaceful merchants was restored. "By such means as these," said Cromwell, "we shall make the name of Englishman as great as that of Roman was in Rome's most palmy days."

After a lapse of nearly two years, Oliver, still clinging to the wish of restoring the ancient constitution, now made another experiment at governing with a parlia-

 ment. It met on the 17th September 1656. About a hundred of the inveterate republicans were excluded, and the house, now tolerably in harmony with the Protector's views, proceeded to a settlement of the nation. The major-generals were abolished early in spring; the form of a new constitution, with two houses of parliament, and one governing person, with the title of *king*, was proposed; and during three months the subject was discussed amidst the intense expectation of the whole people. That Cromwell was willing and even desirous to add this element of stability to his government there can be no doubt; but seeing that the dangers that threatened to accompany the assumption of the title were likely to overbalance its advantages, he finally declined to accept it. The remaining points of the constitution, however, were agreed on, and on the 26th June 1657, he was again, with additional solemnity, invested with the protectorate. The new parliament assembled on the 20th January 1658. The Commons refused to acknowledge the Protector's House of Peers, and on the 4th of February he dissolved them, concluding his last speech with the solemn words "God be judge between me and you!" The whole weight of government again rested on his shoulders, and with unabated energy he went on with his work, crushing the designs of domestic enemies, and maintaining abroad the full prestige of his power. His struggles were now drawing to an end. "He being compelled," says Maidstone,[1] "to wrestle with the difficulties of his place, so well as he could, without parliamentary assistance, in it met with so great a burthen as (I doubt not to say) it drank up his spirits, of which his natural constitution yielded a vast stock, and brought him to his grave; his interment being the seed-time of his glory, and England's calamity." On the 6th August, his favourite daughter, Elizabeth, died after a lingering illness, during which the Protector had watched unremittingly by her side. His health, already declining, now visibly gave way. No space remains here to describe that solemn deathbed, where the lowly penitence of a sinner was heard to express itself in earnest confession, and the thoughts of a great ruler for the good of his people found their last utterance in a prayer. On Friday, the 3d of September 1658, the anniversary of his Fortunate Day, the spirit of Cromwell was released from its earthly toils; Nature herself seeming to prophesy, in the voice of the tempest, that a great power was passing away.

"It has often been affirmed," says Mr Macaulay, "but apparently with little reason, that Oliver died at a time fortunate for his renown, and that, if his life had been prolonged, it would probably have closed amidst disgraces and disasters. It is certain that he was to the last honoured by his soldiers, obeyed by the whole population of the British Islands, and dreaded by all foreign powers, that he was laid among the ancient sovereigns of England with funeral pomp, such as London had never before seen, and that he was succeeded by his son Richard as quietly as any king had ever been succeeded by any prince of Wales."[2]

Historians, till within a comparatively recent period, have been nearly unanimous in their judgment on the character of Cromwell. That he was a man of extraordinary abilities was a necessary and universal admission, but served for the most part only "to point the moral" as an aggravation of his crimes. The only question concerning so terrible a prodigy seemed to be, how far a selfish and unscrupulous ambition may have been modified in him by a blind fanaticism, how far in deceiving others he may gradually have fallen into deception of himself. That his history should have been so interpreted admits of easy explanation. The recoil of sentiment that followed the death of Cromwell, and with him of Puritanism, as a visible power, was great in proportion to the intensity of the previous strain; and a man who attempted to realize Christianity as a practical element in the government of nations, and addressed armies and parliaments in the language of the Bible, was not likely to be looked upon with sympathy in the age of Bolingbroke and Hume. Had Cromwell been less of a Christian and more of a Pagan, historians might have accorded to him some of that leniency with which they have spoken of the vices of a Cæsar or a Peter the Great. But the same office which cowardly hands had done for his bones, servility, ignorance, and prejudice, did for his memory; and during most part of two centuries, the name of the greatest man of his own age, and one of the noblest of any age, has been associated with all the infamy that belongs to a life-long career of unmitigated hypocrisy and insatiable ambition. Truth, however, at length begins to prevail; and Cromwell's own prophetic hope is attaining fulfilment—"I know God has been above all ill reports, and will in his own time vindicate me." The most eloquent of English historians has defended, in pages read by all the world, both the Puritans and their king; and another historian, with still deeper love and admiration, has paid his "tribute to the memory of a hero," in a work which will henceforth enable posterity to know what kind of man Oliver Cromwell really was.[3]

We shall not here attempt any defence of Cromwell. "In speaking," said Milton, "of such a man, who has merited so well of his country, I should do nothing if I only exculpated him from crimes; since it so nearly concerns the country and myself, who am so closely implicated in the same disgrace, to evince to all nations, and, as far as I can, to all ages, the excellence of his character, and the splendour of his renown." After Milton, and Macaulay, and Carlyle, it becomes a difficult task to speak on the subject. Let us, however, as briefly as possible, review the life of Cromwell. In its first obscure period, including two-thirds of his life, he is a plain English farmer, distinguished only by his homely English virtues, his strong common sense and independence, his earnest piety, his forwardness in all good works. At home he is strict yet tender, full of soft sympathies and playful kindness. He enters the British parliament recommended by little political skill or influence, still less by any oratorical attainments; but by his thorough practical force and earnestness he approves himself as a man "to sit well to the mark." In the next stage of his life he is an extempore soldier, who, having learned to govern himself, proves his fitness to be a leader to others. He inspires his men with his own spirit, fights with the enthusiasm of one who believes, and passes

[1] *Letter to Winthrop, governor of Connecticut.* From the same source we must subjoin another interesting extract, descriptive of the Protector's character and personal appearance. "His body was well-built, compact, and strong, his stature under six feet (I believe about two inches), his head so shaped as you might see in it a storehouse and shop both of a vast treasury of natural parts." (Phrenologists have specially noticed this point.) "His temper exceeding fiery, as I have known, but the flame of it kept down for the most part or soon allayed with those moral endowments he had. He was naturally compassionate towards objects in distress, even to an effeminate measure; though God had made him a heart wherein was left little room for any fear, but what was due to Himself, of which there was a large proportion, yet did he exceed in tenderness towards sufferers. A larger soul I think hath seldom dwelt in a house of clay than his was. I do believe if his story were impartially transmitted, and the unprejudiced world well possessed with it, she would add him to her nine worthies, and make up that number a decemviri."

[2] *History of England*, vol. i., p. 139.

[3] "The collection of all his speeches, letters, and sermons," says Mr Hume, "would make a great curiosity, and, with a few exceptions, might pass for one of the most nonsensical books in the world." How the "*Letters and Speeches of Oliver Cromwell, with Elucidations by Thomas Carlyle*," reply to this remarkable verdict, readers must judge for themselves. It may be enough here to say that no such noble service was ever rendered to the memory of a great man by a single hand. For an able biography in which a very opposite view is taken of the character of Cromwell, the reader is referred to Mr Forster's *Statesmen of the British Commonwealth*, vols. vi., vii. (*Cab. Cyclopæd.*)

Cromwell. on from victory to victory. When justice requires it he can be inexorable as death, but he has an affectionate pity for distress, and a patient tolerance for honest doubt or misguided sincerity. As his sphere widens his powers are developed; he displays a faculty equal to the greatest affairs and the darkest emergencies, till all men come to rely on the strength of his arm and the wisdom of his counsel. With a soul-pervading belief in things unseen, ever alike in public and in private, in the shock of battle and the heat of debate, speaking and feeling as a man under the eye of God and an instrument in His hands, he unites a clear and prompt intelligence that finds difficult vent in words, but cuts decisively through the subtlest entanglements, and a vigour of will that takes up the most appalling difficulties with an iron grasp, scatters doubt and opposition to the winds, and establishes order on the basis of fact. He has no theories about government, but he knows in all circumstances what suits the time, and he dares to realize it. A king governs ill, and obstructs the growth of England's true life; he helps to dethrone him, and set up a republic. The republic proves itself unfit for the national requirements, and its leaders talk when they ought to act; he takes the work into his own hands, trampling upon law, resolute only that England shall in some true sense accomplish her destiny. And now he is visibly, as he had long been virtually, the head of the nation. He has disappointed every party, not by deceiving them, but by being more wise to recognise the true state of things, and the true conditions of national well-being. He has converted into enemies many sincere and able men, who cannot see with his eyes, and think their duty consists not in aiding but in opposing him. He has alienated the affections of old comrades, who cling to their loved theories, while he is striving only to put whatever was good in these theories into practice. His superior mind, ever growing, has opened into a wider circle of thoughts, out of the mist and storm of revolution. Experience has taught him many things which are hard to communicate in words, but which he struggles to convert into facts. Elevated into supremacy, regal save only in name, he still preserves the plain simplicity of his former life. Armed with more than regal power, he limits himself within the strict bounds of necessity. He is not elated by power, for it is not strange to him. At home upon a throne, he cares little for the outward shows of royalty, except so far as they involve the nation's honour, or conduce to its security. Too great to be jealous or vindictive for himself, he is swift and stern in crushing the enemies of public tranquillity. He is truly a terror to evil-doers, a praise and protection to them that do well. He fosters learning, though himself not learned, and a companion of men to whom learning is profanity. "If there was a man in England who excelled in any faculty or science, the Protector would find him out, and reward him according to his merit." The head of Puritanism, of a cause now triumphant, he is so little of a "fanatic," that he tolerates all sects, so long as they meddle not to disturb the state—he can tolerate everything but wilful wrong-doing. His large and healthy spirit is bound by no party sympathies—his heart yearns towards all good men, of whatever name. At an era when toleration is still looked upon as foolish in politics and criminal in religion, he stands out in glorious prominence as the earnest advocate of the rights of conscience, and proclaims all men answerable to God alone for their faith. Popery and prelacy he proscribes, on grounds political rather than religious: to the adherents of both he shows private lenience; under his rule men no more suffer at the stake or the pillory. So far do his thoughts reach beyond his age, that he desires, and earnestly attempts, to extend the rights of citizenship to the outcast and persecuted Jews. Himself the greatest, "the most English of Englishmen"—he is determined that England shall be the greatest of states. He encourages trade, he plants colonies, he makes wise peace with whom he will, or wages just and successful war. All Europe trembles at his voice, and the flag of England now and henceforth waves triumphant over every sea. In fine, considering the comparative position of Britain in the times that preceded and followed him, the circumstances of his life, and the difficulties with which he had to contend, making all allowance for his errors and his failings, he is a man for all ages to admire, for all Britons to honour in proud and loving remembrance. No royal name at least since Alfred's is more worthy of our veneration than that of the "Usurper," Oliver Cromwell. (A. N.) Cromwell || Cronia.

CROMWELL, *Richard*, the eldest surviving son of the Protector, was born at Huntingdon, October 4, 1626. In his youth he is said to have been favourable to royalism; but on the elevation of his father he accepted a place in parliament, and was appointed first lord of trade and navigation. He was afterwards made privy-councillor, a colonel in the army, and leader in the House of Lords. On the death of his father he received the sceptre of the Commonwealth; but, surrounded on all sides by the machinations of factions which he had not sufficient intrepidity to quell, he resigned his power (April 22, 1659) and retired into private life. Oppressed with debt, principally contracted to cover the expenses of his father's funeral, of which parliament only partially relieved him, he was obliged to retire to the Continent. In 1680 he ventured to return, and under the assumed name of Clarke he settled in Cheshunt, Hertfordshire, where he died in 1712, aged eighty-six.

CROMWELL, *Thomas*, Earl of Essex, was the son of a blacksmith at Putney, and born there in 1498. He received the greater part of his education abroad, and was for some time clerk to an English factory at Antwerp. From thence he removed to Rome, where he familiarized himself with the Latin classics, and is said to have learned Erasmus' New Testament by heart. On his return to England, he entered the service of Cardinal Wolsey, and defended his patron when impeached before the House of Commons. His boldness on this occasion seems to have recommended him to the favour of Henry, who, after the fall of the cardinal, made him his confidential favourite and prime minister. From the moment Cromwell acquired any authority in the cabinet, he exerted it in favour of the Reformation, and signalized himself by the zeal with which he forwarded the demolition of images, the dissolution of monasteries, and the religious education of the people. He also instituted parish-registers, and introduced numerous other social improvements. His devotedness to the cause of the Reformation led him to take an active part in promoting the marriage of Henry with Anne of Cleves, who was a zealous Lutheran; and the indignation with which the king afterafterwards regarded his bride fell with double fury on the head of the minister. To the people generally he was already obnoxious on account of the subsidies which he had exacted, and by the nobility he was despised as a plebeian intruder into their order, while with the Roman Catholics he shared the fate of every reformer. The charms of Catharine Howard were quickly made available to widen the breach between the king and Cromwell; and after a sudden arrest and a hasty impeachment, in which charges of heresy and treason, bribery and extortion, were made against him, without the liberty of reply, he was condemned and executed on Tower Hill, July 28, 1540. Of Cromwell's character various opinions are given by the adherents of the Reformation and its opponents. His last speech is in keeping with the religious ambiguity of the period; and though his whole life was spent in promoting the interests of the Reformed Church, it is certain that ambition had greater influence in shaping his policy than conscientious conviction. See ENGLAND.

CRONIA, in *Grecian Antiquity*, a festival celebrated more particularly at Athens in honour of Cronos (Saturn)

Cronstadt. on the 12th of the month Hecatombæon, which was the first month of the Attic year, and corresponded nearly to our July. The more ancient name of this month was *Cronius*. The Grecian Cronia corresponded to the Roman *Saturnalia;* and hence by Greek writers the name *Cronia* is applied to that festival.

Plate CXCIV. CRONSTADT, or KRONSTADT, a strongly fortified sea-port town of Russia, and the great naval station of the Russian fleet in the northern seas is situated on the island of Kotline (frequently also called Cronstadt, from the town), at the head of the Gulf of Finland, 20 miles west of St Petersburg, in N. Lat. 59. 59. 26.; E. Long. 29. 46. 30. The population in 1849 was 25,120; but it varies considerably at different times of the year, and in summer generally amounts to about 50,000. The island of Kotline is in general outline an acute triangle, 7 miles in length by about 1 in breadth, with its base towards St Petersburg, and its apex extending obliquely seawards. The eastern or broad end is occupied by the town of Cronstadt; and 1½ miles from the western point of the island is the lighthouse of *Tolboochin* or Tolbeacon. The streets are regular, and in general well paved; but the houses, with the exception of those belonging to government, are chiefly of one story. The town was originally built of wood, and wooden structures are still numerous; but such buildings are now forbidden by law, and the majority of the houses are now built of brick and plastered. Cronstadt is divided into two parts—the *Morskaia chast*, sea district, and the *Koopacheskaia chast* or commercial district—and into four subdivisions. Of the two canals which traverse the town, that of St Peter, constructed of granite, is 2160 feet long by about 30 yards wide. It commences between the Merchant and Middle Harbours, and is in the form of a cross, of which one arm communicates with a dock where ten ships of the line can be repaired at once. The Catherine canal, 1880 fathoms in length, communicates with the Merchant Harbour, and thus enables vessels to take their stores, munitions, &c. directly from the store-houses. Between the two canals stood the old Italian palace of Prince Menschikoff, the site of which is now occupied by a large building used as a school for pilots, and educating above 300 pupils. Among the other public buildings may be mentioned the extensive naval hospital, the civic hospital, arsenal, admiralty, cannon and ball foundry, custom-house, barracks, the exchange (a square range of shops), and the club-house; containing also a seminary in which soldiers' and sailors' sons are educated at the expense of government. The house of Peter the Great is still standing, and serves as a country residence for the military governor; and the garden still contains a few of the trees planted by his royal hand. On the south side of the town there are three harbours, formed artificially by means of piles supporting a superstructure partly of timber and partly of granite, and mounted with guns. The Western or Merchant harbour is capable of containing 600 vessels. Its western flank is formed by a mole running for a distance of 1000 yards in a direction nearly at right angles to the approach, and joining the land fortifications, which here traverse the breadth of the island. Opposite the fort of Cronslott this mole takes a new direction, running for nearly a mile almost parallel to the north side of the island, and separating the Merchant and Middle Harbours from the Little Roads. It has three bastions, on the first of which stands Fort Menschikoff, mounting forty-four 8 and 10 inch guns, in four tiers of casemates. The flank towards Cronslott is pierced with loop-holes for musketry on each of the three lower tiers. The Middle Harbour is used chiefly for the fitting out and repairing of vessels, the hulls being generally built at St Petersburg and brought here for equipment; and attached to it there are excellent docks, with pitch and tar works, powder-magazine, &c. The War Harbour, at the end of the Middle Harbour, is of a rectangular form, about 900 yards in length by 350 in breath. It has two bastions at the extreme end, and two on either flank; those on the west having their salient angles truncated, and an opening left in them for the passage of ships. On the northern side of the island the passage is impracticable, except for very small craft, being obstructed by rows of piles and large masses of stone extending from the island to Lisi Noss on the mainland. The southern channel is the only practicable passage from the Gulf of Finland to St Petersburg, and it is strongly defended on both sides by forts and batteries. The principal of these are Forts Alexander, Risbank, Peter, Cronslott, and that of Menschikoff already mentioned. The Great Road is commanded by Forts Alexander and Risbank, about 1600 yards apart. The former, on the left side of the passage, consists of a front with 4 tiers of embrasures, and two flanks of 3 tiers each, and a rear-wall mounted with guns *en barbette*. It is built of blocks of granite on a foundation of piles in 18 feet of water, and commands the road by one hundred and sixteen 8 and 10 inch guns, all in casemates. Fort Risbank, which was not finished last year (1853), on the opposite side, is also of granite, resting on a foundation of piles in 16 feet of water, and is armed with tiers of guns of the heaviest calibre. Farther eastward, on the left, is Fort Peter, or Citadel Fort, with three towers or bastions joined by two curtains; the first commanding the approach to the rear of Fort Alexander, while the second and third sweep the main channel. These bastions have twenty-eight guns in casemates, and twenty-eight guns above *en barbette:* the curtains have no casemates, but mount twenty guns *en barbette*. To the right of the Little Road is Cronslott, an irregular pentagon, originally built by Peter the Great. It presents to the sea a low line of timber casemates, forming a battery of forty guns placed *à fleur d'eau*, and disposed in the half of each of two bastions with a connecting curtain. All this work, however, has been destroyed, and last year (1853) the piles had been driven on which a granite fort was to be built, which by this time (Oct. 1854) is probably complete. The mole forming the western flank of the Merchant Harbour mounts seventy guns, besides twelve mortars; and the channel, between Cronslott and the mole, is only 250 yards wide. Almost all vessels bound for St Petersburg touch at Cronstadt, and those drawing more than 7 feet of water load and unload here; the goods being conveyed to and from the city in lighters. Vessels of 10 feet draught have, however, been known to go up with high water. The port is ice-bound during the winter months, from November to April. Cronstadt was founded by Peter the Great in 1703. Cronstadt.

CRONSTADT, a town situated near the S.E. extremity of Transylvania, and capital of a cognominal district, which also bears the name of Burzenland, from the Burze, a tributary of the Alt, which waters the province. From the branches of the Carpathians which intersect it, the surface of the district reaches a high elevation, and the climate is intensely cold. It is, however, a rich agricultural and pastoral country, and is inhabited by an industrious population, composed of Hungarians, Wallacks, Armenians, Greeks, and Szeklers. The town of Cronstadt is built in a narrow valley hemmed in by mountains, and is commanded by an isolated hill, on which is a fortress of considerable strength. It consists of an inner town, which is defended by walls and towers, and three suburbs on the N., E., and S. The suburb of Blumenau is inhabited chiefly by Szeklers; the suburb of Bulgarey (which communicates with the inner town by a large esplanade), and that of Ulstadt, are the residence chiefly of the Wallack population. The principal buildings in Cronstadt are the Protestant church, with a tower 140 feet high, the Lutheran church and college, the gymnasium, and the market-house erected in 1545. Besides the churches already mentioned, there are others belonging to the Roman Catholics, Greeks, and Calvinists.

Crosier || Cross.

The transit trade of Cronstadt carried on between Vienna and the principalities was once very extensive, but has recently considerably declined. The principal manufactures are those of cottons, woollens, linen goods, and paper. Cronstadt was the first place in Transylvania at which a paper-mill and printing-press were established. Pop. 36,000.

CROSIER, or CROZIER (from *croix*, a cross, of which it has an image on the top), the pastoral staff of a bishop, symbolic of his dignity and office. This staff is of gold or silver, with an ornamented head, which is curved to resemble a shepherd's crook. The custom of bearing a pastoral staff before bishops is very ancient, as appears from the life of St Cæsarea, bishop of Arles, who lived about the year 500. In the Greek Church, the patriarch alone had a right to the crozier. The prototype of this instrument appears to have been nothing more than a simple wooden staff or baton. Afterwards, it came to be highly ornamented; and artists, such as Benvenuto Cellini and Giovanni da Bologna, were employed to design it. The excess of splendour lavished upon crosiers in later times gave occasion to the following satirical lines:—

> Au temps passé du siècle d'or,
> Crosse de bois, évêque d'or;
> Et maintenant changent les lois,
> Crosse d'or, évêque de bois.—COQUILLE.

It is carried in procession before bishops, abbots, and abbesses. Some writers have asserted that the crosier is derived from the *lituus* or augural staff of the ancient Romans.

CROSLET, in *Heraldry*, is applied to a cross that is crossed again at a small distance from each of the ends.

CROSS (Lat. *crux*; Gk. σταυρός), a gibbet formed of two pieces of wood placed crosswise; and, metaphorically, the punishment of the cross, as well as the pain it inflicts, and in a general sense, any severe suffering or heavy trial. Instead of σταυρός the Greek σκόλοψ is sometimes found as equivalent to the Latin *crux*. Both are in frequent use among the writers who transferred the events of Roman history into the Greek tongue.

In its simplest form, consisting of two pieces of wood, one standing erect, the other *crossing* it at right angles, the cross was known at an early age in the history of the world. Its use as an instrument of punishment was probably suggested by the shape so often taken by branches of trees, which seem to have been the first crosses that were employed. It was certainly customary to hang criminals on trees—arbor infelix. Cicero (*Pro Rabir.* 3) appears to consider hanging on a tree and crucifixion as of the same import; and Seneca (*Ep.* 101) names the cross *infelix lignum*, which may with no undue liberty be rendered the "accursed tree." Trees are known to have been used as crosses (Tertull. *Ap.* viii. 16); and to every kind of hanging which bore a resemblance to crucifixion, such as that of Prometheus, Andromeda, &c., the name was commonly applied. Among the Scythians, Persians, Carthaginians, Greeks, Romans, and the ancient Germans, traces are found of the cross as an instrument of punishment. The sign of the cross is found as a holy symbol among several ancient nations. Among the Indians and Egyptians it often appears in their ceremonies, sometimes in the shape of the letter T, at others in this shape +. At Susa, Ker Porter saw a stone cut with hieroglyphics and cuneiform inscriptions, on which in one corner was a figure of a cross, thus  . The cross, he says, is generally understood to be symbolical of the divinity or eternal life, and certainly a cross was to be seen in the temple of Serapis as the Egyptian emblem of the future life, as may be learnt in Sozomen and Rufinus. In this case, it is always the *crux ansata*, thus  , which is often held in the hands of Egyptian deities. Porter also states that the Egyptian priests urged its being found on the walls of their temple of Serapis, as an argument with the victorious army of Theodosius to save it from destruction. In an obelisk recently discovered at Nineveh, there is a representation of a king, within an arched frame, having the Assyrian symbols over the head, and a cross, like that of Malta, on his breast. From the numerous writings on this subject by La Croze, Jablonski, Zoega, Visconti, Pococke, Pluche, Petit Radel, and others, the symbol of the cross appears to have been most various in its significations. Sometimes it is the Phallus, sometimes the planet Venus, the Nilometer, an emblem of the four elements, or the seasons (Creuzer's *Symbolik*, pp. 168-9). It is not therefore surprising that ancient and even modern Christian writers should on this subject have indulged in some degree of refinement and mysticism. Justin Martyr (*Apol.* i. § 72) says: "The sign of the cross is impressed upon the whole of nature. There is hardly a handicraftsman but uses the figure of it among the implements of his industry. It forms a part of man himself, as may be seen when he raises his hands in prayer."

Cross.

According to Lipsius (*De Cruce*, i. 5–9) and Gretser (*De Cruce Christi*, vol. i. c. 1) there were in general two kinds of crosses;—1, crux simplex; 2, crux composita or compacta. The first consisted of a stake on which the criminal was fastened, or by which he was impaled. For the first kind of punishment, a tree or a specially prepared stake was used, on which the criminal was bound, and either left to perish, or immediately put to death. For *impaling* (infixio) a long and sharpened piece of wood (*pale*) was employed, on which the criminal was put as on a spit. Seneca describes this kind of execution (*Consolat. ad Marc.* c. 20): "I behold these crosses, not of one kind, but made differently by different people. Some suspended the criminal with his head turned towards the earth; others drove a stake through his body." This cruel mode of execution was formerly very customary in Russia, China, Turkey, and other countries, and is not yet universally abolished by law.

Of the crux composita or compound cross there were three sorts: 1, crux decussata; 2, crux commissa; 3, crux immissa. The crux decussata is also called Andrew's cross, because tradition reports that on a cross of this kind the Apostle Andrew suffered death. Jerome (*Comment. on Jerem.* c. 31) describes this cross in the following terms:—Decussare est per medium secare velut si duæ regulæ concurrant ad speciem literæ X quæ figura est crucis. So Isidorus Hisp. (*Orig.* I. i. 3) says that the letter X denotes a cross and the number ten (in Roman numerals).

The crux commissa, Lipsius states, was formed by putting a cross piece of wood on a perpendicular one, so that no part of the latter may stand above the former. This form is found in the figure T. Of the crux immissa, or, as others prefer to term it, crux capitata, the following is given as the description:—"a cross in which the longer piece of wood or pale stands above the shorter piece which runs across it near the top." It is distinguished from the preceding by the part of the longer beam which is above the shorter or transverse, thus †. This form is found in paintings more frequently than any other. On a cross of this kind our Saviour is believed to have suffered death; at least it is thus represented on ancient monuments and coins. Four ecclesiastical historians (Socrates, i. 13, Sozomen, ii. 1, Rufinus, i. 7, Theodoret, i. 18) concur in stating that the Empress Helena, mother of Constantine the Great, in the year of our Lord 326, when seventy-nine years of age, was induced by the warmth of her piety to visit the places which the Saviour had rendered sacred by his presence and sufferings. The hatred of the heathen had led them to obliterate as much as possible all traces of the memorable events which the life and death of our Saviour had hallowed; and to cover Mount Calvary with stones and earth, and raise thereon a temple to the goddess Venus. A Jew, however, had treasured up what traditions he could gather, and was

Cross. thus enabled to point out to Helena the spot where our Lord had been buried. On excavation, it is said that three crosses were found, and the title which that of Jesus bore was also found lying apart by itself. The question arose how the cross of Christ was to be distinguished from the other two. Macarius, bishop of Jerusalem, suggested that their respective efficacy should be tried as to the working of miracles. Sick persons were brought forward and touched by each separately. One only wrought the desired cures, and was accordingly acknowledged to be the true cross. A full view of all the authorities on this matter may be seen in Tillemont (*Mem. Eccles.* chapter on Helena).

Having built a church over the sacred spot, Helena deposited within it the chief part of the supposed real cross. The remainder she conveyed to Constantinople, a part of which Constantine inserted in the head of a statue of himself, and the other part was sent to Rome, and placed in the church of Sta. Croce in Gerusalemme, which was built expressly to receive the precious relic. When subsequently a festival to commemorate the discovery had been established, the Bishop of Jerusalem, on Easter Sunday, exhibited to the grateful eyes of eager pilgrims the object to see which they had travelled so far, and endured so much. Those who were persons of substance were further gratified by obtaining, at their full price, small pieces of the cross set in gold and gems; and that wonder might not pass into incredulity, the proper authorities gave the world an assurance that the holy wood possessed the power of self-multiplication, and, notwithstanding the innumerable pieces which had been taken from it for the pleasure and service of the faithful, remained intact and entire as at the first—ut detrimenta non sentiret, et quasi intacta permaneret. (Paulinus, *Ep.* xi. *ad Sev.*)

The capture of Jerusalem by the Persians, A.D. 614, placed the remains of the cross in the hands of Chosroes II., who mockingly conveyed them to his capital. Fourteen years afterwards, Heraclius recovered them, and had them carried first to Constantinople, and then to Jerusalem, in such pomp, that on his arrival before the latter city he found the gate barred, and entrance forbidden. Instructed as to the cause of this hindrance, the Emperor laid aside the trappings of his greatness, and, barefooted, bore on his own shoulders the sacred relic up to the gate, which the monkish records assure us opened of itself, and allowed him to enter, and thus place his charge beneath the dome of the sepulchre.

From this time no more is heard of the true cross, which may have been destroyed by the Saracens on their conquest of Jerusalem, A.D. 637. The wooden title, however, is said to be still preserved in Rome, not entire, indeed, for only diminutive fragments remain of the Hebrew letters, so that no one can say what in reality the characters are. The Greek and Latin, excepting the letter Z, are both written after the Eastern manner, from right to left. This is said to have happened either because they were written by a Jew, following a national custom, or from a desire on the part of the writer, if a Roman, to accommodate himself to what was usual among the Jews. Nicetus (*Titulus Sanct. Crucis*) holds that it is not all the work of one hand, since the Roman letters are firmly and distinctly cut, but the Greek letters very badly. He thinks that a Jew cut the Hebrew (or Aramæan) and Greek, and a Roman the Latin. All that remains of the Greek is Ναζαρενους β, of the Latin, *Nazarenus*. It is somewhat extraordinary that there should appear in the sole Greek word, what some have thought two mistakes, namely, ε for η, a short for a long *e*; and the termination ους for ος. The history of the discovery of this title is worthy of a brief notice. When sent by Constantine to Rome, it was deposited in a leaden chest, above the vaulted roof of the Church Sta. Croce, in a little window, and then bricked into the wall; its position being recorded in a mosaic inscription without. Time rendered the inscription almost illegible; and the window, owing to the carelessness of workmen engaged in repairing the church, was accidentally broken open, when the holy relic was discovered. This discovery, and the genuineness of the title, Alexander III. authenticated by a bull. The letters found on the title, if taken according to their numerical value, make 1532, a circumstance which led Stifelius to fix that as the year for the termination of the world. Cross.

Jortin has, in his own manner (*Remarks*, vol. iii.) discussed the evidence which bears on the discovery and genuineness of the cross, to which discussion those who desire satisfaction may refer. One or two remarks seem required in this place. None of the authorities give a close description of the three crosses said to have been found in the rubbish under the temple of Venus, which is the less surprising, since they were not eye-witnesses. The three crosses, it appears, were very much alike, and nothing short of miracles could distinguish that of the Saviour. That the crosses were of wood, all declare, but no one states the peculiar kind of wood; nor is any mention found in the four historians of the tradition, which may be traced back to the days of Chrysostom, that the true cross consisted of three kinds, cypress, pine, and cedar, or of four kinds, cedar, cypress, palm, and olive.

> Quatuor ex lignis Domini crux dicitur esse;—
> Pes crucis est cedrus; corpus tenet alta cupressus;
> Palma manus retinet; titulo lætatur oliva.

Lipsius (*De Cruce*) supposes that the cross was made of oak, since it is likely it would be constructed of such wood as was most abundant, and therefore probably nearest at hand, and oak grew plentifully in Judæa: the relics too are said to resemble oak.

According to Ambrosius (*Oratio de Obitu Theodor.* p. 498), the piece which bore the title stood on the top of the cross of our Lord (John xix. 19-22; comp. Matt. xxvii. 37; Mark xv. 26; Luke xxiii. 38): the form would be somewhat thus  . This fact would lead to the expectation of more accurate information from those who are said to have found the cross. The language of the scriptural writers seems to imply that it was only on the cross of Jesus that a title was placed; and it does not therefore appear to be a case in which human sagacity could have been so wholly at a loss as the accounts imply; yet Rufinus says, *Hic jam humanæ ambiguitatis incertum, divinum flagitat testimonium.* Probably a divine testimony was required by other considerations than such as arose from the essential ambiguity of the case. But the conduct of Helena in dividing the cross, setting aside one part for Jerusalem, another for Constantinople, and another as a phylacterion for her son, and the subdivisions thereof, which subsequently took place, rendered it impossible to ascertain in any satisfactory manner, not only whether the alleged was the real cross, but also of what wood and in what shape it had been made.

This only then as to the shape of the Saviour's cross can be determined, that the prevalent form was that of the crux capitata, and that this form is generally found on coins and in the so-called monogram (Munter's *Sinnbilder*, I. iv.)

Much time and trouble have been wasted in disputing as to whether three or four nails were used in fastening the Lord to his cross. Nonnus affirms that three only were used, in which he is followed by Gregory Nazianzen. The more general belief gives four nails, an opinion supported at much length by Curtius, an Augustine friar, who wrote a treatise *De Clavis Dominicis*, in the beginning of the seventeenth century. Others have carried the number of nails so high as fourteen. Of the four original nails, the Empress Helena is reported to have thrown one into the Adriatic, when furiously raging, thereby producing an instant calm. The second is said to have been put by Constantine into

Cross. either his helmet or crown. This nail, however, was afterwards to be found in a mutilated state in the church of Sta. Croce. In the Duomo of Milan is a third nail, which Eutropius affirms was driven through one of Jesus' hands, and which Constantine used as a bit, intending thereby to verify the prophecy of Zechariah (xiv. 20): "In that day shall be upon the bells (margin, *bridles*) of the horses, *Holiness unto the Lord.*" Trèves possesses the fourth nail, which is alleged to have been driven through the sufferer's right foot. Those who maintain the number of nails to have been more than four have had no difficulty in finding as many nails as their hypothesis in each case needed, and as many sacred places for their safe keeping.

Crosses in former times were usually erected on the tops of houses, by which tenants pretended to claim the privileges of the Templars hospitallers, to defend themselves against their rightful lords. But this was condemned by the statute Will. II., cap. 37. It was formerly the custom also to set up crosses in places where the corpse of any of the nobility rested as it was carried to be buried, that *a transeuntibus pro animo ejus deprecentur*. It is worthy of remark that crosses are forbidden, by 13th Eliz. cap. 2, to be brought into England, on pain of a *præmunire*.

Cross, Invention of the, an ancient feast solemnized on the 3d of May, in memory of St Helena, the mother of Constantine, finding the true cross of Christ deep in the ground on Mount Calvary, where she erected a church for the preservation of part of it. The remainder was brought to Rome, and deposited in the church of Sta. Croce in Gerusalemme. (*Vide supra*, under Cross.)

Cross, Exaltation of the, an ancient feast held on the 14th of September, in memory of the restoration to Mount Calvary, in 628, of the true cross, which had been carried off 14 years before by Chosroes II., king of Persia. (*Vide supra*, under Cross.)

The adoration of the cross appears to have been practised in the ancient church; for the heathens, particularly Julian, reproach the primitive Christians with this species of idolatry, and we do not find that their apologists disclaim the charge. Mornay indeed asserted that this had been done by St Cyril, but could not support his allegation at the conference of Fontainebleau. St Helena is said to have reduced the adoration of the cross to its just principle, since she worshipped in the wood not the wood itself, but him who had been nailed to this wood. With such modifications some Protestants have been induced to admit the adoration of the cross. John Huss allowed the phrase, provided it were expressly added, that the adoration was relative solely to the person of Christ. But, however Roman Catholics may seem to triumph in virtue of such distinctions, it is well known that these have no great place in their own practice. Imbert, the good prior of Gascony, was severely prosecuted in 1683 for telling the people that in the ceremony of adoring the cross practised in that church on Good Friday, they were not to adore the wood, but Christ who was crucified on it. The curate of the parish, however, told them the contrary, affirming that it was the wood, and the wood only, they were to worship. Imbert replied, it was Christ, not the wood; and for this he was cited before the Archbishop of Bordeaux, suspended from his functions, and threatened with chains and perpetual imprisonment. It little availed him to cite the Bishop of Meaux's distinction; it was answered that the church allowed it not.

Cross-Bearer (*porte-croix, cruciger*), in the Romish Church, the chaplain of an archbishop or a primate, who bears a cross before him on solemn occasions.

The pope has the cross borne before him on all public occasions; a patriarch anywhere out of Rome; as have also primates, metropolitans, and those who have a right to the pallium, throughout their respective jurisdictions. Gregory XI. forbade all patriarchs and prelates to have it borne in presence of cardinals. A prelate bears a single cross, a patriarch a double cross, and the pope a triple one on his arms.

Cross || Crotch.

Cross-Bearers also denote certain officers in the inquisition, who make a vow before the inquisitors or their vicars to defend the catholic faith, though with the loss of fortune and life. Their business is to provide the inquisitors with necessaries; and they were formerly of great use; but in process of time their constitutions were changed, and they were called to undergo the penance of St Dominic.

Pectoral Cross, a cross of gold, silver, or other precious material, often enriched with diamonds, worn at the neck by bishops, archbishops, abbots, and regular abbesses.

Order of the Cross or *Crusade*, an order of ladies instituted in 1668 by the Empress Eleonora de Gonzagua, wife of the Emperor Leopold, in commemoration of the miraculous recovery of a little golden cross in which were inclosed two pieces of the true cross, from the ashes of part of the palace, which had been consumed. The sacred wood is said to have resisted the action of the flames, which burnt the case that inclosed it, and melted the crystal.

Cross, in *Heraldry*, an ordinary composed of fourfold lines, of which two are perpendicular, and the other two transverse. See Heraldry.

This bearing was first bestowed on such as had performed, or at least undertaken, some service for Christ and the Christian profession, such as an expedition to the Holy Land. In those expeditions the Scots carried a St Andrew's cross; the French, a cross argent; the English, a cross or; the Germans, a cross sable; the Italians, a cross azure; the Spaniards, a cross gules. The cross is held by some writers to be the most honourable charge in all heraldry.

St George's Cross, or the red cross, in a field argent, is now the standard of England; that saint being the reputed patron of this nation.

Not only in crosses is the variety very great; the same is observable in many other bearings, and particularly in lions, and in parts of lions, of which Columbière notices no less than 96 varieties. Leigh mentions 46 different crosses; Sylvanus Morgan, 26; Upton, 30; Johannes de Bado Aureo, 12; and so on.

CROSS-BOW. See Bow.

CROSS-TREES, in a ship, pieces of oak timber, supported by the cheeks and trestle-trees, at the upper ends of the lower and top masts, to sustain the frame of the tops in the one, and to extend the top-gallant shrouds on the other.

CROTALUM, an ancient instrument of the castanet kind, and which, by some writers, has erroneously been supposed to be the same with the sistrum. The crotalum consisted of two little plates of metal, and sometimes of two shells, or was formed of a piece of reed split lengthwise; and these were held in the hand and shaken so as to produce a rattling noise.

Female dancers who used the crotalum were termed *crotalistriæ*. Aristophanes uses the word crotalum metaphorically, to signify a great talker.

Clemens Alexandrinus attributes the invention to the Silicians, and forbids the use of it among Christians, on account of the indecent gestures with which it was accompanied.

CROTALUS, the Rattlesnake. See Serpents.

CROTCH, William, Doctor of Music, was born at Norwich, on 5th July 1775, and died suddenly at Taunton on 29th December 1847, in the house of his son, the Rev. W. R. Crotch. When only three years and a half old, he was able to play tunes with their basses on the organ with great correctness. Dr Charles Burney, the English historian of music, gave an interesting account of the infant Crotch in the Philosophical Transactions of the Royal Society, vol. lx., part i., for 1779. Crotch also exhi-

Crotchet || Croton.

bited in his infancy a talent for drawing, which he afterwards cultivated so far as to become a very respectable amateur painter of landscapes. At the early age of twenty-two he was appointed professor of music in the university of Oxford, and there in 1799 took his degree of doctor in that art. In 1800, and the four following years, he read lectures on music at Oxford. Next he was appointed lecturer on music to the Royal Institution; and, subsequently, in 1823, principal of the London Royal Academy of Music. He published a number of vocal and instrumental compositions, of which the best is his Oratorio of "Palestine." In 1831 appeared an 8vo volume containing the substance of his lectures on music, delivered at Oxford and in London. Previously, he had published three volumes of "Specimens of various styles of Music," referred to in his lectures. Among his didactic works is "Elements of musical composition and thorough-bass." London, 1812. He arranged for the pianoforte a number of Handel's Oratorios and Operas, besides symphonies and quartets of Haydn, Mozart, and Beethoven. The great expectations excited by his infant precocity were not fulfilled; for he manifested no extraordinary genius for musical composition. But he was a hard student and a sound musician, and justly holds a high place among English cultivators of his art. He performed all his public duties laboriously, zealously, and honourably; and in private life was much beloved and respected. (G. F. G.)

CROTCHET, in *Music*, a note or character equal in time to half a minim, or two quavers.

CROTCHETS, in *Printing*, marks or characters serving to inclose a word or sentence distinguished from the rest: thus [ ].

CROTON or CROTONA (COTRONE), in *Ancient Geography*, a celebrated city of Magna Græcia, at the mouth of the small river Æsarus, in the country of the Bruttii, on the western shore of the Ionian Sea. It was founded in the year 710 B.C. by a colony of Achæans under the command of Myscellus, in accordance with a decree of the oracle at Delphi.

The first well established fact in the history of Crotona is the friendship that subsisted between it and the rival city of Sybaris. Till the arrival of the philosopher Pythagoras these two cities continued advancing in material prosperity, and cultivating the arts of war and peace with much success. The Crotoniats were renowned for their skill in all athletic exercises; the Sybarites for that luxury and effeminacy which has made their name proverbial. The government of Crotona, oligarchical in form, had hitherto been confined to the council of one thousand, who traced their descent from the Achæan founders of the city. But Pythagoras introduced great political changes, with the details of which we are not acquainted. A secret society of 300 of his disciples contrived to guide, and even overawe, the deliberations of the supreme council. The people, who were carefully excluded from all share in the government, rose in rebellion against the Pythagoreans, expelled them from the city, and established a democracy. Confusion spread through all the south of Italy, and was heightened by the overthrow of Sybaris. Under the command of the celebrated athlete Milo, the Crotoniats marched against that city, and though opposed by an army three times their own in number, took it and levelled it with the ground. This event took place in 510 B.C. Before 30 years had elapsed, the Crotoniats themselves sustained a still more disgraceful defeat from the united forces of the Locrians and Rheggians, which however, was not attended with such disastrous consequences to their city. This event is referred by the best authorities to the year 480 B.C. During the Athenian invasion of Sicily, the people of Crotona refused to side with either of the contending parties; they supplied the Athenians with provisions, but refused to allow them a passage through their territory. In 389 B.C. Crotona fell into the hands of the elder Dionysius, who retained possession of it for twelve years; but on his death at the end of that period it recovered its independence. The prosperity of the city, however, was greatly impaired by the intestine feuds which raged within its walls, and the growing power of external foes. Being hard-pressed by the Bruttians, Crotona applied to the Syracusans for assistance. Succours were sent by that people, but the Crotoniats were obliged to conclude a treaty with the Bruttii, as they were now in danger from their own exiles. Menedemus, their general, defeated the exiles, and established a tyrannis which lasted for some time. In the beginning of the third century B.C., the city fell into the hands of Agathocles, who retained it for some years; and in the wars of the Romans with Pyrrhus it suffered so severely, that whereas its walls had formerly inclosed a space of 12 miles in circumference, not half of that extent was now inhabited. In the absence of Pyrrhus in Sicily, Crotona fell into the hands of the Roman consul, Cornelius Rufinus, B.C. 277. During the latter years of the second Punic war, Crotona was the headquarters of Hannibal for three successive winters. This completed the ruin of the town, which a few years after was colonized from Rome. From this time Crotona sank into total obscurity, and is not mentioned again in Roman history till the wars of Narses and Belisarius against the Goths. After that it remained subject to the Byzantine emperors till it passed into the hands of the Normans.

Croton Oil.

Crotona was celebrated in ancient times for the excellence of its situation, to which was attributed the beauty of its women and the strength of its men. Milo, the most famous athlete of antiquity, was a native of Crotona. The medical school of Crotona was, in the days of Herodotus, and long after, the most renowned in Greece. The most celebrated physician of that school was Alcmæon. It is not known whether Crotona was remarkable in an architectural point of view. But the temple of Lacinian Juno, six miles from the city, was the most sacred and magnificent work of that kind in the whole of Magna Græcia, and contained, among other ornaments, one of the masterpieces of Zeuxis. Some fragments of this great edifice are still visible.

About a mile from the site of the old Crotona stands the modern town of Cotrone, an insignificant place. It is strongly fortified, however, and contains a population of about 6000 souls.

CROTON OIL is expressed from the seeds of an euphorbiaceous shrub, the *Croton tiglium*, a native of Hindustan and of the warmer parts of Asia. The fruit is about the size of a hazel nut, of an ovate triangular shape, and containing three ovate seeds about the size of a pea. The kernels of these yield, on pressure, about 50 per cent. of oil, which is of a pale amber colour, and a thickish consistence like castor oil. It has no odour, but has a peculiar acrid taste, which is felt most strongly in the back of the palate and throat. Croton oil is a speedy, powerful, and sure cathartic, in small doses of one to three drops; and it possesses two valuable properties, 1st, that however active and powerful the purgative action may be, it soon ceases, and leaves little or no debility; and, 2d, that it excites the billiary secretion more powerfully than any known medicine. In consequence of one or two drops being a dose, and its action commencing very shortly after its administration, it is invaluable in impending apoplexy, and in almost all diseases in which torpor or paralysis exists. In hydrocephalus, even when effusion of water on the brain appears to have taken place, the late Dr Abercrombie stated that it would often bring about the recovery of the patient. It is a medicine which deserves far more attention than it has yet received. (J. S—K.)

CROUP, a specific inflammatory affection of the larynx

Crousaz. and trachea (windpipe), giving rise to a peculiar secretion which concretes as soon as it is thrown out, and forms a false membrane which blocks up the air tube, and produces rapid death by suffocation. This disease is peculiar to children from a few months old to the age of 12 years; and is most common in damp low-lying situations, in the neighbourhood of the sea, of marshes, or of rivers. It makes its appearance suddenly during the night. The child goes to bed apparently in perfect health. After he has been asleep for a few hours he is heard to give an occasional cough of a peculiar ringing character, as if he had coughed through a brass trumpet. The cough rapidly becomes more frequent, with an increasing difficulty of breathing, accompanied by a peculiar crowing and wheezing noise at each inspiration; the voice becomes rough and hoarse, the child restless and feverish, the face flushed, and with an excited anxious expression; he complains of uneasiness in the throat, and says he is choking. The difficulty of breathing rapidly increases, and great efforts are made by the child to dilate the chest in order to get breath; the air is drawn into the lungs with extreme difficulty, as if by a piston, and through a very narrow apertue, and the crowing sound is audible at a considerable distance. Sometimes these symptoms, if not very severe, subside after midnight, to return the next night; but if severe, unless the child be promptly relieved, the disease will rapidly terminate fatally.

As soon as the disease is noticed, the child ought to be put into a hot bath, and kept there for ten minutes, or even until slight faintness is experienced. Simultaneously, or while this bath is getting ready, an emetic ought to be administered; and by far the best for this purpose is the sulphate of copper, in doses of two or three grains, dissolved in a little hot water. If this be not at hand, an emetic of ipecacuan or of antimony may be substituted; and in any case the emetic should be repeated at intervals of half-an-hour or an hour, according to circumstances, till the child is somewhat relieved. Immediately after the vomiting is over, calomel in half-grain or one-grain doses should be given every second hour till the symptoms yield, and the breathing becomes free and natural. In very severe cases it is useful to blister the throat; and by far the most efficacious and speedy way of accomplishing this is to rub the nitrate of silver over the whole course of the windpipe. Bloodletting, in all its forms, is a dangerous remedy (though very generally recommended), as, unless it removes the disease at the moment, which it very rarely does, it increases the tendency to the formation of the false membrane in the windpipe. (J. S—K.)

CROUSAZ, JEAN PIERRE DE, an eminent mathematician, was born at Lausanne April 13, 1663. He was a Protestant of noble extraction, and was destined by his father for the profession of arms, but preferred the more tranquil pursuit of letters. He applied himself particularly to the study of the mathematics, and became a warm partizan of the Cartesian philosophy. After some time spent in travelling, he returned to his native place, where he was successively appointed pastor, professor of philosophy, and rector of the academy. In 1724, he was called to Groningen to teach mathematics, and appointed governor to the young prince Frederick of Hesse-Cassel. The king of Sweden also conferred upon him the title of counsellor of embassies. Crousaz died March 22, 1750, at which time he was a member of the Academy of Bordeaux, and foreign associate of the Academy of Sciences at Paris.

His works are exceedingly voluminous, but seldom rise above mediocrity. The most important are *Système des Réflexions qui peuvent contribuer à la netteté et à l'étude de nos Connoissances, ou nouvel Essai de Logique*, Amsterdam, 1712, 2 vols. 8vo; *Traité de Beau, où l'on montre en quoi consiste ce qui l'on nomme ainsi*, Amsterdam, 1715, 8vo; *De l'Education des Enfans*, Hague, 1722, 2 vols. 12mo; *Examen du Traité de la Liberté de Penser d'Antoine Collins*, Brussels, 1715, Amsterdam, 1718, 8vo; *Géométrie des Lignes et des Surfaces rectilignes et circulaires*, Amsterdam, 1718, 2 vols. 8vo; *Examen du Pyrrhonisme ancien et moderne*, Hague, 1733, fol.; *Œuvres diverses*, 1737, 2 vols. 8vo; *Traité de l'Esprit Humain*, against Wolff and Leibnitz, 1741; *Réflexions sur la belle Wolfienne*, Lausanne, 1743, 8vo.

Crow || Crown.

CROW. See index to ORNITHOLOGY.

CROW, in *Mechanics*, a bar of iron with a claw at one end and pointed at the other, used as a lever for raising great weights, &c.

Crow's-Bill, in *Surgery*, a kind of forceps for extracting bullets, &c., from wounds.

Crow's-Feet, in the military art. See CALTROP.

CROWLAND, or CROULAND, an ancient town and parish of Lincolnshire, situated in a low flat district, about eight miles N.E. from Peterborough. It stands at the confluence of the Welland with two smaller streams; and at their junction there is a curious triangular bridge, built in the reign of Edward II., which is, however, passable only on foot. There are also several interesting remains of a famous mitred abbey, which was built about the end of the eleventh century on the site of an ancient Anglo-Saxon monastery, destroyed by the Danes. Among its abbots was the historian Ingulphus. Pop. 2466.

CROWN (Ger. *krone*, Fr. *couronne*, Lat. *corona*), an ornament worn on the head by kings and sovereign princes, as a badge of their dignity.

Crowns are often mentioned in Scripture; but the term "crown" appears to have been applied to other ornaments for the head than those exclusively worn by royal personages, and to which modern usage would give such distinctive names as coronet, band, mitre, tiara, garland, &c. For example, the mitre of the Jewish high priest—which was a tiara with the addition of a golden fillet—is also called a "crown." This circumstance serves to explain the use of the term as applied to the ornament worn on the head by the inferior priests, and even by private persons among the Israelites, since the Jews and several Eastern nations were accustomed to bind their hair with a ribbon or fillet, to prevent it falling over the face.

The regal crown originated in the diadem, which was a simple fillet fastened round the head and tied behind, as we still see it represented on ancient medals around the heads of Jupiter, the Ptolemies, and the kings of Syria. Kings, however, were generally distinguished by a fillet of a different colour from that usually worn,—as, for instance, by a golden band. In this shape it sometimes forms the basis of raised ornamental work, in which case it becomes what would commonly be considered a crown; and, indeed, the original diadem may be traced in most ancient crowns.

The Roman emperors had four kinds of crowns, which are still seen on medals; namely, a crown of laurels, a radial or radiating crown, a crown adorned with pearls and precious stones, and a kind of bonnet or cap, somewhat like the mortier.

The Romans had also various kinds of crowns which were bestowed as the rewards of military achievements, and others which were used in festive and funeral decorations, &c. Of these, the most important were the following:—

Corona Obsidionalis, or *Graminea*, which conferred the highest honour, was the reward of a general who had delivered the Roman army from a blockade. It was composed of grass or weeds that grew on the spot; in allusion to a very ancient custom, by which the vanquished party in a contest of strength or agility acknowledged defeat by presenting to the victor a handful of grass torn up from the place where the contest took place.

Crown || Croydon.

Corona Civica, the second in honour, was a garland of oak leaves presented to him who had saved the life of a citizen in battle. This conferred on the possessor extraordinary privileges, as noticed under the head Civic Crown.

Corona Navalis, or *Rostrata*, awarded to him who first boarded the ship of an enemy, was a circle of gold decorated with the *rostra* or beaks of ships, and sometimes with representations of the entire prow. It would seem that this reward, when bestowed for any extraordinary achievement—as on a commander who had destroyed a whole fleet or gained a very signal victory—was called *Corona Classica*.

Corona Muralis, a circle of gold, indented and embattled, or decorated with turrets, was bestowed on him who first scaled the walls of a besieged place, and was regarded as one of the highest of military honours.

Corona Vallaris, or *Castrensis*, a crown of gold ornamented with palisades, formed the reward of him who was the first to force an entrenchment.

Corona Triumphalis, a mark of honour conferred, as its name implies, on a victorious commander. Triumphal crowns were of three kinds. The first in dignity, and hence termed *laurea insignis*, was composed of laurel or of bay leaves. The second kind, made of massy gold, and frequently enriched with jewels, was held over the head of the commander during his triumph. These crowns were presented to the victorious general by the army. The third kind, called *aurum coronarium*, was originally a golden crown of great value, which was sent as a present from the provinces to a commander to whom the honour of a triumph had been decreed; but in time this came to be exacted as a tribute, and eventually was commuted into a sum of money. See Aurum Coronarium.

Corona Ovalis, composed of myrtle leaves, was bestowed upon a commander who was entitled to the honours of a lesser triumph, called *ovatio*.

Besides these, there were various other *coronæ*, of which the following may be mentioned: the *corona aurea*, often bestowed on soldiers without any particular designation; athletic crowns, and crowns of laurel, bestowed on victors at the public games, poets, orators, and others. Lastly may be noticed the *corona radiata*, which was given to gods and deified heroes, and assumed by some of the emperors (as mentioned above) as a mark of their divinity. This kind of crown may be seen impressed on some of their coins.

The use of crowns as rewards among the Greeks, in the early period of their history, was chiefly confined to those given as prizes in the athletic contests; but previous to the time of Alexander the Great crowns had become so common, and were so indiscriminately conferred, as to lose much of their value as marks of honourable distinction.

Crown, in an ecclesiastical sense, is used to denote the clerical tonsure of the Roman Catholics. This is a little circle of hair shaved off from the crown of the head, more or less broad, according to the quality of the orders received; that of a mere clerk being the smallest, and that of priests and monks the largest. The clerical crown was anciently made in imitation of a fillet, by shaving off a portion of hair around the head. This may be seen in several ancient statues and monuments. The orders of St Dominic and St Francis still retain it. See Tonsure.

Crown, in *Astronomy*, a name given to two constellations, the southern and the northern.

Crown, in *Geometry*, a plane ring included between two parallel or concentric peripheries of unequal circles.

Crown-Office. See Coroner.

CROYDON, a town and parish of England, in the county of Surrey and hundred of Wallington, nine miles south of London. It stands near the source of the river Wandle, and is supposed to be the *Novismagus* of the Antonine Itinerary, and the *Croinedone* of Domesday Book. In the neighbourhood there are distinct traces of Roman occupation, and several gold coins bearing the stamp of the later emperors have been found. A cluster of twenty-five *tumuli* between the town and Addington Park, and a circular encampment with a double moat, form the most interesting portion of the remains. The manor of Croydon, originally presented to Archbishop Lanfranc, remained till within a recent period the residence of the primates of Canterbury; but it is now converted into a factory, and the grounds are used as a bleachfield. The new town of Croydon consists principally of a well-built street stretching along the road to Brighton. The principal buildings are the parish church (containing several sumptuous tombs of the primates) and the town-hall. There are places of worship for the various bodies of dissenters, numerous schools, a literary institute, and an ancient hospital founded by Whitgift. About a mile distant is the East India Company's military college at Addiscombe. Croydon is the seat of a county court, and of the assizes alternately with Guildford. Its site is remarkable for the number of springs which issue from the soil. One of these, called the "Bourne," bursts forth a short way above the town at irregular intervals of from one to ten years or more; and after running as a torrent for two or three months, it as quickly vanishes. This phenomenon seems to arise from extensive falls of rain over the chalk-hills of the district, which sink into the porous soil and reappear after a considerable interval from crevices at lower levels. Croydon was visited with a remarkably fatal fever in 1852. Pop. 10,260.

Crown || Cruden.

CROZOPHORA, a genus of rubiaceous plants, the best known of which is *C. tinctoria*, a native of the south of Europe, which affords the deep purple dye called at Montpellier *tournesole*. The plant is acrid, emetic, and purgative.

CRUCIBLE, a chemical vessel for containing substances to be exposed to a high temperature. They are formed either of an apyrous clay, or of a mixture of that with plumbago, and sometimes of platina or other metals not easily fusible. See Chemistry.

CRUCIFERÆ. See index to Botany.

CRUCIFIX, a cross on which the body of Christ is fastened in effigy, and which holds a conspicuous place in the religion of the Roman Catholics.

CRUCIFIXION, a mode of inflicting the punishment of death by affixing the criminal to a cross. This kind of punishment was frequent among the ancients; but in recent times it has been confined chiefly to the Mohammedans. On receiving sentence of condemnation, the criminal was scourged, by way of prelude to the cruel death he was doomed to die. He then carried his cross, or at least the transverse beam, to the place of execution, where he was stripped naked, and affixed to the cross by means of iron nails driven through each hand and foot, or through the wrists and ankles; and the arms and legs were sometimes bound with cords. When the criminal, instead of being nailed to the cross, was bound to it by cords, this was designed as a more cruel, because a more lingering, punishment. Crucifixion with the head downwards (the mode in which St Peter is said to have chosen to suffer, as unworthy of the same kind of death as his Master) may be considered as a refinement on this barbarous species of punishment. See Cross.

CRUDEN, Alexander, the well-known author of the English *Concordance*, was born at Aberdeen in 1701. Having removed to London in 1728, he set up a bookseller's shop in the Royal Exchange, and supported himself by correcting the press. He was subject to occasional fits of derangement, and died in a lunatic asylum at Islington, Nov. 1, 1770. In addition to the Concordance, Cruden compiled an index to Milton, appended to Bishop Newton's edition of that poet.

CRUSADES,

Crusades. A NAME given to the military expeditions undertaken by the Christians of Europe for the deliverance of the Holy Land from the dominion of the Saracens and Turks.

About seventy years after the death of Christ, Jerusalem was taken and destroyed by Titus. But, sixty years afterwards, the city was rebuilt by Hadrian, and the Christians were permitted to return to it. Their establishment, however, existing only by a precarious tolerance, was by no means flourishing, till Constantine embraced the Christian faith, and declared it the religion of the empire. This auspicious change, as might have been expected, greatly improved their condition; and when the Empress Helena visited Jerusalem, this princess, having ordered the places which had been signalized by evangelical events to be cleared of rubbish, caused the most hallowed spots to be inclosed within the walls of a spacious church. But, in the latter days of the empire, as knowledge declined, superstition advanced, and the feelings of reverence originally inspired by Christianity itself were transferred to the material and visible objects with which the principal events in the life of its great founder were associated. Hence, among zealous but ignorant Christians a strong desire was excited to visit the scenes of our Saviour's miracles and passion; and pilgrimages to Palestine accordingly became a frequent, because they were considered as a meritorious practice, throughout the whole of Christendom. In the year 637, Jerusalem was taken by the Saracens; but either from indifference regarding observances which they despised, or from motives of immediate interest, the resort of pilgrims to Jerusalem was not interdicted nor discountenanced by these conquerors. This toleration however ceased when the Turks, in the year 1063, got possession of the holy city. That wild, fierce, and fanatical horde, though superior in force and military prowess, were yet immeasurably inferior in civilization, to the people whom they had expelled; and as they made no scruple to plunder and insult their Christian visitors, the dangers of the pilgrimage, painted in the darkest colours by those who had returned, began to threaten a discontinuance of what was then considered as a sacred duty. But a strong revulsion of feeling was ere long produced. Terror yielded to the fiercest indignation, and religious enthusiasm, blending itself with the martial spirit of the age, produced and stamped upon the general mind that adventurous character which ultimately led to these memorable expeditions. About this time, too, an opinion prevailed in Europe, which tended much to inflame the desire to visit the Holy Land. It was believed that the thousand years mentioned in the twentieth chapter of the Revelations were fulfilled; that Christ would soon make his second appearance in Palestine to judge the world; and that journeys to that country were consequently in the highest degree meritorious, if not even absolutely necessary. Accordingly, multitudes of pilgrims flocked to Palestine; and as these were systematically plundered and maltreated by the Turks, they on their return filled all Europe with complaints against the infidels who had profaned the holy city by their presence, and derided the sacred mysteries of Christianity even in the place where they were fulfilled. At this time Pope Gregory VII. had formed a design of uniting all the princes of Christendom against the Mahommedans; but his exorbitant encroachments upon the civil power of princes had created him so many enemies, and rendered his schemes so suspicious, that he was unable to make any considerable progress in the undertaking. The work was reserved for a meaner instrument.

These memorable expeditions commenced in the year 1096. Peter, commonly called the Hermit, a native of Amiens, in Picardy, had made the pilgrimage to Jerusalem; and, being deeply affected with the dangers to which that act of devotion exposed the pilgrims, as well as with the oppression under which the eastern Christians groaned, he formed the bold, and, to all appearance, impracticable design of leading into Asia, from the farthest extremities of the West, armies sufficient to subdue the warlike nations by whom the Holy Land was now held in subjection. He proposed his scheme to Urban II., who then filled the papal chair; but this pope, though apparently sensible of the advantages which would accrue to himself from such an undertaking, resolved not to interpose his authority until he saw a greater probability of success. He therefore summoned at Placentia a council, consisting of four thousand ecclesiastics and thirty thousand laymen; and as no hall could be found large enough to contain so great a multitude, the assembly was held on a plain. Here the pope himself, as well as Peter, harangued the people, representing the dismal situation of their brethren in the East, and the indignity offered to the Christian name in allowing the holy city to remain in the hands of the infidels. These speeches were so agreeable to those who heard them, that the whole multitude suddenly and vehemently declared for war, and solemnly devoted themselves to perform this service, which they believed to be highly meritorious in the sight of God. Crusades.

But though Italy seemed to embrace the design with ardour, yet the pontiff thought it necessary, in order to insure perfect success, to engage the greater and more warlike nations in the same enterprise. Having therefore exhorted Peter to visit the chief cities and sovereigns of Christendom, he summoned another council at Clermont, in Auvergne. The fame of this mighty and pious design being now universally diffused, the greatest prelates, nobles, and princes attended; and when the pope and the hermit renewed their pathetic exhortations, the whole assembly, as if impelled by an immediate inspiration, exclaimed with one voice, "It is the will of God; it is the will of God." These words were deemed so memorable, and considered so much the effect of a divine impulse, that they were employed as the signal of rendezvous and battle in all the future exploits of the crusaders. Men of every rank now flew to arms with the utmost ardour; a cross was affixed to the right shoulder by all who enlisted in the holy enterprise; and the projected expedition was denominated a *crusade*.

At this time Europe was sunk in the most profound ignorance and superstition. The ecclesiastics had gained a complete ascendant over the human mind; and the people, who committed the most horrid crimes and disorders, knew of no other expiation for their sins than the observances imposed upon them by their spiritual pastors. But amidst the abject superstition which then prevailed, the military spirit had also universally diffused itself; and, though supported neither by art nor by discipline, it had become the general passion of the nations governed by the feudal law. All the great lords possessed the right of peace and war. They were engaged in almost continual hostilities;—the open country had become a scene of outrage and disorder;—and the cities, being still mean and poor, were neither guarded by walls nor protected by privileges. Every man was obliged to depend for safety upon his own force or his private alliances; and valour was the only quality held in

Crusades. esteem, or which gave one man a pre-eminence above another. When all the superstitions. therefore, were united in one great object, the ardour for military adventure took the same direction; and the whole of Europe, as the Princess Anna Comnena expresses herself, torn from its foundations, seemed ready to precipitate itself in one united body upon Asia.

As all orders of men now deemed the crusades the only road to heaven, they became impatient to open the way with their swords to the holy city. Nobles, artisans, peasants, and even priests, inrolled their names; and to decline this service was to incur the reproach of impiety or cowardice, probably of both. The nobles who enlisted themselves were moved by the romantic spirit of the age to hope for opulent establishments in the East, which was at that time the chief seat of arts and commerce; and in pursuit of these chimerical projects, they sold at the lowest price their ancient castles and inheritances, which indeed had by this time lost all value in their eyes. The infirm and the aged contributed to the expedition by presents and money; whilst many of them, not satisfied with this, attended it in person, being determined, if possible, to breathe their last in sight of that city where Jesus Christ had died for the human race. Even women, having concealed their sex under the disguise of armour, attended the camp; and, as is said, forgot their duty still more, by prostituting themselves to the army. The greatest criminals were forward in a service which they considered as an expiation of their crimes; and, during the course of these expeditions, the most enormous disorders were committed by men inured to wickedness, encouraged by example, and impelled by necessity. The multitude of adventurers soon increased so greatly, that their more sagacious leaders became apprehensive lest the vastness of the armament should cause the ruin of the enterprise. For this reason they permitted an undisciplined multitude, computed at three hundred thousand men, to go before them under the command of Peter the Hermit, and Gaultier or Walter, surnamed the Moneyless, from his being a soldier of fortune. These took the road through Hungary and Bulgaria towards Constantinople; and trusting that heaven, by supernatural assistance, would supply all their necessities, they made no provision for subsistence on their march. But they soon found themselves obliged to obtain by plunder what they had vainly expected from miracles; so that the enraged inhabitants of the countries through which they passed attacked the disorderly multitude, and slaughtered them almost without resistance. The more disciplined armies followed after; and, having passed the strait of Constantinople, they were mustered in the plains of Asia, to the amount of nearly seven hundred thousand men.

The first crusade, as already mentioned, occurred in the year 1096 The princes engaged in it were Hugo, count of Vermandois, brother of Philip I. king of France; Robert, duke of Normandy; Robert, earl of Flanders; Raymond, earl of Toulouse; Godefroy of Bouillon, duke of Lorrain, with his brothers Baldwin and Eustace; Stephen, earl of Chartres and Blois; Hugo, count of St Paul; with a great number of other lords. The general rendezvous, as above stated, was at Constantinople. Having besieged and taken Nice, and defeated Solyman, in 1097, the crusaders under Godefroy proceeded eastward, where Baldwin conquered Edessa, and erected it into a principality. In the end of 1098 they took the town, but not the citadel, of Antioch, and defeated an army of six hundred thousand Saracens which had advanced to the relief of the latter. In 1099 they advanced to Jerusalem, with little more than a twentieth part of their original number, and, after a siege of forty days, carried it by storm, putting all its inhabitants, except the Christians, to the sword. The victorious Godefroy was now raised to the throne of Jerusalem, and soon added security to his conquest by defeating the soldan of Egypt with an innumerable army on the plains of Askalon. But the heroic chief was deprived of the reward of his valour by a papal legate, who had been elected patriarch, and who contrived to unite the temporal with the spiritual power, leaving to Godefroy only the small principality of Jaffa, and some immunities in that of Jerusalem. The crusaders, seeing their object accomplished, now began to return to Europe, and the few who remained in the settlements of Jerusalem, Antioch, Edessa, and the Syrian Tripoli, were obliged to depend for defence against the Turks on the gradual accession of adventurers whom the fame of their exploits had attracted from Christendom. Thus terminated the first crusade. Crusades.

The second crusade, preached by Bernard, the founder of the monastic order of Bernardines, and undertaken in the year 1146, was headed by the Emperor Conrad III. and by Louis VII. king of France. Their united forces amounted to about three hundred thousand; but the emperor was defeated by the Turks near Iconium, and with difficulty escaped to Antioch; and, a short time afterwards, Louis suffered a similar reverse, having, through the disaffection of the Christians of Syria, been forced to raise the siege of Damascus, and compelled to witness the ruin of his army. The disastrous issue of these attempts for their relief only hastened the decline of the Christian principalities in Asia. Having defeated the army of Jerusalem at the battle of Tiberias, and made prisoner Guy of Lusignan, who then wore the crown, the soldan of Egypt entered the holy city as a conqueror in the year 1187.

The third crusade, undertaken in the year 1188, immediately followed the taking of Jerusalem by Saladin.[1] The princes engaged in this expedition were, the Emperor Frederick Barbarossa, and Frederick, duke of Suabia, his second son; Leopold, duke of Austria; Berthold, duke of Moravia; Herman, marquis of Baden; the Counts of Nassau, Thuringia, Missen, and Holland, and above sixty other princes of the empire; together with the Bishops of Besançon, Cambray, Munster, Osnaburg, Missen, Passau, Visburg, and several others. In this expedition the Emperor Frederick defeated the sultan of Iconium; but his son Frederick, having been joined by Guy of Lusignan, king of Jerusalem, in vain endeavoured to reduce St Jean d'Acre or Ptolemais. During these transactions Philip the Second of France, and Richard the First of England, joined the crusade, by which means the Christian army was raised to three hundred thousand fighting men. With this enormous force Ptolemais was again besieged, and, in spite of a very gallant resistance, taken; but Philip, unable to brook the real or affected superiority of his rival, quitted the Holy Land in disgust, and Richard had the undivided honour of defeating the mighty Saladin. His victory, however, was productive of nothing but glory. Reduced by the casualties of war, enfeebled by the influence of climate, and utterly paralysed by intestine broils, the army gradually melted away, and Richard Cœur de Lion, like the preceding leaders, returned to Europe, unaccompanied even by a remnant of his once mighty host. But on his way through Austria he was arrested and detained in prison until an immense ransom had been extracted from his subjects. Before his departure from Syria, however, he had concluded a peace with Saladin, who soon afterwards died.

The fourth crusade was undertaken in the year 1195,

[1] This is a corruption of *Salah-Eddin*, the true name of the soldan or sultan.

Crusades

by the Emperor Henry VI. after Saladin's death. In this expedition the Christians gained several battles over the infidels, took many towns, and were in a fair way of success, when the death of the emperor obliged them to quit the Holy Land, and return into Germany.

The fifth crusade was proclaimed by order of Pope Innocent III. in 1198. But those engaged in it made fruitless efforts for the recovery of the Holy Land; for, although John de Neule, who commanded the fleet equipped in Flanders, arrived at Ptolemais a little after Simon of Montfort, Reynard of Dampierre, and others, yet the plague having destroyed many of them, the rest either returned, or engaged in the petty quarrels of the Christian princes. In 1202, Baldwin, count of Flanders, collected an army to act against the Mahommedans, but commenced with the Christians of Greece. Having arrived at Constantinople during a disputed succession, he tempted one claimant to assassinate his rival, then dispatched the other by the hand of the executioner; and, having indulged his followers with the plunder of the city, seated himself on the throne of the eastern empire. In this splendid conquest the original object of the expedition was forgotten, and only a few knights passed over into Asia.

The sixth crusade commenced in 1228. On this occasion the Christians took the town of Damietta, but were afterwards forced to surrender it. The next year the Emperor Frederick made peace with the soldan of Egypt, brother of Saladin, for ten years, and obtained possession of Jerusalem by treaty. But the holy city was soon wrested from the Christians by a new enemy, namely, the Tartars, who fled before the irruption of Genghis Khan, and, having overrun all Judea, forced the crusaders to confine themselves to the maritime towns on the coast of Syria. About 1240, Richard, earl of Cornwall, and brother of Henry III. king of England, arrived in Palestine at the head of the English crusade; but finding it most advantageous to conclude a peace, he re-embarked, and steered towards Italy.

The seventh crusade was headed by Louis IX. commonly called St Louis, who in the year 1249 took the town of Damietta. But sickness having broken out in the Christian army, the king endeavoured to retreat. In this, however, he was unsuccessful; for being closely pursued by the Saracens, he was defeated and taken prisoner near Massoura, in 1250, along with nearly all his nobility. A truce was then agreed to for ten years, and the king and his followers were set at liberty upon the payment of a ransom.

The eighth crusade, undertaken in 1270, was headed by the same prince, who having embarked with an armament from the southern ports of his kingdom, landed in Africa, and encamped near the ruins of Carthage. But he was immediately surrounded and besieged by the Moors; a contagious distemper now attacked his troops, carrying off great numbers; and Louis, having himself caught it, died in the fifty-fifth year of his age. The king of Sicily, however, having arrived with a considerable fleet, and joined Philip the Bold, son and successor of Louis, the king of Tunis, after several engagements in which he was always worsted, sued for peace, which was granted upon conditions advantageous to the Christians; and after this both princes embarked for their own kingdoms. Prince Edward of England, who arrived at Tunis at the time of this treaty, sailed towards Ptolemais, where he landed with a small body of three hundred English and French, and prevented Bendokdar from laying siege to that place; but being obliged to quit Palestine in order to take possession of the crown of England, this crusade ended without contributing in any degree to the recovery of the Holy Land. In 1291, the town of Acre, or Ptolemais, was taken and plundered by the soldan of Egypt, and the Christians were driven entirely out of Syria.

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After this time there was no crusade, though several popes attempted to stir up the Christians to such an undertaking, particularly Nicholas IV. in 1292, and Clement V. in 1311. Indeed, long before the age of St Louis the appetite for holy wars had been greatly blunted in Europe, and, owing to the small number of recruits who arrived in Palestine, the Christian settlers were gradually led to intermarry with their Moslemin neighbours. The descendants of the crusaders consequently degenerated into a mongrel race, half Christian half Mahommedan, who ere long either forgot their pretensions to an European origin, or became altogether indifferent about the subject. After Tyre and Ptolemais had been wrested from them they soon became blended with the Mahommedan population of Syria, and not a vestige of the Christian conquest remained.

The foregoing sketch embraces but a faint and meagre outline of these memorable expeditions; but were the details to be filled in so as to constitute an expanded narrative, several volumes would be insufficient to contain it. What we have aimed at is merely to trace out in their order the leading facts, to indicate the prominent characteristics, and to mark the immediate results of each successive enterprise undertaken for the conquest of the Holy Land. Our object has been to direct the attention of the reader, in the first instance, to the events themselves, exclusively of all speculations either as to their general complexion, or the consequences, whether proximate or remote, of which they are supposed to have been productive. What still remains, in order to complete the design of the present article, is, first, to exhibit a general sketch of the grand picture presented by the crusades; and, secondly, to endeavour to estimate the influence which they exerted, both at the time and afterwards, on the state and condition of society.

I. The history of the middle ages presents no spectacle half so imposing as that of the expeditions undertaken for the recovery of the Holy Land from the Infidels. The picture which these exhibit is that of the people of Europe and Asia reciprocally armed against each other; that of two religions in fierce conflict for the mastery. By a sudden and extraordinary impulse, the West, formerly menaced by the Moslemins, and indeed exposed to their attacks, seemed to rise *en masse* in order to precipitate itself on Asia. Forgetful of their individual interests, sinking their mutual jealousies, and abandoning their ancient feuds, the nations of Europe, uniting in a common pursuit, fixed their eyes upon a single country as the only one upon earth worthy the ambition of conquerors. It might have been supposed indeed that the world contained no city but Jerusalem, and no country fit to be inhabited except that in which Jesus Christ had lived and taught, suffered and died. Every road leading to Palestine was drenched with blood, and along its dreary tract lay scattered at no distant intervals the skeletons and the wrecks of nations. In this general commotion the most sublime virtues were displayed in the midst of the most frightful disorders. The soldiers of the cross, animated with a supernatural enthusiasm, braved hunger and thirst, fatigue and disease, the influence of a deadly climate and the fury of exasperated enemies; in the greatest dangers, and amidst incessant disorders and excesses, nothing could shake their perseverance, nothing exhaust their resignation. After four years of toil, and misery, and victory, Jerusalem was conquered by the crusaders; but as their conquests were not the work of wisdom and prudence, but the fruit of a blind enthusiasm and an ill-directed heroism, they laid the foundation of no permanent settlements, and, in fact, soon melted away like frost-work in the sun.

When the banner of the cross had passed from the he-

Crusades. roic hands of Godefroy of Bouillon into those of his feeble and incompetent successors, Jerusalem, which had now become Christian, was forced to implore fresh succours from the West. At the call of St Bernard, the Christians again took up arms, and, conducted by an emperor of Germany and a king of France, rushed to the defence of the Holy Land. But they had no longer great captains to command them, and no longer did they exhibit the magnanimity and heroic resignation which had distinguished their predecessors. Asia beheld the new invaders without dismay; already it presented a different spectacle from that which the first crusaders had witnessed. The followers of Mahommed had recovered from their consternation; they had even become possessed with a delirium similar to that which had impelled the crusaders against them; they opposed enthusiasm to enthusiasm, and fanaticism to fanaticism; and, in their turn, they burned with a sanguinary zeal to shed blood in a religious war. The spirit of discord, which had formerly proved their ruin, was now confined to the Christians. The luxury, the manners, and the climate of the East had enfeebled the courage of the defenders of the cross, and caused them to forget the objects for which the holy war had been undertaken. Jerusalem, the conquest of which had cost the crusaders so much blood, fell into the hands of the Infidels, and became the prize of a wise and warlike prince, who had united under his banners the forces of Syria and Egypt.

The genius and fortune of Saladin enabled him to inflict a mortal blow on the ill-cemented power of the Christians in the East. In vain did an emperor of the West, and two kings renowned for their valour, put themselves at the head of the forces of their respective states, and march to deliver Palestine. These new armies of crusaders found everywhere insurmountable obstacles or invincible enemies: and efforts, which promised so much, produced only splendid misfortunes. The kingdom of Jerusalem, the ruins of which were still disputed, had become but the shadow of a name; and even the captivity and misfortunes of the holy city soon ceased to draw tears from the eyes of Christians, or to fill them with the transports of a warlike piety. The crusaders who had armed themselves for the deliverance of the heritage of Christ, allowed themselves to be seduced by the riches of Greece, and instead of rushing with fervid impetuosity on Palestine, stopped short to attempt the conquest of Constantinople. From this time the crusades began to assume a new character, and appear to have had another object, as well as another motive, than at the period of their commencement. Whilst a small number of Christians still shed their blood for the deliverance of the holy sepulchre, the greater part of the princes, leaders, and knights of the cross listened only to the voice of ambition; and the popes completed the corruption of the original spirit by preaching crusades against Christian states and against their personal enemies. Holy wars thus degenerated into civil commotions, in the course of which religion and humanity were equally outraged, while the rights of nations and the liberties of mankind were trampled under foot.

This abuse of the crusades, and the fatal passions which it called into play, had plunged Europe into disorder and anarchy, when a pious monarch undertook once more to arm the West against the Infidels, and to rekindle in the bosoms of new crusaders the heroic ardour which had animated the companions of Godefroy. But the two expeditions, directed by this sainted leader, proved the most disastrous of all. In the first, the world had the spectacle presented to it of an army in captivity, and a king in fetters; in the second, that of a powerful monarch perishing near the ruins of Carthage, of the same pestilence which had desolated his ranks. In Egypt, the fortune of arms placed him at the mercy of the Infidels whom he went to conquer; in Africa, the plague claimed him as its victim. These misfortunes contributed powerfully to dispel the illusion which had so long reigned supreme over the public mind; and from this time Jerusalem ceased to excite the passions or to attract the regards of the children of the West. But Europe, much as it had suffered, was, by the compensatory law of Providence, destined to reap important benefits in return. So many revolutions did not take place, so many distant expeditions were not undertaken, in vain. Some gleams of civilization penetrated athwart the darkness of barbarism; and the first effect of the light which the crusades began to scatter abroad, was to weaken the spirit of exaltation in which they had had their origin. Attempts were afterwards made to rekindle the flame which had at first overspread all Europe, and burned with consuming fury in Asia; but these proved utterly abortive. The nations recovered from their pious delirium; languor succeeded to enthusiasm, and lassitude passed into indifference, so that, when Germany found itself menaced by the Moslemins, who were already masters of Constantinople, the banner of the cross could scarcely summon together a few thousand warriors; and Europe which had risen almost *en masse* to attack the Infidels in Asia, could oppose to them only a feeble resistance upon its own territory. Crusades.

II. Having thus endeavoured to explain the origin and to illustrate the spirit and character of the crusades, it now remains to show what influence they produced upon the state and condition of society. On this subject different opinions have been entertained at different times. In the seventeenth century sentiment prevailed over reason; the heroic valour of the crusaders was admired, their reverses were deplored; and, without reference to the good or evil produced by these distant expeditions, men respected the pious motives which had induced the warriors of the West to take up arms. In the eighteenth century, which had imbibed the spirit of reform, an opposite tendency showed itself; and these enterprises were represented as the joint product of ignorance, fanaticism, and barbarism. In 1773 Voltaire published a history of the crusades; but the subject was then so generally decried, and the author had thrown so much ridicule on the events which he related, that his book excited little curiosity, and found but few readers. The same tone was afterwards assumed by the writers of the *Encyclopédie*, who adopted the sarcasms and greatly exaggerated the declamations of Voltaire; and this mode of judging the crusades became so general, that even the panegyrists of St Louis could scarcely forgive that pious monarch his exploits and misfortunes in Egypt and at Tunis. But in due time philosophy, enlightened by research and analysis, investigated the causes of events, studied their effects, and, searching for the truth, abandoned satire and declamation. In the introduction to his *History of Charles the Fifth*, Robertson expressed his conviction that the crusades had favoured the progress of freedom and the advancement of the human mind; and the conclusion of the historian, whether it flattered some of the opinions of the time, or exercised on the public mind the natural ascendency of truth, soon found many partizans. From this time writers began to judge with less severity of the oriental expeditions of the crusaders, and to consider these as a subject of philosophical inquiry, rather than as a theme for declamation or ridicule. Hence, nearly forty years ago, the Institute of France, in a truly liberal and enlightened spirit, proposed to the learned in general, as a subject of competition, the advantages which society had derived from the crusades; and two memoirs, one by M. Hercen, and another by M. de Choiseul d'Aille-

Crusades. court, obtained the prize offered by the Institute on this occasion. The object of both these productions, which are remarkable for the erudition and sound critical spirit which they display, is to establish the principle that the holy wars were, in their consequences, productive of advantages to posterity which greatly overbalanced the calamities they inflicted on contemporary generations. It may be added that these very able and learned memoirs form as it were the basis of Michaud's more ample and satisfactory work, entitled *Histoire des Croisades*, to which we are happy in having an opportunity of expressing our obligations. Upon the whole, then, it appears that, in the course of two centuries, opinions have several times changed on the subject of the crusades; and that, long as the period is which has elapsed since these memorable expeditions were undertaken, there is still great room for the exercise of caution in endeavouring to estimate the precise amount of the influence which they eventually exercised on society.

It may be observed, indeed, that what the crusades wanted in order to propitiate favourable judgments, was success. Let us, however, suppose for a moment, that these distant expeditions had succeeded to the fullest extent, and endeavour to show what would, in that case, have been the results. Egypt, Syria, and Greece would have become Christian colonies; the nations of the East and of the West would have advanced hand in hand in the career of civilization; the language of the Franks would have penetrated to the extremities of Asia; the coasts of Barbary, inhabited by pirates, would have received the manners and the laws of Europe; and the interior of Africa would not long have remained a region impenetrable to the activity of commerce, or the researches of science and discovery. In order to judge what might have been gained by this union of so many nations and races of men under the same laws and the same religion, it is only necessary to consider the state of the Roman world under the successors of Augustus, forming in some sort but one people, living under the same laws, and speaking the same language. All the seas were free; the most distant provinces communicated with one another by means of admirable roads; cities exchanged their arts, their industry, and their varied productions; nations maintained a commerce of knowledge, on principles of perfect reciprocity. If the crusades had subjected the East to Christendom, it is not unreasonable to believe that this magnificent spectacle, which the human race had only once seen, would have been renewed in modern times; and then opinions would not have been divided as to the advantage of the holy wars. But, unhappily, the crusaders could neither extend nor preserve their conquests; they wanted the faculty of improving victory, and they were unable to repair the consequences of defeat. The results of the crusades, therefore, are on this account more difficult to be determined; whilst the good which is ascribed to them is immeasurably less obvious and striking. The evils which they caused to humanity were great, though temporary; as to the good which they produced, it was like a germ which remained long hid in the earth, and at length developed itself slowly and imperceptibly. Let us, however, glance at the state and condition of the different powers of Europe before, during, and after the crusades, noting the principal changes that occurred, and the ameliorations which were gradually effected.

1. At the commencement of the twelfth century, the French monarchy had fallen into a state of weakness and decay; but in the course of the succeeding ages, it revived and attained to great prosperity and splendour. Able negotiations, successful wars, useful alliances, the decay of the feudal system, and the progressive emancipation of the commonalty, favoured the dynasty of the Capets in the aggrandisement of their states and the increase of their authority. Several centuries were employed in consummating this great work of fortune or of policy; but the revolution, thus slowly operated, was attended with effects proportionally durable. The policy of the French kings, however, was seconded by the great events of the crusades; and it was natural that the nation which had taken the greatest share in these enterprises, should profit the most by them, for the increase of its power and the amelioration of its social condition. The royal authority derived equal benefit from the exploits and the reverses of the numerous warriors whom the crusades had hurried into Asia. The removal, the death, or the ruin of the great vassals of the crown, equally enabled the sovereign to disengage himself from the fetters of feudal anarchy, and to establish order in the kingdom. More than a century before the first crusade, the barons and the prelates had ceased to meet in general assemblies, for the purpose of regulating the forms of justice, and of giving to the acts of the sovereign the support of their political influence. But at the time of the second crusade, there were several assemblies of the grandees of the kingdom, at which they occupied themselves with preparations for the expedition, and with measures for maintaining public order and the execution of the laws during the absence of Louis VII.; and in these meetings the French beheld a faint image of the assemblies, so celebrated under the former races of kings, in which the monarch and his subjects deliberated together as to the best means of insuring the safety of the throne and the independence of the nation. Thus the crusades aided the kings of France in recovering their legislative power, and enabled the more enlightened portion of the nation to repossess themselves of those ancient prerogatives which they had exercised under the descendants of Clovis and of Charlemagne. The great vassals who, in the time of Hugues Capet, and for more than a century afterwards, had been continually opposed to the crown, from which they had separated their interests, became animated with different sentiments when they saw the French monarchs at the head of expeditions which fixed the attention of Christendom, and in which the cause of Jesus Christ himself and that of all Christian nations was concerned. In a word, to understand how much the kings of France were indebted to the crusades, and how much they gained by the part they took in these expeditions, it is only necessary to compare Philip I. shut up in his palace during the council of Clermont, excommunicated by Urban, condemned by the bishops, and abandoned by his grandees, with Philip-Augustus, victorious over Saladin in Syria, and over the enemies of his kingdom at Bouvines; or with Louis XI. surrounded in his reverses by a faithful nobility, respected by the clergy and people, revered as the firmest supporter of the church, and proclaimed by his age the arbiter of Europe. The crusades, indeed, were the signal of a new order of things in France, the foundations of which were laid with great solidity during the wars in Palestine and in other countries of the East.

Crusades.

2. If royalty had sunk to a low ebb in France at the period of the first crusade, in England it was lusty and vigorous, and, together with the feudal system, pressed upon the nation with all the weight of the tyranny established by William the Conqueror. But an authority founded by victory and supported by violence, inspired a feeling of opposition which time and circumstances afterwards developed. Military despotism had succeeded in silencing opinion; but it had failed to produce an entire change in the manners of the English, or to eradicate their attachment to their ancient customs. The passions repressed by the sword found vent when the force of terror

Crusades. was removed, and broke out with a vehemence proportioned to the constraints to which they had previously been subjected. In England, therefore, the change which took place was just the reverse of that which had been effected in France. A monarchy formerly powerful began to decline, and liberty made progress at the expense of the royal authority. The crusades, however, had probably less influence on the civilization of England than on that of several other states of Europe; but they may, nevertheless, have concurred with other causes in accelerating the changes which afterwards took place in the English monarchy. Richard Cœur de Lion showed himself more anxious to acquire the renown of a great captain than the reputation of a great king; and in seeking glory in arms, he neglected the cares of government. At his departure for Palestine he sold the revenues, prerogatives, and domains of the crown, and would have sold the city of London itself if he had found a purchaser; but his reverses and his captivity ruined his people, and his long absence nourished the spirit of faction among the nobility, nay even in the bosom of his own family. The English barons several times indicated a determination to set out for the East without the permission of the king; and the thought of opposing a monarch whom they disliked heightened their impatience to embark for Palestine. In fact, princes sought to take advantage of the opinions of their time, and engaged to join the crusades for the sole purpose of obtaining subsidies, which they employed in other enterprises; conduct which brought contempt on their policy, and increased the public distrust of all their proceedings. But there was another cause which mainly contributed to subvert the foundations of absolute monarchy in England; we mean the violent enterprises of the popes against the sovereigns of that country, enterprises which were favoured by the spirit of the religious wars. In the league of the barons against Henry III., the rebels bore the badge or ensign of a cross, as in the wars beyond sea, and the priests promised the crown of martyrdom to all who should die in the cause of liberty. It is a remarkable circumstance that the chief of the league formed for establishing the independence of the English nation was a French gentleman, the son of the Count de Montfort, who had acquired so great renown in the crusade against the Albigenses. After long and persevering efforts, liberty at length took root in that soil whence we trust it will never be eradicated, and many fierce and painful struggles issued in positive and durable results, of which succeeding ages reaped the full benefit.

3. But whilst the monarchy of France was strengthened at the expense of liberty, and liberty in England was conquered from the monarchy, Germany presented a different spectacle, and the empire, which had flourished till the commencement of the eleventh century, exhibited symptoms of a rapid decline during the period of the crusades. In order to resist the great vassals, the emperors granted several advantages to the clergy, and conferred privileges on the towns. But the clergy employed these advantages in favour of the popes, who attacked the imperial power; and the towns profited by the concessions made to them in order to establish their independence. In spite of all the efforts of the emperors, the crown remained elective, whilst the great fiefs had become hereditary; and thus the heads of the empire depended for their election on the nobility and princes who had freed themselves from all dependence. The succession was therefore a subject of perpetual intrigue and contention, whilst, in the struggle, ambition was often preferred to moderation and virtue. Amongst the princes who ascended the imperial throne, several were men of great character; but their active and stirring genius hurrying them into disproportionate enterprises, exhausted their means, and accelerated the decline of the empire. The recollection of ancient Rome, and of the power of the Cæsars, was continually present to their thoughts. They carried their arms into Italy, where a war of extermination was declared against them by the popes; two families of emperors sunk under the thunders of Rome; and whilst they exhausted themselves in vain efforts to establish their power in Italy, they completed the ruin of their influence in Germany. The policy pursued by the kings of France was wiser and more fortunate. They confined their efforts to the extension of their own power; their conquests tended only to reunite the scattered branches of a great family; and their authority became more popular, in proportion as they came to be considered as the natural bond of connection between the French of all the provinces. But the glory which the emperors of Germany acquired by their conquests was personal to themselves, and possessed no attraction for the German people. It had nothing in common with the nation of which they were only the nominal heads; it was neither a principle of union nor a source of support; it combined no interests, it appealed to no national feelings; and each sought his own safety or his own aggrandisement by his individual means. Hence arose a state of things more fatal to Germany than even the absolute power of the emperors. From the ruins of imperial greatness there sprung up a multitude of small states, opposed to one another by difference of laws and by a spirit of rivalry; and whilst the monarchical spirit predominated in these principalities, secular as well as ecclesiastical,—whilst the great towns were actuated by the love of liberty and independence, and the nobility continued to urge the pretensions of the aristocracy,—it was vain to expect that, having conflicting interests, they would pursue the same policy, or direct their efforts towards any common and salutary end. The popes continually interposed; great disorders were produced; the sceptre of Charlemagne was broken; pretenders to the imperial dignity multiplied, under the encouragement of Rome, in proportion as the empire itself was falling to pieces; and, in the midst of this anarchy, Germany lost its political as it afterwards did its religious unity. The enormous and inert mass of the confederation could never be set in motion; even the presence of actual danger failed to awaken its energy, or to induce it to adopt any vigorous decision for the safety of Germany. In the meanwhile, the crusades afforded a pretext, of which the popes availed themselves, for removing the emperors of Germany, and hurrying them into disastrous expeditions, which accelerated the ruin of their power; and thus the enthusiasm of the holy wars, which contributed to unite other Christian nations, only served to produce confusion and disorder in the bosom of the empire. At the same time, it was under the influence and auspices of the court of Rome, whilst seriously occupied with a crusade, that the family of Rodolph of Hapsburg took its rise; a family whose power restored to the empire something of its ancient splendour, and saved Europe from the invasion of the Turks. It was also during the epoch of the crusades that the cities of Dantzick, Thorn, Elbing, Königsberg, and others, sprung up in the midst of deserts and of forests; that Finland, Lithuania, Pomerania, and Silesia, became flourishing provinces; and that new states were formed, destined afterwards to occupy a high rank among the powers of Europe.

4. If from Germany we turn to Italy, we shall there find other forms of government, and revolutions of a different character. When the last columns of the Roman empire were overturned, Italy found itself covered with ruins. The Huns, Franks, Vandals, Goths, Germans, and Lombards, successively carried into that fine country the

Crusades. scourge of their domination, and left there traces of their manners, their legislation, and their character. But, in the tenth century, when the emperors of Constantinople could no longer extend their arms to Italy, other powers arose, some by conquest, others by fortune, and others again by means unknown to history. The influence of the popes sometimes defended Italy with success against the invasions and the yoke of the emperors of Germany; but the struggle was protracted, whilst the various fortune of the contest served only to perpetuate confusion and discord; and, during several centuries, the factions of the Guelphs and Gibelines desolated Italy without defending it. That country, unfortunately, had no point of centralization around which to rally and unite its means of defence. On the contrary, divided into a multitude of petty states, it reckoned within its natural boundaries several nations, and twenty republics, each having its own laws, its own interests, and its own history. Amongst a numerous population thus split into factions, there could scarcely prevail any community of feeling, because there existed no identity of interest; whilst, on the other hand, all the elements of disorder and contention were accumulated in destructive abundance. Hence we find little else than continual wars and strifes, not only between different towns and different states, but even between the citizens of the same town or the same republic; strangers were called in to take part in their intestine feuds; and the same mutual distrust which hired and armed mercenary adventurers to decide their disputes, destroyed the true sentiment of patriotism, and almost effaced the remembrance of the Italian name. The feudal system was abolished in Italy sooner than in other countries; but with this system disappeared the ancient honour of the *preux chevaliers*, and all the virtues of chivalry. In republics defended by mercenaries bravery ceased to be respected, and the generous sentiments which it inspires were forgotten. A loose rein was given to the most violent passions; excesses of hatred and vengeance, which appear scarcely probable even in our tragedies, were indulged in; the finest country in Europe seemed to be peopled with demons incarnate; and Dante had only to look around him in order to find the model of his *Inferno*. Society, always ready to fall in pieces, seemed to have no other motive force than the fury of parties, no other life than discord and civil war; against anarchy there was no guarantee but tyranny, against tyranny none but the despair of factions and the daggers of conspirators. As the power of the little states which covered Italy was disproportioned to their ambition, their rulers were consequently weak, and, wanting both courage and moderation, they sought their aggrandisement or their safety by all the means which treachery or perfidy could suggest. Any plot however infamous, any proceeding however scandalous, any crime however great, appeared good in their eyes, provided it only served to support their quarrels or to satisfy their ambition and their jealousy. Morality, in short, disappeared; and then was formed that school of politics, the maxims of which are embodied, for the purpose probably of exposing them, in the *Prince* of Machiavelli.

At the period of the crusades, however, the cities of Lombardy, and the republics of Genoa, Pisa, and Venice, had attained great prosperity. This arose from the commerce of the East, which Italy had carried on before the epoch of these expeditions, and which it continued with all the additional advantages offered by the contest in Palestine. But these mercantile republics, which had their attention continually fixed on Syria, Egypt, and Greece, were better fitted to enrich Italy with the products of their commercial industry than to nurse among the Italians the sentiment of true independence. At the same time, the power of Venice was everywhere advanced by the arms of the crusaders, and by the men of that age the queen of the Adriatic was regarded as the empress of the East. Her decay commenced only at the period when the progress of navigation, to which she had so greatly contributed, opened a new passage to the Indies, and led to the discovery of a new world. The greater part of the other republics had neither the same lustre nor the same duration, but, towards the close of the crusades, disappeared in the chaos and tumult of discord and civil war. As to the kingdom of Naples and Sicily, it formed, as it were, part of the high road by which the crusaders marched to Greece and to Palestine; and as its riches appeared to have no protectors, a country which its inhabitants had never been able to defend naturally tempted the cupidity of the princes and knights proceeding to seek their fortunes in Asia. For more than two centuries, accordingly, its history is blended with that of the crusades, which often served as a pretext or occasion for conquering it; whilst, as to the wars in which this kingdom engaged, they exhibit monstrous crimes rather than glorious exploits, revolts instead of battles, and consummate cowardice united with remorseless and unsparing cruelty. Crusades.

5. During the course of the crusades Spain was chiefly occupied in defending her own hearths against the same Saracens whom the people of other nations of Europe went to combat in the East. Accordingly, she did not take part in these enterprises until the spirit in which they originated had begun to decline in the rest of Europe. This country, however, derived some advantages from the expeditions to the East. In almost all the enterprises of Christendom against the Moslemins of Asia, a great number of crusaders disembarked on the shores of Spain in order to combat the Moors; and several crusades were published in the West against the infidel masters of the Peninsula. The celebrated victory gained over the Moors at Tolosa was the fruit of a crusade preached in Europe, and particularly in France, by order of the sovereign pontiff. The expeditions beyond sea also aided the cause of the Spaniards, by detaining in their own country the Saracens of Egypt and Syria, who might otherwise have joined those on the coasts of Africa, and proceeded to the assistance of their countrymen in Spain. The kingdom of Portugal was moreover conquered and founded by the crusaders; and their expeditions first suggested the idea of certain orders of chivalry, which, in imitation of those of Palestine, were formed in Spain, and mainly contributed to enable the people of that country to triumph over the Moors. We may add, that Spain is the country where the memory of the crusades was longest preserved. In the course of last century there used to be published, every year, in all the provinces, a bull called *Crusada*, which solemn publication recalled to the Spanish nation the triumphs which their ancestors had gained over the Moorish invaders of their country.

In thus surveying the condition of the principal countries of Europe at the epoch of the crusades, it is impossible not to be struck with the great diversity observable in their manners, their institutions, and the destiny of their inhabitants. But still it is no easy task to follow and to mark the progress of civilization in so many monarchies and republics, some emerging in splendour from the bosom of barbarism, and others falling back into decay and ruin. Nor is it less difficult to detect the influence exercised by the crusades amidst so many revolutions, which had often the same origin, though their effects were different and sometimes opposite. Nevertheless, this influence was in all cases considerable, and in a few strikingly great. In France it favoured the growth of the monarchy at the expense of a turbulent and powerful feudal aristocracy In England, it favoured the growth of liberty at the ex-

Crusades. pense of an absolute monarchy. In Germany, it accelerated the decline of an empire with an elective head, and depressed the aristocracy, whilst it encouraged the industry and enterprise of the towns, enabling them at the same time to secure a sort of independence. In Italy, if it failed to mitigate the political evils with which that country was unhappily cursed, it gave a new stimulus to commerce and navigation; enriched those mercantile republics which then monopolized the trade of the East; and gradually paved the way for discoveries which have since produced the most striking effects on the destinies of mankind. And, lastly, in Spain, it powerfully contributed to the deliverance of the Peninsula from the yoke of the Saracens, and gave rise to the institution of the Cortes, the emancipation of the commonalty, the enfranchisement of the towns, and other measures which signalized the decline of the feudal system and of the absolute authority of the sovereign in that country. Such were the more immediate political results of the crusades. Let us now for an instant inquire what effects they produced on the authority of the church, and on the institutions and manners of the middle ages.

III. The situation of the popes in the middle ages presents a singular spectacle. As sovereigns of Rome, they had scarcely any authority, and were frequently exiled from their own states; as the heads of Christendom, they exercised an absolute empire to the very extremities of the world, and their name was revered wherever the gospel was preached. Possessing this unlimited spiritual authority, the popes obtained credit with some for originating the crusades; but they who support such an opinion have little knowledge of the general movement which then agitated the Christian world. No power on earth was capable of producing so mighty and universal a commotion; it belonged only to Him who raises and stills the tempest at his pleasure to inspire of a sudden into the hearts of men that enthusiasm which absorbed all other passions, and hurried on vast multitudes as if impelled by an invisible force. It has also been said that the crusades greatly increased the authority of the popes; and this is true, though perhaps scarcely to the extent which some are willing to believe. At first, indeed, the popes did not seem to be aware of the advantages which they might derive from these expeditions; and, accordingly, it was not until the second crusade that they became sensible of the ascendency which the holy see might exercise by means of the efforts made for the conquest of the Holy Land. Latterly, however, the crusades furnished the popes with a pretext for usurping, in all the states of Europe, the principal prerogatives of the sovereign power. In name of the holy war, they assumed the right of raising armies and levying imposts; their legates exercised supreme authority in all the countries of Christendom; the presence of these haughty envoys inspired respect and fear; wherever they went their will was law. Armed with the cross, they exacted the most implicit obedience from the clergy; and as the latter naturally possessed a very great ascendency over the people, the empire of the popes knew neither limits nor opposition. At the same time, the papal power received but little increase in Asia during the holy wars; whilst the quarrels and disorders which incessantly disturbed the Christian colonies multiplied their embarrassments without adding to their power. Their voice was not always listened to amidst the din of arms; and sometimes the soldiers of the cross resisted the will and contemned the counsels of the pontiffs. The legates of the holy see were often at variance with the chiefs of the Christian armies, and their character was not always respected in the midst of camps; whilst, on the other hand, as the popes aspired to direct the crusades, they were held in some sort responsible for misfortunes and disorders which they could not prevent; and this responsibility, exposing them to be judged with rigour, impaired their reputation for ability and sagacity. By a gross abuse of the crusading spirit, the popes also engaged in wars where ambition was more concerned than religion; they thought of their temporal when they should have attended only to the interests of their spiritual dominion; and in seeking to advance the one they neglected the other. The crusade against the Albigenses was productive of no solid advantage to the papal authority. The intolerance which occasioned that war may no doubt be regarded as an emanation of the fierce spirit of the time; but the Inquisition, which then took its rise, awakened more passions than it repressed. The enormous tributes imposed on the clergy also served to weaken the papal authority, by the universal discontent which these exactions produced. Tenths were raised not only for a crusade, but for every attempt at a crusade, and not only for the expeditions to the East, but for every enterprise undertaken against the enemies of the court of Rome; whilst the rigour with which the agents of the pontiffs collected the imposts, and the scandalous manner in which they often misapplied the sums wrung from the faithful, excited the most lively indignation, and called forth loud remonstrances. "Rien ne fut plus funeste à l'autorité pontificale (says Michaud) que ces plaintes qu'on entendait de toutes parts, et dont s'arma enfin la rédoutable hérésie de Luther." In short, to quote the words of the same author, "la domination des papes alla toujours s'accroissant pendant un siècle jusqu'à Innocent III.; elle alla ensuite en déclinant pendant un autre siècle, jusqu'à Boniface VIII., époque où finissait les croisades d'outre-mer." Crusades.

2. Before the period of the crusades, the feudal system had begun to exhibit some symptoms of decline. Founded on the basis of military colonization, the governments of the middle ages may be compared to a victorious army dispersed in a conquered country, having the territory which it occupied parcelled out in certain definite proportions, and always ready at the signal of its officers or supreme head to march against the common enemy, and to defend its possessions. Hence, as long as discipline and obedience subsisted in these colonies, public order was not disturbed. But when the reciprocal relations of protection and submission, services and duties, became enfeebled—when discipline relaxed, and the rigour of military law had been insensibly mitigated—society then presented the spectacle of an army abandoned to license, or freed in some measure from the control of its chief or head; and every successive abatement was so much withdrawn from the strength and solidity of the fabric of feudalism, so much added to the antagonist force which had already begun to attack its foundations. Still, at the period of the crusades, the ties of fidelity produced by the feudal relations were so powerful that the preachers of these expeditions sometimes invoked these in their exhortations; they preached the duties of feudalism in concurrence with the precepts of the gospel; and, to excite the Christian warriors to assume the cross, they called them *the vassals of Jesus Christ.* The crusades, however, unquestionably exercised a salutary influence upon the spirit and manners of feudalism; they contributed to destroy, by exhausting, the ferocity which that system had nurtured, as well as to eradicate some of the grosser abuses which it had engendered; they preserved, by stimulating and encouraging, the generous sentiments which it had inspired; and they concurred in developing whatever it contained that was favourable to the progress of civilization. They opened a seasonable and sufficient outlet for an overboiling spirit, which, if compressed, would have blown to pieces the whole fabric of society; and, by their re-action, they favoured the growth

Crusades. and expansion of interests which became identified with the cause of general improvement and of public order. The whole of man was not yet known, and the idea of virtue was still in a great measure merged in that of mere duty or obedience. But the crusades created a desire, or we should rather say produced a necessity, for acquiring personal distinction, in addition to that conferred by mere rank or possessions; every man above the common herd was compelled by ambition to illustrate his name with some brilliant achievement; and even the meanest and humblest individual became in some sort ennobled by the performance of great actions. This feeling belongs to a rising civilization; it is the first indication of that spirit which sooner or later issues in the intellectual, moral, and political improvement of society.

3. The crusades were not altogether without fruits even to that class which, in the first instance, suffered most by them; we mean the nobility. Some acquired principalities in the East; many of the cities of Greece and Syria were erected into signories; and the military orders which were then introduced afforded them some compensation for the losses which they had sustained. A few, more fortunate than the rest, ascended the thrones of David and of Constantine, and took their place among the great monarchs of Christendom. All acquired distinction or renown; and, by means of sirnames and armorial bearings, which were now introduced, their glory was emblazoned and preserved in the achievements of their escutcheons. The feudal system declined apace, and the power of the great barons was gradually but certainly yielding to the encroachments of royalty on the one hand, and the inroads of public liberty on the other. But the spirit of chivalry came instead of the colder and more repulsive principle of feudalism; and if the nobility served the state in a new character, they still retained a predominant influence, and, in fact, constituted the greater part of its defensive force.

4. The condition of the people was more slowly ameliorated, and they long groaned under intolerable oppressions. The peasantry remained in a state of servitude or villeinage, subject to the arbitrary jurisdiction of their feudal lords, and without any law to protect them against tyranny of the worst description. But the inhabitants of the towns were more fortunate; and as the policy of princes concurred with the advancement of their consequence, they were early enabled to shake off the fetters which long weighed so heavily on the serfs of the plains. The cities of Lombardy, and of a great part of Italy, were the first to throw off the feudal yoke; in Germany the towns also became free, though at a later period; in England the manifestation of the spirit of liberty dates from the era of the crusades, prior to which the towns, with the exception of London, which had obtained some privileges, seem never to have once dreamed of independence; and in Spain, the war against the Moors not only favoured the rise of the commons, but secured them the protection of institutions which guaranteed the enjoyment of a large measure of freedom. The towns of the south of France soon followed the example of those of Italy and Spain, and obtained franchises which in time became consecrated by usage as well as by positive laws. The liberty of the towns commenced with corporations; because experience had taught their inhabitants that they were only strong when united, and also because the conservation of their privileges and franchises would otherwise have been impossible. This emancipation of the commons, however, was attended with very different results to the great vassals and to the crown. It weakened the authority of the barons and feudal lords, because the spirit of liberty naturally turned against its more immediate and dangerous enemies; but it increased the royal authority, because the cities which were either free, or expected to become so, naturally turned towards the monarch, the author of that boon, whose interest, in one important particular, was identical with their own. Hence we find kings and princes placing themselves, as it were, at the head of the general movement of society, and seeking to establish order and to promote improvement because they knew that they would thereby extend their power and increase their authority. The serfs of the plains, however, groaned in subjection to tyranny long after the towns had become free. From the crusades they derived little or no direct advantage. They could not unite, like the inhabitants of towns; they were dispersed, and therefore feeble. But a propitious impulse had been given, and the day of deliverance at length arrived. Some cities in Germany contributed to the freedom of the peasants of their territory; the same thing occurred in Italy and Spain; and although in England the yoke of villeinage was worn for a longer period, yet it was at length removed, and with it the last external badge of feudal servitude. Crusades.

5. The crusades have been reproached with having first given the idea and introduced the practice of taxation. The notion, however, is too simple in itself to make it necessary to search so far back for its origin. But it is not improbable that the mode in which the tenths were levied for the holy wars served as a model to those who afterwards established regular contributions. Further, when the feudal regime, which cost nothing, had been overturned, it became necessary to provide for the expenses of a new system of administration; and when the state could no longer calculate on the defenders with which the tenure of military service had supplied it, it was obliged to seek for others, and of course to pay them for their services. Hence arose the necessity for stipendiary armies and regular and permanent imposts. Other means, indeed, were at first employed. The coin of the realm was debased; the Jews were persecuted; violence was employed; justice was sold. But all these resources, which tended at once to corrupt the government and the nation, were soon exhausted, and none other than that of taxation remained. With regard to regular armies, again, there can be no doubt whatever that the first idea of these was suggested by the expeditions to Palestine and other countries of the East. These distant and protracted enterprises changed the conditions of the feudal service, and accustomed men to see permanent armies, supported and commanded by princes.

6. Chivalry was known in the West before the era of the crusades. But these wars, which appeared to have the same object as chivalry, namely, that of defending the oppressed, serving the cause of God, and combating the Infidels, imparted to this institution greater lustre and consistence, and gave it a direction at once more extensive and more salutary. On this important branch of the subject, however, it is only necessary here to refer to the article CHIVALRY in this work, which contains a clear, eloquent, and masterly exposition of the more prominent features of that extraordinary institution, and, in particular, explains the changes and modifications which it underwent in consequence of the memorable expeditions of which we are treating. When the institution of chivalry fell by the abuse which had been made of it, and particularly in consequence of the changes which had taken place in the military system of Europe, there still remained in the mind of society some of the sentiments which it had inspired; in the same manner as there remains with those who have forgotten the religion in which they were born, something of its precepts, and especially of the impressions which they had received in their infancy. In the time of chivalry, the price of good actions was glory and

Crusades. honour; and this coin, which is so useful to nations, yet costs them nothing, did not fail to possess some currency in the ages which followed. Such is the effect of a glorious recollection, that the marks and distinctions of chivalry still serve as the most appropriate and enviable recompense of bravery and merit. Seeing, then, that the crusades added some lustre and gave some ascendency to an institution which formed, as it were, a barrier against license and barbarism, it must be admitted that these expeditions, however wild in themselves, have, in this respect at least, conferred a real service on humanity.

IV. Having thus viewed the crusades in connection with the effects which they are supposed to have produced on the condition of different classes of society, and having traced to the same source the origin of several of our institutions, it now only remains to advert shortly to the progress which was made, during the same period, in navigation, commerce, industry, the sciences, arts, letters, and useful knowledge.

1. Before the twelfth century, the seas of Europe and Asia, with the exception of the Mediterranean, were scarcely frequented by the nations who occupied their shores. At the commencement of the crusades, France had only two or three ports on the coast of Normandy, and not one either in the Atlantic or the Mediterranean, till the seventh crusade, when Louis IX. caused that of Aigues-Mortes to be constructed. England had not made greater advances; and the trifling navigation of that age was carried on by some towns on the coasts of the Baltic, in Holland, Flanders, and Spain. But when the crusades commenced, the spirit of devotion uniting with that of commerce, gave a new and more extended scope as well as impulse to the enterprises of navigators. The inhabitants of Denmark appeared in the seas of Syria; and the Norwegians, who had arrived in ships, assisted at the capture of Sidon. At the siege of Ptolemais were found citizens of Lubeck and Bremen; and from all the coasts of the West sailed vessels and even fleets to transport pilgrims, provisions, and arms, into the kingdom of Jerusalem and the other principalities in Asia founded by the arms of the crusaders. Thus the navigators of all countries were met in the seas of the East; and, under the auspices of the cross, commercial relations began to be established between the maritime states of Europe. At the commencement of the twelfth century, a fleet of Pisans, united with some other Italians, assisted the Aragonese in conquering the Balearic Isles; and the navigators of Italy thus extended their knowledge of the shores of Spain, with which they had previously been so little acquainted that they mistook the coasts of Aragon for the country of the Moors. Having gained experience in distant voyages, the navigators of Lubeck, Bremen, and Denmark also explored the hitherto unknown coasts of the Baltic;—a communication was established between the Baltic, the Mediterranean, the Spanish Ocean, and the seas of the North;—a spirit of emulation and enterprise united different nations in pursuit of the same advantages;—and nautical science received important accessions in almost all its branches. The configuration of coasts, and the position of capes, harbours, bays, islands, and headlands was determined; seas were explored to their furthest extremities; the direction of winds, of currents, and of tides, was observed; and various points in hydrography were likewise settled with tolerable precision. Lastly, the discovery of the compass, which had been made about this time, although it did not come into general use until a subsequent period, enabled those navigators who had obtained possession of the secret, to embark in more adventurous voyages, and to brave the terrors of the ocean. Naval architecture was also improved during the crusades. The construction of vessels was rendered more solid, at the same time that their size was increased; Crusades. and they were for the first time provided with several masts, in order to multiply their sails, and enable them to shape a course upon a wind. To guard the interests and protect the freedom of navigation, a code of maritime law was likewise framed, upon the model which had been furnished by the nautical sages of Barcelona about the beginning of the twelfth century. In an assembly held at St Sophia, in 1255, the Venetians adopted the code entitled *Consulat de la Mer*, which was afterwards recognised by the Pisans and the Genoese, and became the common law of the seas of the East; whilst another code, first published by Eléonore de Guyenne, and afterwards by Richard Cœur de Lion, under the title of *Roles d' Oleron*, obtained the assent of several maritime states, and was at length accredited in all the seas of the West. Protected by this legislation, navigators reaped the fruits of their lengthened enterprises, and were soon enabled to dispute the empire of the Mediterranean with the Infidels. Indeed, if Italy and several countries of the West were not subjugated by the Saracens, they owed their safety more to the superiority of their fleets than to that of their armies. In short it is more than probable that, without the crusades, the genius of navigators would not, till a much later period, have enabled them to traverse the immense space which separates the Baltic from the Mediterranean and the Indian Ocean, or to shoot across the mighty waste of waters interposed between the Old and the New World.

2. Every climate has its peculiar productions; and this diversity of wealth naturally leads to interchange or commerce, which in time establishes communications between the most distant regions. In the middle ages, the indolent and effeminate Greeks neglected to import into the West the merchandise of Asia; and the Saracens landed on the coasts of Europe only to subject them to the scourge of war. But the commercial enterprise of the West sought out those products which had ceased to be imported; and the frequent voyages to the East were altogether to the advantage of the Occidentals. Before the period of the crusades, the merchandise of Asia had arrived in Europe, sometimes by the overland route, traversing the Greek empire, Hungary, and Bulgaria; more frequently by way of the Mediterranean, which may be said to abut, as it were, on all the ports of Italy. Both these routes were rendered easy by the holy wars; and then commerce, protected by the standard of the cross, advanced with rapid strides. Most of the maritime towns of the West enriched themselves by supplying Europe with the productions of the East; and they also derived considerable advantages from the transport of pilgrims and of the Christian armies. Fleets hovered around the coasts where the crusaders fought, supplying them with munitions of war and provisions; and thus commerce brought back to Europe part of the treasures which had been carried into Asia by the princes and barons who had ruined themselves in order to provide the necessary means for combating the infidels. In fact, all the riches of the maritime towns of Syria, and even of Greece, belonged to the merchants of the West. They were masters of the greater part of the Christian cities of Asia; they possessed all the islands of the Archipelago; for a time, they ruled in Constantinople; and the Greek empire was almost another Venice, with its laws, its fleets, and its armies. The Latins, however, were not long masters of Constantinople, Jerusalem, and most of the countries conquered by their arms. But commerce, more fortunate than war, persevered in its conquests after the crusades. The city of Tana, built at the mouth of the Tanais, became to Venice a colony which opened useful relations with Persia, Tartary, Tauris, Trebizond, Bagdad, and Bassora; whilst the Genoese, established in the small

Crusades. town of Caffa, in the Crimea, explored the mines of the Caucasus, and received the treasures of India by way of Astracan. But several of the great kingdoms of Europe had as yet but little share in this commerce, which still continued in the hands of a few maritime towns. England had nothing but her wool to give in exchange for the merchandise of Asia, imported by Spanish and Italian merchants. The towns of France, excepting Marseilles, had little share in the trade of the East. Italy, from her position, which commands the Mediterranean, enjoyed almost exclusively this advantage, and became the grand emporium of a traffic as extensive as it was profitable; sending into all parts of Europe, not legions and proconsuls like Rome in the days of its greatness, but caravans of merchants, who subjected the provinces they traversed to the calculations and wants of commerce, and disposed, by their industry, of all the money which then circulated in the West. In a word, Europe has scarcely a great city where the name of Lombard affixed to some street or quarter does not to this day attest the long residence of the Italian merchants.

3. It is not easy to separate the progress of industry, or even of agriculture, from that of commerce. In order to ascertain, however, what each gained by the relations with the East, it is necessary to attend to the state of these two sources of wealth among the Orientals at the period of the crusades. Before this time the Saracens had manufactures of various stuffs, such as silk, woollen, and linen. At Damascus and in the towns of Egypt they worked in metals with greater perfection than in the West. The Christians of Palestine often went to Damascus to purchase arms. At Tripoli in Syria, camlets were manufactured; and, in the same town, as well as in several of the cities of Greece, there were a great number of trades connected with the preparation and manufacture of silk. All this could not escape the observation of the merchants and pilgrims who visited the East. We find, in fact, that, about the middle of the twelfth century, Roger II. king of Sicily, caused several of these artisans to be brought over to Palermo; that this was the result of an expedition to the coasts of Greece; that the mulberry tree throve in the fine climate of Italy as well as in that of the Morea; and that the Sicilians soon surpassed the Greeks in this valuable species of industry. Several useful inventions were also derived from the East; among which wind-mills have been mentioned. Tyre was then renowned for its glass ware, which the fine sand in the neighbourhood enabled its workmen to bring to a degree of perfection unknown in other countries; and to this place the Venetians were indebted for instruction in an art in which they afterwards greatly excelled. It is probable, also, that the Greek fire suggested the idea of gunpowder, and ultimately led to the important invention which has immortalized the name of Berthold Schwartz. During the fourth crusade, Boniface of Montferrat sent maize and wheat from Turkey to Italy; the plum of Damascus was imported by a duke of Anjou, who had visited Jerusalem; our gardens owe to the holy wars the ranunculus, so dear to the Orientals, and the echallotes, which derive their name from Askalon; and the knowledge or rather the use of saffron, of alum, and of indigo, is also due to the crusades. In the territory of Tripoli in Syria, the crusaders beheld, for the first time, the sugar cane, which was transported to Sicily about the middle of the twelfth century, and thence passed into other countries. It was transferred by the Spaniards to Madeira, whence it is supposed to have been carried, at a subsequent period, to the New World. Natural history, which is connected with the progress of industry and agriculture, was enriched with some useful discoveries during the crusades. The productions of distant climates were exchanged; and Europe acquired a knowledge of several animals peculiar to Africa and Asia. Crusades.

4. Architecture was also greatly improved. The sight of the monuments and superb edifices of the East excited wonder, and awakened a spirit of emulation. Nothing could equal the astonishment of the crusaders when they first beheld the city of Constantine. Foucher de Chartres exclaimed in his enthusiasm, " Oh, que Constantinople est une belle et vaste cité;" and the French knights, on viewing the magnificent towers and superb palaces of Byzantium, could scarcely persuade themselves, " que si riche ville pust être en tout le monde." These no doubt were the feelings produced by novelty and surprise; but they soon gave place to a desire to imitate the fabrics which had excited so much admiration. Italy, in particular, profited much by the classical masterpieces of Greece, which served as models; whilst the wealth acquired by commerce enabled the inhabitants to indulge their taste for the embellishment of their cities. With the exception of architecture, however, the fine arts owed little to the frequent intercourse with the East. Painting was despised by the Moslemins, who were forbidden by the Koran to make any image of man or beast; and the Latins, after the capture of Constantinople, destroyed the greater part of the monuments erected by the genius of sculpture, converting into coin some of the masterpieces of Phidias and Praxiteles. The Orientals had no music, and Greece had long lost the secret of those melodious strains which, in the time of Linus and Orpheus, were fabled to have tamed savage beasts, charmed Rhodope, and led captive the woods of Mænalus. The history of this art, therefore, has but little relation to the holy wars.

5. The science which derived most improvement from these distant expeditions was unquestionably that of geography. Before the crusades, this science was altogether unknown. Countries the least remote had no communication with one another. Burgundy was scarcely known in Paris, or Paris in Burgundy. The crusaders who followed Peter the Hermit were ignorant of the names of the towns which they passed through in Germany and Hungary. They experienced a defeat at Merseburg; but the contemporary chroniclers, unacquainted with the name of the place, content themselves with calling it *Malleville*, or the city of misfortune. But if the Franks scarcely knew their own country, what must have been their ignorance of the countries of the East? It was so great indeed that they were under the necessity of hiring guides among the Greeks, whom they distrusted, and of committing the fate of expeditions to conductors by whom they were often deceived and abandoned. Several armies, in fact, perished from not knowing the places to which they were conducted by victory. The greater part of the chroniclers were as ignorant as the crusaders; and hence it is difficult to follow their details respecting Asia Minor, Egypt, and Syria. Of more than two hundred who speak of Egypt, not one makes the least mention of the pyramids. James of Vitry, who had sojourned long in Palestine, and who appears to have possessed all the knowledge of his time, repeats, in his description of the East, the fables of the Amazons and the Phœnix. And Joinville, in his *Mémoires*, tells us gravely that the trees of the terrestrial paradise produced cinnamon, ginger, and cloves, and that these spices were fished out of the waters of the Nile, to which they were carried by the winds. In a word, the crusaders, continually occupied with fighting, had neither time nor inclination to study the countries conquered by their arms. But in their train religion and commerce, guided, the one by a desire to spread the gospel, and the other by the hope of amassing riches, opened some new routes, and collected much useful information respecting the East. Mission-

Crusades. aries sent out by the court of Rome also traversed the most extensive regions of Asia; and the relations of Rubruquis, Asselin, Carpin, and Marco Paolo contain observations, the truth and accuracy of which have since been fully confirmed. At the same time, the geographical charts of this period exhibit neither the configuration of the globe, nor the extent of countries, nor the position and boundaries of states; they are limited merely to tracing, by vague designations, what struck the majority of travellers, as, for example, the curiosities of each country, animals, edifices, and men differently dressed. Maps were equally rude. They wanted the four cardinal points, whilst on the four sides were sometimes inscribed the names of the principal winds; Jerusalem was placed in the centre of the three parts of the known world, and around it were grouped the cities of Palestine, Syria, and Egypt, whilst distances were marked without the least regard to accuracy. In short, geography was still in its infancy; but, from the impulse given by the crusades, it soon made considerable progress; and, in the fourteenth century, the countries of the East were much better known.

If the crusaders had profited by the knowledge of the Orientals, some of the sciences most useful to man, such as medicine, might also have been improved. In medicine particularly the Arabians had more positive knowledge than the Latins. At the siege of Ptolemais, Saladin sent his physicians to Richard; but we do not learn that Richard sent his to Saladin when the soldan fell sick. In the first crusade of St Louis, the physicians who accompanied the army understood nothing of the ravages which scurvy and the ordinary epidemic diseases committed in the Christian camp; and their ignorance was not less fatal than the contagion. Nevertheless, the East furnished some processes and remedies from which medicine long derived very great advantage. Cassia and senna came from Asia, and were known in the West at the epoch of the crusades. Treacle, which had so distinguished a place assigned it in the medicine of the middle ages, was brought from Antioch to Venice. And Robert of Normandy, returning from the Holy Land after the capture of Jerusalem, obtained from the school of Salerno a collection of those precepts of health which have since become proverbs amongst all the nations of Europe. Nevertheless, the discoveries and the knowledge of the Orientals in the healing art served in no material degree to enlighten the West; and it may with truth be said that more new diseases than new remedies were imported from the East during the holy wars. Amongst these may be mentioned numerous leprosies, which, for a considerable time, committed great ravages, and at length disappeared, without the aid of medicine.

6. The crusades contributed in several ways to advance the cause of learning. They established relations, which were never wholly interrupted, between the cities of Italy and the empire of Byzantium; and some sparks of the genius of the Greeks irradiated Italy even before the taking of Constantinople by the Turks. A college of young Greeks was established at Paris during the reign of Philip Augustus; and, in the thirteenth century, flourished the Universities of Bologna, Paris, and Salamanca, where the Greek tongue was taught, and latterly the Oriental languages, conformably to a decree of the council of Vienna. When the Turks became masters of Constantinople, the learned, exiled from their own country, established themselves in Italy, where the Greek were, so to speak, married to the Latin muses. The venerable interpreters of antiquity were everywhere cordially received, and the communication of their knowledge repaid the attentions of a generous hospitality. About the same time printing was discovered, and employed to preserve the literary treasures derived from the East against the accidents of time, the fury of war, or the hand of barbarism. The Iliad and the Odyssey found readers in the scenes which had inspired the Æneid; the orations of Demosthenes were perused amidst the ruins of the forum, where still lingered the echo of the voice of Cicero; the genius of the Italians, inspired by the great works of ancient Greek and Roman art, produced new masterpieces; and Italy presented a phenomenon which the world will never again perhaps behold, —that of a nation which, in the space of a few centuries, had twice obtained the palm of literature in two different languages. It is to Constantinople that we are indebted for the philosophy of Aristotle; but whether or not the friends of real knowledge ought to felicitate themselves on this boon seems exceedingly doubtful. Aristotle had disciples, partisans, even martyrs; and the authority of the Bible itself could scarcely compete with that of the philosopher of Stagyra. Reason was studied, not in the mind of man, but in the dogmas laid down in a book; and the laws of the universe were not investigated by induction, but sought for in Aristotle. The schools also exhibited a species of intellectual fencing or gladiatorship. In an age when every thing was decided by violence, the mind even desired to indulge in a species of warfare; and as, in ordinary affairs, victory constituted justice, so, in the schools, it passed for reason. It may be supposed that this disputatious philosophy was little favourable to the advancement of real knowledge; but, on the other hand, whilst it exercised the faculties of men, it contributed to their development; and if it for a season misdirected the human mind, it certainly did not retard its advancement. In the early stages of society, it is not the misdirection of the mind, but its inactivity, which tends to keep nations in the darkness of barbarism. Crusades.

7. Among the productions of the human mind, the first place is due to those which have for their object to preserve the memory of past events. In all the epochs of the middle ages, there appeared chronicles in which facts of importance to history were recorded, with greater or less fidelity. In several monasteries there were kept registers or journals, in which every remarkable occurrence was inscribed; and the monks sometimes communicated these registers at their general assemblies, in the view of rendering their chronicles more complete. The old chroniclers were simple and pious men, who regarded the slightest falsehood as a mortal sin, and sometimes scrupled to tell the truth, even when they knew it, if a shadow of doubt crossed their minds. The greater part would have thought themselves wanting in their duties as historians, if they had not ascended to the creation of the world, or at least to the deluge. Amongst the events which they relate, they never forget those which are calculated to strike the vulgar, and which indeed made a strong impression upon themselves, such as revolutions of nature, famines, and prodigies. But we are at the same time sensibly touched by their simplicity, and interested by their naïveté; and when they speak of marvellous occurrences, which were believed in their time, and of the reality of which they themselves seem fully persuaded, they only delineate their own character, and that of the age in which they lived. Further, it would be a great error to imagine that the Oriental chronicles of the same period are in any degree superior to those which we have been endeavouring to describe. On the contrary, they exhibit the same spirit of superstition and credulity which appears in the chronicles of the West, united with that belief in fatalism which characterizes the Mahommedan religion, and with a degree of negligence or caution which deprives these productions of all individual interest. The chronicles of the middle ages, therefore, have nothing to envy in those of the East. The greater part, it is true, are ex-

Crusca. tremely dry, and destitute alike of precision and method; but there are several which appear to be not altogether unworthy of the attention of historians. Among these may be mentioned William of Tyre, who may be styled the Livy of the crusades; Albert of Aix; Baudry, archbishop of Dol; Odon of Deuil; James of Vitry, whose lively and animated descriptions are clothed in a style at once rapid and flowery, and whose narrative is almost always elegant; and, lastly, Ville-Hardouin and Joinville, who wrote in the French language, and whose works constitute the earliest monuments of French literature.

8. The muse of the troubadours celebrated chivalry, love, and beauty; that of the trouveurs, who inhabited the banks of the Loire, and the provinces situated beyond that river, delighted in graver strains. The trouveurs had rivals both in England and in Germany. Those poets had created for themselves a new and heroic world, which inspired their lofty lays. They celebrated the high feats of Arthur, Renaud, the knights of the round table, Charlemagne, Rolland, and the twelve peers of France; and to these names they added those of Godefroy, Tancred, Richard, and Saladin, whose names possessed a lively interest for all the Christian nations of the middle ages. But these chivalric strains soon gave place to wilder and bolder creations, into which the marvellous entered as a predominant ingredient. The traditions of the North were blended with those of the South, and produced a semi-barbarous mythology, which, in its composite form, had nothing in common with the gay and gorgeous mythology of Greece. But the labours, the perils, and the exploits of a religious war, carried on at a great distance, like that of the crusades, gave a nobler direction to the imagination of poets, and effectually guarded them against whatever was common or extravagant in the romanesque conceptions of a rude age. Hence arose a literature adapted to a new state of society: and if this literature, which had impressed upon it a strong character of national originality, had produced such masterpieces as the Iliad and the Odyssey, the muses would have entered upon a career unknown to the ancients; the language would have been enriched, improved, and fixed; and history would have spoken of the age of the crusades as it now speaks of that of Pericles and Augustus. But the greater part of the poets and romancers of this epoch, having no models upon which to form themselves, and wanting the taste necessary to guide them, could discover no other means of interesting their readers, than by exaggerating the sentiments of chivalry. Imitation, pushed to the extreme, was mistaken for reality; and there were knights, like the hero of Cervantes, who wished to put in practice what they had read in poems and romances. This was the origin of knight-errantry; a practical caricature of chivalry, which, by bringing it into contempt, exposed it to ridicule, and thus sealed the doom of an institution which, with all its follies, absurdities, and vices, has conferred essential benefits upon mankind. The romances which were consecrated to chivalry and the crusades, underwent modifications conformable to those which the manners and usages of society had received; and literature took its tone from the spirit of the time, and in its turn re-acted upon the state of society which had originally imparted to it its peculiar direction and character. Crusca.

Little more remains to be said as to the results of the crusades. To appreciate the advantages which they produced, it is only necessary to consider what would in all probability have occurred if these expeditions had not taken place. In the eleventh century several countries of Europe were invaded, and others were menaced by the Saracens. That remarkable race were then in the full career of victory and conquest; while the Christian states, distracted by discord, a prey to anarchy, and plunged in barbarism, were destitute of all means of defence. If, then, Christendom had not, as it were, gone out by all her gates to attack this formidable enemy, and, at different times, poured forth fresh multitudes of assailants, impelled by a fierce enthusiasm, this enemy, profiting by the inaction of the Christian nations, would have surprised them in the midst of their divisions, and subjugated them one after another to its sway. France, Germany, England, and Italy, might have experienced the fate of Greece and of Palestine, and the crescent might have been elevated in triumph above the shivered fragments of the cross. The crusades, as we have already remarked, presented the spectacle of a fierce and sanguinary contest between two religions contending for the empire of the world. But in this formidable struggle, the real means of defence consisted in superiority of knowledge, civilization, and social qualities. As long as ignorance and barbarism prevailed among the nations of the West, as well as among those of Asia, the victory remained uncertain; but when Europe beheld the dawn of civilization, it then knew security, and its enemies also began to know fear. The Mahommedan religion, by its doctrine of fatalism, taught its disciples to despise the calculations of prudence, and in the day of calamity served to depress rather than to elevate the courage of its warriors. The Christians, on the contrary, lost none of their faculties in their reverses, which often served to redouble their energy and their activity; and the defeats experienced by their armies in Asia excited, even more than their victories, the enthusiasm of the warlike population of Europe. Thus Christianity, and the heroic virtues with which it inspired its disciples in the middle ages, served as an impenetrable buckler to Europe, enabling it to force back the invaders who had long threatened its independence, and to inflict a blow on their power, from which it never afterwards recovered. "On ne peut donc nier," says Michaud, "que les croisades n'aient puissament contribué à sauver les sociétés Européennes de l'invasion des barbares, et ce fut là sans doute le premier et le plus grand de tous les avantages qu'en ait retiré l'humanité."

Gibbon, *History of the Decline and Fall of the Roman Empire;* Voltaire, *Histoire Générale; Encyclopédie ou Dictionaire raisonné des Sciences,* art. *Croisades;* Hercen and Choiseul d'Aillecourt, *Mémoires sur les Croisades;* Mainbourg, *Histoire des Croisades; Esprit des Croisades;* Mills, *History of Chivalry;* Hélyot, *Histoire des Ordres Monastiques;* Jacques de Vitry, *Chronique des Croisades;* Fiévée, *Des Intérêts et des Opinions; Mémoire pour servir à nouvelle Histoire de Louis XII.;* Michaud, *Histoire des Croisades.*

(J. B—E.)

CRUSCA, an Italian term signifying *bran*, was employed to denote that celebrated academy called *Della Crusca*, established at Florence in 1582 for purifying and perfecting the Tuscan language. The academy took its name from the end for which it was instituted, namely to refine the language, and, as it were, to separate the chaff from the wheat. Accordingly, its device is a sieve; and its motto *Il piu bel fior ne coglie, it gathers the finest flour.* In the hall of meeting, everything bore allusion to the name and device; the seats were in form of a baker's basket; their backs were like a shovel for corn; the cushions were of gray satin, in the form of sacks or wallets; and the branches where the lights were placed resembled sacks. The vocabulary *Della Crusca* is an Italian Dictionary composed by this academy, and considered as the touchstone of pure Italian.

CRUSTACEA.

Crustacea. THE subjects of the animal kingdom to which, in this article, we propose to direct the attention of our readers, were considered as related to *Insects* by the authors of the most popular systems of zoology of recent times. In common life they are confounded with animals of a very different character, under the general denomination of *Shell-fish*, and are familiarly known by particular names, as crabs, lobsters, shrimps, and prawns.

The ancients, in their contemplation of shell-fish, denominated such as were furnished with true shells, Οστρακοδερμα, or testacea, whilst such as were covered with a softer crust were termed μαλακοστρακα, or crustacea. The former group comprehends those molluscous animals which are usually described in our systems of conchology (see the article MOLLUSCA of this work), whilst the latter will form the subject of the following remarks.

The crustacea belong to that extensive division of *Annulose* animals which have been denominated *Condylopoda*, on account of the regularly jointed structure of their limbs, and which also includes spiders, insects, and millepeds. They differ, however, in many respects from the three last groups, especially in the greater perfection of their circulating system, and by the adaptation of their respiratory organs to water or damp air. The true character of the differences will be rendered more obvious while we unfold the physiology of the crustacea, preparatory to a few remarks on their systematical arrangement.

CHAPTER I.

PHYSIOLOGY OF THE CRUSTACEA.

Crustaceous animals exhibit various modifications of head, body, and tail. The head bears the antennæ, the eyes, and the mouth, while the body and tail support the organs of locomotion and respiration. The body, above, is usually protected by a thorax or *shield*, marked with grooves or eminences corresponding to the position internally of the more important organs. These parts have been denominated *regions*, with annexed terms indicative of the organs which they cover. Thus the *stomachal region* is situate in the middle of the shield, and immediately behind the eyes, and is followed towards the centre of the shield by the *genital region*, to which succeeds the *cardial region*. Between the cardial region and the junction of the shield with the tail is the *posterior hepatic region*, the *anterior hepatic region* being situate on each side of the stomachal one. The branchial regions extend on each side from the genital and cardial regions to the margins of the shield. These distinctions, which were suggested by the craniological speculations of Gall, are of some value in the discrimination of nearly allied species, and have been successfully employed by the industrious Desmarest in illustrating the character of such as occur in a fossil state, and which in general have their members mutilated or bruised.

SECT. I.—EXTERNAL COVERING.

The covering of crustaceous animals may be considered as composed of a cuticle, a crust or scale containing much earthy matter, and a thin membrane representing the true skin of the vertebral animals. The cuticle in some cases is extremely thin, while in others it is developed into prominent hairs and other similar appendages. The crust Crustacea. contains, besides the animal matter which forms its basis, and which in the lobster constitutes about a fourth of the whole, the carbonates and phosphates of lime, the former occurring to the amount of sixty per cent. the latter to fourteen per cent. in the animal referred to. The flexible laminated matter of the crust remaining and retaining its form after the earthy salts have been dissolved by acidulated water, has been shown by M. Odier to consist chiefly of CHITINE, a substance which constitutes the basis of the elytra of insects, and which differs from gelatine and coagulated albumen in its insolubility in boiling water or caustic potash.

The crusts of crabs and lobsters, though they exhibit various tints of colours when the animals are alive, or not acted upon by heat, yet after death they are suddenly changed to a red colour when subjected to the action of boiling water. This change appears to take place in consequence of the decomposition of a substance, which leaves in a free state a red coloured oil, which, though insoluble in cold or boiling water, is soluble in cold alcohol and sulphuric ether. Besides these singular ingredients in the crust, M. Chevreul has detected the presence of iodine.

The moulting of the crustacea, or the casting of their skins, takes place at seasons of the year differing somewhat according to the species. During this period of their weakness, when their crusts are yet soft, and incapable of yielding the requisite protection which in a mature state they afford, these animals become the prey of their numerous foes. The evil is in part guarded against by their retirement to places of shelter and concealment. In their moulting state we have taken half a dozen of the Lithodes maia from the stomach of a codfish, a place to which they would not have been conveyed had their crusts acquired their mature hardness.

SECT. II.—ORGANS OF MOTION.

The residence to which the crustacea are in a great measure restricted, confines their motions to swimming, walking, and leaping. For the purpose of executing the first of these motions, the feet are constructed with flattened joints, which present a considerable surface of resistance to the surrounding medium; and their expanse is greatly enlarged by the fringe of stiff hairs by which they are in general surrounded, as in *Portunus puber*, figured in Plate CXCV. The gravity of their bodies being considerably greater than the surrounding medium, their suspension and motion in the water can only be effected by the active use of their limbs, while their progress is usually irregular. In walking, the crustacea, in general, advance sidewise, owing to the motions of the limbs being perpendicular to the mesial plane, instead of parallel to its direction, as in many other animals. Their progress, even laterally, is irregular and constrained. Indeed they appear better adapted to move over an uneven surface, by a process resembling climbing, than by ordinary walking. They mount with ease along the leaves of the sea-weeds, and the stems of the zoophytes, in search of their prey.

When pursued by their foes, or even in the execution of their ordinary purposes, many species are capable of leaping with considerable facility. This kind of motion they effect by suddenly unbending their tail or abdomen. In swimming they not unfrequently combine in their progress the leap with the employment of the feet as oars. In some

Crustacea. species the kind of progressive motion is confined to walking or climbing, in others the motion is exclusively natatory.

The limbs of the crustacea consist of the five following parts: The *hip* is the medium of articulation between the limb and the body, and is divided into two parts; the *coxa* next the body, and the *trochanter* articulating with the thigh. These two joints are usually short, and nearly equal in size. The *thigh* or *femur* is usually the longest and the thickest of all the joints in the limb. The *leg* or *tibia*, though shorter than the thigh, frequently exceeds in dimensions, especially in length, the hip-joints. The tarsus is in general as large as the leg, and supports the last joint or claw. When the claw or unguis is placed on the extremity, or as a continuation of the tarsus, a *simple* leg is formed; but when placed laterally, so as to move and act in opposition to the extremity of the tarsus, it performs the function of a thumb, and the limb is said to have pincers, or to be *didactyle*.

The facility with which the crustacea can throw off their limbs when they are injured or detained, has often attracted the notice of the curious. The suture at which the parting takes place sustains but little loss by bleeding, and is soon able to exercise its reproductive functions. The new-formed limb, however, is smaller in all its dimensions, though consisting of the same number of parts, than the one thrown off; and it is not till after several moultings that the new limb acquires its mature size. The repairing power can more easily renew a whole limb than an individual joint, and is incapable of repairing a bruised or mutilated one. When the annual moulting of the crustacea is taken into consideration, this renewing process of the limbs will excite less surprise, though it still displays a striking feature in the economy of these animals, that in order to save their bodies from capture by their foes, they can cast off so readily the claws or legs which have been seized.

SECT. III.—ORGANS OF SENSATION.

The nervous system in the crustacea may be considered as exhibiting three different modifications. The first of these forms is displayed in the Podophthalma, or those with moveable pedunculated eyes, in which the brain is formed above into four lobes, the two middle giving rise to the optic nerves. Below, four nerves take their rise, and proceed to the antennæ, detaching in their course some filaments to the neighbouring parts. The posterior portions of the brain give rise to the two cords, which, in their course, supply the mandibles with filaments, and, after encircling the alimentary canal, unite in forming a medullary oval ring-like mass in the middle of the thorax, many times larger than the anterior ganglion or brain. From the circumference of this ring nerves proceed to the jaws and feet, and, retrally, a single nerve is sent to the tail. This arrangement prevails in the common crab. In the cray fish, the cords which proceed from the brain are shorter, and, after forming the collar, unite in an oblong ganglion, and supply the jaws with nerves. Leaving this ganglion, the two cords remain near each other, uniting at intervals to form five ganglia for the supply of the corresponding pairs of feet, and afterwards proceed into the tail, where they form six ganglia: the last of these masses gives rise to four nerves, which are distributed as radii to the scaly fins that terminate the tail. In the first condition of the nervous system the ganglia are reduced to two in number, by the union of all the ganglia behind the collar into a single medullary ring, a form well suited to the compact orbicular form of the body. In the last condition the lengthened form of the body draws out, as it were, the nervous cords, to form several ganglia, though these cords preserve a tendency to approximate throughout their Crustacea. whole extension.

The second form of the nervous system in the crustacea is exhibited in the Edriophthalma, or such as have sessile eyes. Among these animals the two cords of the nervous system, as in Talitrus, in proceeding from the brain, do not coalesce at any point, but form their ganglia separately, symmetrically, and in pairs. Though this modification of the nervous cords be so different from that which prevails in the former group, in the tendency of these cords to keep separate, there appears in Idotea and other genera a tendency in each cord to become accumulated or condensed towards the middle of its ordinary course, as in the common crab.

In the third form of the nervous system, occurring in the Entomostraca, the development is imperfect. In some the brain is in the form of a nearly transparent globule, the medullary cord double, with an enlargement at each of the numerous articulations of the body. In others the substomachal ganglion, though distinct, gives rise to filaments which, though representing the two cords, scarcely swell into ganglia in their course.

The eyes of the crustacea are either compound or simple. The compound eyes are sessile in one group, and little elevated above the common integuments. In another they occupy the extremity of a moveable peduncle, differing greatly in length according to the genera. In general the eyes are two in number, in some cases four, and in a few instances they seem to unite in one spot. The compound and simple eyes occur in different animals, though in other cases in the same individual both kinds of eyes exist.

The organs of hearing among the crustacea generally may be considered as in a great measure obliterated. Among the decapodous podophthalma, however, distinct traces of this sense may be observed in a perforated cavity, situate at the base of each of the exterior tentacula, filled with a watery fluid, and supplied with auditory nerves. The sense of smell is inferred more from the habits of the species than from their structure, and a similar remark is applicable to the function of taste. The organs of touch, however, are very fully developed. The number of tentacula they possess, together with numerous other external organs, readily give information of the presence of objects, and likewise of their shape. The eye and the touch are indeed the two senses which occur in this class in the fullest development. The taste and smell perhaps come next in order.

SECT. IV.—ORGANS OF DIGESTION.

The organs exhibited by the crustacea, which assist in the capture of their prey, are of various kinds. The organs of motion are extremely well adapted for preserving within the reach of the mouth the object which is to serve as food, and the organs of the mouth exhibit a remarkable degree of complexity. In the decapodous crustacea an upper lip or labrum may be observed, covering a pair of mandibles with their palpi. Underneath these may be found the first pair of maxillæ, similar in many respects to those belonging to insects. The second pair of maxillæ, which follow, appear to occupy the place of the under lip or labium of insects, within which is a tongue, but imperfectly developed, and usually bifid. These organs of the mouth are covered by three pair of auxiliary maxillæ, which are regarded as corresponding with the three pair of feet in insects, an analogical inference which receives considerable countenance from the circumstance that the number of legs increase in certain genera, in proportion as the auxiliary maxillæ diminish in number, these undergoing modifications fitting them for their new functions.

The ordinary food of the crustacea appears to be either minute zoophytes and molluscous animals, or dead animal matter. In some species a preference appears to be given to vegetable food; and one crab, the Birgus latro, is celebrated for climbing trees for the purpose of stealing or rather eating cocoa nuts. To entice their prey, or conceal their own approach, a few crustacea, as the Inachi and Macropodiæ, cut portions of fuci and corallines, which they cement to their bodies, and in this grotesque style of dress effectually hide their true forms. It is not improbable that in this garb they can transport themselves more readily from one place to another, it being practised chiefly by those species which are bad swimmers. The dead substances on which so many of the crustacea feed are probably discovered by the help of their organs of smell; and so quickly do they detect substances suited to their taste, that the lobster creels and crab pots, when suitably baited, seldom fail to allure their victims.

The masticating organs are succeeded by a short gullet opening into a stomach more or less complicated, with cartilaginous bands, in many genera furnished with osseous teeth, to complete the reduction of the solid food which the mouth had been unable to bruise. On each side of the stomach a round flat calcareous stone is found previous to the moulting, which serves as a store of earthy matter for the renewal of the shell. These stones, vulgarly known by the name of crabs' eyes, were long highly esteemed for their medicinal virtues as absorbents. The intestine, in the decapodous crustacea, has a valvular enlargement with an attached cæcum. In the other groups the intestine is simple, proceeding directly to its terminal opening under the tail.

SECT. V.—ORGANS OF ASSIMILATION.

The nutritive fluids derived from the contents of the stomach and intestines, are conveyed, in the decapodous crustacea, to a pulmonic ventricle, situated dorsally and retrally in reference to the stomach. From this vessel one or two principal arteries have their origin, and transmit the blood by as many subdivisions as there are branchiæ. After the process of aeration has been effected, the blood is returned to a heart, placed ventrally or below the intestine, forming in this manner a nearly complete double circulation.

Among the Entomostraca the heart appears to be single, and to approach in its character the dorsal vessel of insects.

The organs of respiration are of three kinds. Among the decapoda they are plumose pyramids, situate at the base of the feet, covered by the shell, and watered by a current which enters by an aperture from behind the feet, and escapes by an opening near the mouth. Two pair belong to the auxiliary maxillæ, and five pair to the true feet, in the true crabs; while among the lobsters the branchiæ belong to the four anterior feet, and the first auxiliary jaws have four in each group, making twenty-two branchiæ in all, on each side, instead of fourteen as in the former group.

In another group of crustacea the branchiæ are not concealed, as in those already noticed, but are external, appearing under various forms, attached to or occupying the place of natatory feet. In a third the branchiæ are reduced to vascular scales, differing greatly in the degree of exposure or protection.

The liver occupies a prominent place, being very fully developed. In the decapoda it is placed ventrally to the stomach, large in its size, indeterminate in its form, and of a yellow colour.

Among the peculiar secretions of the crustacea, the singular property of emitting light, which some species possess, merits some notice. On the passage from Madeira to Rio de Janeiro, the sea was observed by Sir Joseph Banks to be unusually luminous, flashing in many parts like lightning. He directed some of the water to be hauled up, in which he discovered two kinds of animals that occasioned the phenomenon; the one a crustaceous animal, which he called Cancer fulgens. In form it bears some resemblance to the common shrimp. It is however considerably less, and the legs are furnished with numerous setæ. The light of this animal, which is very brilliant, appears to issue from every part of the body. The light is otherwise distributed in another crustaceous animal, observed by Captain Tuckey in the Gulf of Guinea. The luminous property resided in the brain, which, when the animal was at rest, resembled a most brilliant amethyst, about the size of a large pin head, and from this there darted, when the animal moved, flashes of a brilliant silvery light.

SECT. VI.—ORGANS OF REPRODUCTION.

With the exception of some entomostracous genera, the sexes are distinct among the crustacea in different individuals. The males abound in some of the genera, in others the females occur in apparent excess. In the decapodous group the seminal organs are situate between the stomach and heart, towards the centre of the body, and send forth two vasa deferentia to the two external organs, which may be observed behind the fifth pair of feet. The ovaria also occupy a central position, and each sends out a tortuous oviduct, opening in the corresponding third sternal plates at the base of the third pair of feet. With the edriophthalma, in general, the sexual organs are placed under the tail. Among the Entomostraca these organs vary greatly in the different groups, and in some genera the sexes appear to be united; and among the Daphniæ a single intercourse with the male suffices to render prolific seven or eight generations.

The evolution of the egg takes place in several of the Entomostraca within the body of the mother, but in general the hatching is external. In the latter case the eggs, often amounting to a great number, are attached by a glutinous cement to certain filaments under the tail, or to certain plates with which the branchiæ are also connected. In other cases, as Cyclops quadricornis, the uteri are external sacs.

When newly hatched, the young of some of the Entomostraca nearly resemble the parent, while in others the difference is so great as to have given rise to spurious genera. In the more perfect groups, as among the edriophthalma, the young are deficient in the number of segments of their body and corresponding number of feet, which they acquire by degrees. Among the decapoda it was long considered that they issued forth from the egg in a perfect state. The interesting "Zoological Researches" of Mr Thompson have, however, unfolded more correct views, and demonstrated the existence of a metamorphosis so great, that in the first stages of their growth they have been constituted into particular genera, of which zoea is the type. In this condition the young are essentially natatory, with cleft members, which change into simple feet, solely, adapted for crawling. Mr Thompson has traced this change in many decapodous genera. In the genus Mysis the change from the young to the adult state is effected by a gradual and successive development of parts. According to the observations of Rathke, the young crawfish, when it bursts the egg, has the external organs formed, but in a soft state, and advances to maturity by gradual development.[1]

With the observations of Mr Thompson in view, con-

[1] See Supplemental Remarks.

Crustacea. trasted with those of Rathke, it seems desirable that the early life of the crustacea were studied with care, and the facts established subjected to the process of a cautious generalization.

The duration of the crustacea has not been investigated with care. Among the Entomostraca the individuals seem to perish with the close of the season in which they had their birth, leaving behind them eggs, to be hatched in the following spring, as preservatives of the race. In the higher groups, especially the decapoda, life is maintained during a succession of years. When moulting, they are an easy prey to their foes; and when their shell has acquired its hardness, the seeds and eggs of a variety of parasitical plants and animals adhere to it, locomotion is retarded, and starvation follows.

In the distribution of the crustacea, the greater number of species live in the sea, a few in fresh-water lakes and rivers, and fewer still on the land. These last, however, visit the sea periodically to deposit their spawn, and at all times can preserve their gills in a moist state, to enable them to effect the process of aeration of the blood. Some lodge in holes excavated in the mud, while others seek protection in a deserted univalve shell, requiring such a covering to their tender and soft posterior extremity.

The species which have become extinct are few in number, and chiefly confined to the newer series of rocks, if we except the anomalous group of Trilobites, afterwards to be taken notice of. In the rocks of the saliferous epoch few traces of crustaceous organisms occur. During the cretaceous epoch, however, or at the period when the various deposits of oolites, lias, and chalk were in the course of formation, several crustaceous animals appear to have flourished, the remains of which now occur imbedded in these rocks. The species chiefly belong to the Macrourous tribe, approaching generally the shrimps in character. In the strata of the penult epoch, or those which are interposed between the chalk and the sedimentary masses of a comparatively modern date, the remains of crabs and lobsters occur pretty generally distributed. In the rock well known under the denomination London Clay, they have been found imbedded in considerable numbers. The cause of the extinction of these crustaceous species, at these different periods, must be sought for in those physical alterations which took place on the globe, by which the very materials brought into the seas and lakes by rivers, to form stratified matter, at these distinct eras, presented altered characters. Such changes rendered the seas unfit to support one race of beings, while it became a suitable abode for those which were destined to succeed.

The crustacea are extensively employed for dietetical purposes. They are eagerly sought after on many parts of our rocky coast, and traps for their capture are in very general use. This kind of fishery, as being of a *littoral* kind, is chiefly prosecuted by the more aged of our maritime population, who have become unfit for employment where greater vigour is required. These fishers make themselves familiar with the haunts as well as the general economy of their game, and the kind of garbage which constitutes the most enticing bait. As food, the crustacea are used either plainly boiled, or dressed with various condiments, sometimes also marinated with vinegar.

CHAPTER II.

SYSTEMATICAL ARRANGEMENT OF THE CRUSTACEA.

The species known to Linnæus were few in number, and were distributed into the four genera, Cancer, Oniscus, Monoculus, and Phalangium. In the genus Cancer the celebrated Swede introduced a number of sections or sub- Crustacea. divisions which succeeding authors have raised to the rank of orders or genera. Fabricius enlarged the number of genera of crustaceous animals, assigning to them, at the same time, more precise distinguishing characters. In this field of improvement he was followed by Latreille, Lamark, Dumeril, and Leach. The last-mentioned naturalist, by great zeal and labour, has not only added many new species to the class, but has succeeded in unfolding many new characters, and giving to the generic marks a degree of precision which they did not previously possess.

The various groups into which different naturalists have divided the crustacea resemble one another more in their composition than in the terms by which they have been designated. If we assume the aerating organs as the basis of arrangement, we shall find, correlative with these, certain distinguishing features in the circulation and in the nervous system, as well as in the digestive and locomotive organs. Such considerations appear to have induced Lamark to distribute the crustacea into two orders, which he has termed Homobranchia and Heterobranchia, the former having a solid shield concealing the branchiæ, which are placed on the sides at the base of the feet and auxiliary jaws, while the aerating organs of the latter never occur in the same position, but are variously placed in the different subordinate groups. The organization of the first order is extensively developed, and furnishes well-marked features of discrimination, separating it from the second division, which includes animals of more simple structure.

ORDER I.—HOMOBRANCHIA.

The crustaceous animals of this order have the body covered by a continuous shell, which contains the viscera, and a tail which serves the threefold purpose of giving passage to the extremity of the intestinal canal, of acting as an organ of progressive motion, and of retaining the eggs by means of its fringed appendages. The thorax and abdomen, as well as the head, may be considered as united. The eyes are two in number, and compound, lodged in cavities in the anteal margin of the shield, and are supported on moveable peduncles, which vary greatly in their length in the different groups. The peculiar footstalks of the eye have given rise to the term *Podophthalma*, by which in some systems they are denominated. The antennæ are four in number, the intermediate pair being divided into filaments. The mouth occurs in this group in its most complicated form, with three pair of auxiliary jaws furnished with palpi. The legs are ten in number, the first pair usually of a large size and formed into pincers, the rest terminating in simple claws. In some cases, however, the second and third pairs are also formed into pincers; and in some of the genera the posterior pair have compressed joints as oars for swimming. The regularity in the number of feet in this group has suggested the term *Decapoda*, by which they are denominated by Latreille. In the structure of the tail the animals of this division exhibit very remarkable differences. In one tribe the tail consists of but few joints, the last one being simple, the whole shorter than the body, and usually folded up under the shield in a cavity for its reception. This shortness of the tail has suggested the title Brachyura. In the other tribe the tail is usually exposed, about the length of the body, and furnished with plates at the extremity. The second form of the tail has given rise to the term Macroura, by which they are known.

1. *Tribe Brachyura.*

In this division of crustaceous animals the body is usually of an orbicular or compact form, and this condition,

 joined with the imperfect development of the tail, restricts the progress of the species to crawling rather than swimming. The animals here referred to are well known under the familiar name *crabs*. The sexes are readily distinguished by the form of the tail, which in the male is narrow and short, while in the female it is proportionally of much greater dimensions.

Among those animals of this tribe which exhibit the more ordinary forms, there is one family characterized in a particular manner by the structure of the feet being adapted to swimming. In general with such the body is broad, rather short, rounded anteriorly, and the margin spinous. With the exception of the pincers, which are fitted for grasping, all the remaining feet in some genera are formed for swimming, while in others the flattened form of the joint is restricted to the hinder pair. The facility with which these animals can transport themselves permits a wider range of motion than the other species, which are chiefly confined to the shore. In a foreign group, including the genera Podophthalma and Lupa, the peduncles of the eyes are remarkably produced, and received into a groove on each side. In the other genera the eyes have short stalks lodged in oval cavities. The genus Portunus contains many species which are common on our shores, but seldom applied to any useful purpose.

A second family of crustaceous brachyuri, denominated ARCUATA, have the joints and claws of the feet rounded and conical. The anterior margin of the shield is semicircular and full, while the posterior is contracted and truncated. Like the preceding family, the tail of the males in general has only five joints. They chiefly inhabit our rocky shores, and are eagerly sought after. It is in this group that the cancer pagurus, or common crab, occupies its place in the system generically characterized by the large basilar joints of the exterior antennæ, and economically employed as an esteemed article of food.

The family QUADRILATERA, as the name implies, have a more or less quadrangular form, in some species approaching to heart-shaped, with the front inclined, forming a sort of hood, and truncated. The tail in both sexes consists of seven distinct fragments. Though in these points of resemblance the genera of this family stand related to one another, yet in their habits or physical distribution they exhibit the most striking differences. Among those which inhabit the sea, the *Gonoplax angulata*, a species not uncommon on the southern and western coasts, lives in excavations formed in the hardened mud, open at both extremities; the *Pinnotheres*, a genus containing several species, take up their abode in living bivalve shells, such as mussels, pennæ, and oysters. By some of the ancients these crabs were considered as acting as sentinels; by others, as co-operating for interested purposes.

> Thus fed by mutual aid, the friendly pair
> Divide their gains, and all the plunder share.

A few of the species of this group, belonging to the genus Thelphusa, are restricted to fresh water, from which however they can withdraw themselves for a while to the air. The Thelphusa fluviatiles, figured at Plate CXCV., found in Italy, the Levant, and Egypt, is esteemed as food, and occupies a prominent figure on ancient Greek medals. When the attention of the economists of this country shall have been suitably fixed on the importance of peopling our present watery wastes, including lakes and rivers, with animals of ornament and use, it appears probable that this species of crab will speedily be naturalized, its habits furnishing every facility for its transportation.

A third group in this family are capable of inhabiting the land, burrowing in holes, and feeding on all sorts of garbage. They are chiefly confined to the equatorial regions. As an example, see the Gecarcinus ruricola, figured on Plate CXCV.

A fourth family, denominated *Orbiculata*, exhibit a rounded shell, usually solid and smooth, the peduncles of the eyes short, the pincers of unequal length, according to the sex, the region of the mouth contracted at its upper extremity, with the third joint of the outer auxiliary feet in the form of a lengthened triangle. The Corystes cassivelanus, figured Plate CXCV belongs to this group,—a species which is very common in the sandy bays of the country, and frequently cast ashore after storms.

The group which has been denominated *Trigona* is more distinctly marked than some of the preceding families. The body is full and rounded behind, and produced and pointed before, and in many species armed with strong spines. The legs are usually long and slender, and hence the name of sea spiders, by which they are familiarly known. The region of the mouth is nearly square. To some of the species, as *Maia squinado*, a susceptibility to the charms of music and extraordinary sagacity have been attributed. Another species, *Hyas araneus*, is detested by the oyster fishers, as injurious to the young spawn.

The two remaining groups of brachyuri, which may be denominated *Heteropoda*, from the condition of their legs being peculiar, are capable of division into two families. The first, termed *Cryptopoda*, have the shield semicircular or triangular. The feet, with the exception of the pincers, are capable, when at rest, of withdrawing into a marginal cavity of the shield. In the genus *Calappa*, the pincers are elevated into a crest above, and folded in the anterior margin so as to close in the front of the shield. The species are natives of equatorial seas.

The other group, termed *Notopoda*, is distinguished by the last pair of feet having their origin above the general margin of the shield. This gives to these organs a dorsal rather than a ventral aspect. The species are few in number, and in general strangers to the northern seas, though one species of the genus Dromia has been recently added to the British fauna.

2. *Tribe Macroura.*

The crustaceous animals belonging to this division, familiarly known as lobsters or shrimps, have the body more produced than in the preceding. The tail is as long, or longer, than the body, exposed or simply recurved at the extremity. It is composed of seven segments, with appendages at the extremity, forming a fin. In their motions they are more agile than those of the preceding group, and as their organs are of a natatory character, the species are restricted in a great measure to the waters.

In the first division of this tribe, including the species of more perfect organization, the first pair of feet at least are in the form of pincers, the remainder not bifid or natatory. The lateral appendages of the tail are so placed as to form a fan-shaped fin.

In the first subdivision of these crustacea, denominated by Latreille *Carides*, the exterior antennæ are placed more ventrally than in the intermediate pair, and have their peduncles covered by a large scale or plate. The snout projects, and is frequently spinous, while the body is usually much incurved. There are five pairs of caudal feet. Some of the species are eagerly sought after as food, as the common shrimp, Crangon vulgaris, along with another species, Palæmon serratus or prawn.

The second subdivision, including those species having the antennæ placed on the same line, readily admit of distribution into three families. The first, including the genus *Scyllarus*, has the pincers imperfect, and the external antennæ destitute of a stalk, with the basilar joints dilated,

Crustacea. forming a horizontal crest on each side. It may be considered as an equatorial group.

The second family exhibits equally imperfect pincers, but the external antennæ are largely developed. The *Palinurus vulgaris*, or thorny lobster, sometimes also termed cray-fish, is a well-known example in the markets of London and Paris.

The third family, of wh ch the common lobster may be regarded as the type, has the first pair of legs in the form of pincers, and in some of the other genera the second, and even the third pairs, are didactyle. The group contains a few fresh-water species, among which the *Astacus fluviatilis* or craw-fish may be mentioned, as inhabiting many of the rivers of England, in the clayey banks of which the individuals form their holes.

The second division of Macrouri exhibits certain anomalous characters, which separate them from the more perfect and regular group to which we have made reference. The first subdivision comprehends the hermits or soldier crabs. These are distinguished by the tail not being in the form of a fin, and the diminished size of the posterior legs. In one group all the upper parts are crustaceous and protected, but in another, a portion of the thorax and the tail being membranaceous, they are exposed to greater danger. This is guarded against in a remarkable manner. Many of the species inhabit deserted univalve shells, introducing their short tail into the spiral cavity of the shell, their thorax filling the last whorl. The pincers, which are in some measure protected by the pillar of the shell, are the least in size. These crustacea move easily from place to place in their assumed abode, and shift into a shell of larger dimensions as their own bodies increase in size. The *Pagurus Bernhardus* is common on all our shores, and is figured at Plate CXCV.

Another species, the *Pagurus Diogenes*, common in Jamaica, for example, may be viewed as a terrestrial species.

The second subdivision, denominated Fissipedes, are destitute of pincers, while the feet have an appendage externally, issuing near the base, giving them a natatory character. Instead of the eggs being carried by the false feet under the tail, they adhere to the base of the thoracic feet; a circumstance which has given rise to the denomination opossum shrimps.

ORDER II.—HETEROBRANCHIA.

The crustaceous animals of this order exhibit characters more varied and anomalous than those of the preceding order. The branchiæ are external when they consist of imbricated plumes, or in the form of aerating pouches, but never placed, as in the preceding order, under the shield, but either on the under side of the belly or tail, and unconnected with the auxiliary jaws. They are of small size when compared with those already noticed.

The animals of this order may be divided into two tribes, in the first of which should be placed those which have their mandibles bearing palpi, and into the second those having mandibles destitute of such appendages.

Among the crustaceous animals of the first tribe with mandibles furnished with palpi, the *Stomapoda* seem entitled to hold the first rank. In the pedunculated form of their eyes they resemble the animals of the order homobranchia. The branchiæ are exposed, and attached to the five pair of appendages under the tail, which act as natatory organs. The covering is usually soft, and even transparent. In general the species of this family inhabit the tropical seas. The Squilla mantis, however, is a native of the Mediterranean; and the *Alima hyalina*, from the west coast of Africa, is figured in Plate CXCV.

With the second family of palpigerous crustacea denominated *Amphipoda*, the group commences which has been termed *Edriophthalma*, having sessile eyes, all those groups previously referred to having their eyes seated on a peduncle. The Amphipoda have the body usually compressed and incurved. The first pair of feet, corresponding to the second pair of auxiliary jaws in the decapodous crustacea, are attached to the first segment of the body. The branchiæ appear to be constituted by the hairs on the divided natatory appendages under the tail. Some of the species occur in rivers and streams, others attach themselves to the sea shore. They swim on their side, and many species leap with facility by the sudden unbending of their body. They prey upon dead animal matter, and constitute a favourite article of food for the birds which frequent the shore. Crustacea.

In the crustacea which follow, the mandibles are destitute of palpi. The family denominated *Læmodipoda* are distinguished by the absence of the tail, the last pair of legs being inserted near the extremity of the body. The anterior pair of feet are attached to the head; these, together with the following pair, which are the largest, end in pincers. The tentacula are four in number. At the base of the third and fourth pairs of feet, in some cases also of the second pair, are vesicular appendages. The third and fourth pairs of feet are in some species greatly reduced in their organization. The species of some of the genera dwell among fuci and zoophytes, while some Cyami attach themselves to the bodies of cetaceous animals, and are on that account known to sailors under the denomination of *whale lice*. The Cyamus ceti is figured on Plate CXCVI.

The *Isopoda* differ from the preceding group, in the anterior feet not being attached to the head, but, like the following pairs, connected with a distinct segment of the body. Leaf-like appendages, or vesicles, occur under the tail, usually inclosed or covered by lateral plates. The habits of this group exhibit very remarkable differences. The *Epicarides*, having neither eyes nor antennæ, are parasitical on the prawn.

Among the *Cymothoada*, the Limnoria terebrans, though of small size, is well known as peculiarly destructive to beams of timber employed in the construction of sea harbours.

The peculiar character of this animal was first ascertained by that eminent engineer Mr Stevenson, during his observations connected with the construction of the Bell Rock light-house. It excavates its cylindrical hole for its dwelling, and propagates so rapidly that in a few years submerged timber is rendered useless. So destructive indeed is this small animal, that Norway logs laid down at the Bell Rock to support temporary railways in 1807, were found, when lifted in 1811, to have been reduced by its ravages from ten inches square to seven inches, or at the rate of about an inch in the year. Mr Stevenson, in order to observe more particularly the ravages of this destructive animal, fixed down on the Bell Rock in 1814 specimens of teak wood, oak, black birch, Memel and Norway fir timber. The only specimen which remained unperforate till 1820 was the teak wood; the rest were almost entirely destroyed in the course of two or three years. Sheathing with copper the beams thus employed in marine architecture, seems to be the only preventive of the injuries of this small but successful destroyer.

The Idoteadæ have habits, as marine species, differing little from the Amphipoda. One species, figured at Plate CXCVI., has been denominated, from its locality, *Astacilla Baffini*, a native of Baffin's Bay. The genus to which it belongs was instituted by the Rev. Charles Cordiner of Banff in 1784, for the reception of a British species which has been denominated *Astacilla longicornis*. The same

 species was afterwards described in Sowerby's *British Miscellany* in 1805, as a new species, under the title *Oniscus longicornis*. In 1825 it was produced by Dr Johnston of Berwick, not only as a new species, but as constituting a new genus, to which the name Leacia lacertosa was assigned. The other species, Astacilla Baffini, was collected by Captain Parry among the marine productions of the Arctic seas, and figured and described by Captain Sabine, in the appendix to the First Voyage, as *Idotea Baffini*. Overlooking the observations of our arctic voyagers, M. Latreille, in the fourth volume of the *Regne Animal* of Cuvier, revived the arctic species under the new title *Arcturus tuberculatus*.

In those denominated Assellota, the Asellus aquaticus occupies a distinguished place. It is a fresh-water species.

The Oniscides terminate the group. They are terrestrial, requiring, however, damp air, to enable the branchiæ to exercise their functions. They are denominated in England wood-lice, in Scotland slaters.

The last crustaceous group of the *Heterobranchia* which we have to notice have been denominated *Entomostraca*, or *Branchiopoda*. They have corneous integuments, with a shield in one piece, or divided like a bivalve shell. Hence the origin of the first of the epithets by which they have been characterized. The branchiæ are in the form of hairs or feathers, forming a part of the feet. In general these crustacea are of small size, and may be denominated microscopical. The fry of some of the decapodous crustacea have in this group appeared as distinct genera; while the fry of species belonging to the group have been raised to the rank of genera.

The first great division of the Entomostraca includes the animals of which the genus Monoculus of Linnæus consists. They are distinguished by their simple natatory feet, the eyes united, the antennæ generally four in number, the mouth composed of a labrum, two mandibles, a tongue, and one or two pair of jaws. The head is incorporated with the thorax.

In one family, the *Lophyropa*, the feet do not exceed ten, with joints more or less cylindrical. The *Cyclops quadricornis*, to be found in almost every fresh-water pool, is an interesting example of the group. When kept in a phial, it multiplies with amazing rapidity, and forms a pleasing object for the microscope. The females may be readily distinguished by the bags on each side of the tail, as represented in Plate CXCVI., containing the eggs. In another family, in which the body is inclosed in a bivalve shield, the individuals of many species are to be found in ditches in vast numbers, and form very pleasing objects of observation. Among these the peculiar markings of the Cypris ornata, figured at Plate CXCVI., seldom fail to arrest the attention.

In the second family, denominated by Latreille *Phyllopa*, the number of feet exceed twenty, and their joints, especially of the posterior ones, are flattened in the form of ciliated leaves. The eyes are two in number, and in some instances pedunculated. The *Artemia salina* occupies a prominent place in this group. It is commonly known by the name of Lymington shrimp, or brine-worm. The Rev. Mr Rackett has furnished the following interesting notice of this curious animal:—

"Myriads of these animalcula are to be found in the salterns at Lymington, in the open tanks or reservoirs, where the brine is deposited previous to the boiling. It attains the desired strength by evaporation, from exposure to the sun and air, in about a fortnight. A pint contains about a quarter of a pound of salt; and this concentrated solution instantly destroys most other marine animals.

"These tanks are called clearers, as the liquor becomes clear in them; an effect which the workmen attribute in some degree to the rapid and continual motion of the brine-worm, or to the particles which cloud the liquor serving for its food; but this is mere conjecture. So strongly persuaded, however, are the workmen of this fact, that they are accustomed to transport a few of the worms from another saltern, if they do not appear at their own. They increase astonishingly in the course of a few days.

"It is observable that the brine-worm is never found in the sunpans, where the brine is made by the admission of sea-water during the summer, and which are emptied every fortnight; but only in the pits and reservoirs, where it is deposited after it is taken out of the pans, and where some of the liquor constantly remains. When it becomes much diluted with rain-water, from October till May (during which time the manufacture is at a stand), a few only of the worms are visible; but at the approach of summer young ones appear in great numbers."

Another species, the *Branchipus stagnalis*, figured in Plate CXCVI., greatly magnified, is found in ditches of soft standing water, in which they swim constantly on their backs, keeping themselves suspended by the vibrations of their numerous fins, and moving forwards by giving a sudden spring with their tails. They delight much in the sunshine, during which they appear near the surface of the water. On the least disturbance they start in the manner of small fish, and endeavour to secrete themselves by diving in the soft mud.

A third species of the group, the Lepidura prolongata, greatly resembles the preceding, in being found in stagnant marshes, usually in great numbers, making their appearance in certain years in those places to which for a time they had been strangers.

The second great division of the Entomostraca, denominated by Latreille *Pœcilopoda*, differ from the preceding in the ambulatory or prehensile character of the anterior feet, and the branchial or natatory forms of the posterior ones. They are likewise destitute of mandibles, and even jaws, the mouth being suited for soft food. They live, in general, as parasites on the bodies of fishes, feeding on their substance. The *Caligus curtus* feeds on the gills of the salmon; the Anthosoma Smithii, figured in Plate CXCVI., adheres to the shark.

Besides these more ordinary groups of crustaceous animals, to which a general reference has been made, there are yet two others to which we shall merely allude. The *Trilobites* occur only in a fossil state. They make a near approach to the *onisci*. But even in the best preserved specimens the existence of feet has not been satisfactorily determined. By the labours of Brongniart, Desmarest, and others, the permanency and difference of certain forms have been ascertained, so as to justify the establishment of several genera in the group, and enable geologists to employ more definite language.

The *Cirrhipides*, including the shells which constituted the Linnean genus Lepas, make a near approach to the crustacea in many respects, especially to the Entomostraca. But in an article of this kind it would be unprofitable to give the detailed view which would be requisite for the purpose of establishing the relationship, by the exhibition of the analogies which exist.

The crustacea are in general very easily preserved for the cabinet. Their members readily relax after being dried, and admit of being *set* according to any particular attitude. The species which inhabit the sea require to be steeped for several hours in fresh water before they are dried. If this precaution be omitted, the salt water which adheres to the several parts, especially the ligaments, keeps them damp, and occasions mouldiness and decomposition.

In studying the crustacea generally, the following

Crustumerium || Cryolite.

works may be consulted with advantage:—Latreille, *Histoire Naturelle générale et particulière des Crustaces, et des Insectes;* Lamarck, *Histoire Naturelle des Animaux sans Vertèbres;* Cuvier, *Règne Animal;* Desmarest, *Considérations générales sur la classe des Crustaces.*

In the examination of the British species, useful help may be obtained from the *British Zoology* of Pennant. *The Entomologist's Useful Compendium,* by Samouelle, containing a compilation of Leach's views, will yield much assistance, especially if Leach's splendid work, *Malacostraca Podophthalma Britanniæ,* be accessible. (J. F.)

SUPPLEMENTAL REMARKS.

The history of the detection of metamorphoses in crustaceans is curious. The first discovery is undoubtedly due to Slabber, who in 1778 published an interesting little book in which he figures the animal (afterwards described by Bose) as a new genus of crustacean, under the name of *Zoea,* which he saw transformed into another form, of which he also gives a figure, that evidently belongs to the animal described by Leach as a *Megalopa.* Both forms were proved by Vaughan Thompson to be metamorphoses of the shore-crab, *Carcinus Mænas.* The discovery of the Dutch naturalist was not recognised by any writer until the publication of Thompson's paper in the London Phil. Trans. for 1823. The conclusions of Thompson were called in question by Mr Westwood in a succeeding volume of the Transactions; but have since been confirmed in the beautiful work of Heinrich Rathke's, entitled *Untersuchungen über die Bildung und Entwickelung des Flusskrebses,* published in folio at Leipzig in 1829. In this work Rathke established the metamorphosis of the river prawn, *Astacus fluviatilis.* It was proved also by Mr Brightwell in the common lobster, *Homarus vulgaris.* Similar observations were made by Dr Philipps and Captain Du Cane, in *Ann. Hist. Nat.* vol. vi.; but above all, by the observations of Richard Q. Couch, in the *Memoirs of the Cornwall Polytechnic Society,* where he completely established metamorphosis in the genera Cancer, Zantho, Portunus, Carcinus, Pilumnus, Polybius, Maia, Galathea, Homarus, and Palinurus. Cryophorus.

The subject has been ably illustrated in the *Histoire Naturelle des Crustacées,* of Milne Edwards (Paris 1834), and in Jones's *Outline of the Animal Kingdom.*

From the ease of obtaining the animal, metamorphosis has been more frequently observed in the *Carcinus Mænas* than in other crustacea. When its young are first extruded from the egg, they have the length of about half a line, are very active swimming creatures, and have the singular form which has been described as *Zoea Taurus;* in their second stage of development, they resemble the genus *Megalopa* of Leach; and, according to Couch, ere they attain the form of the perfect crab, they undergo a sort of third stage of development, in which the sessile eyes have become pedunculated, and the eight smaller feet and the two chelæ are visible, though the body has a different form from that of the perfect animal. (T. S. T.)

CRUSTUMERIUM, or CRUSTUMIUM, in *Ancient Geography,* a city which originally belonged to Sabinum, but in later times was always regarded as belonging to Latium. It was situated in the midst of a very rich and fertile plain, from which large quantities of grain and fruit were sent to Rome. Crustumerium was one of the cities which rose in arms to avenge the rape of the Sabine women. The army was defeated, however, and the city itself became a Roman colony. It regained its independence, and was a second time taken by the Romans under the first Tarquin, but it did not finally acknowledge the supremacy of Rome till 499 B.C. Crustumerium was the place to which the Roman army retired, when led by the Decemvirs against the Sabines B.C. 447. This event was subsequently known in history as the *Crustumerina secessio.* After this date the name of the city does not again occur in the annals of Rome. No remains of the city or traces of its site have been discovered.

CRUTH, in *Welsh* CRWTH, a kind of musical instrument formerly in use among the common people in Wales. It was a stringed instrument, and somewhat resembled a violin; was twelve inches in length, and an inch and a half in thickness. It had six strings, which were stretched over a flat bridge placed obliquely to the sides of the instrument, and was played on with a bow. The instrument is now disused. Sir John Hawkins mentions, that in his time there was but one person in the whole principality of North Wales who could play upon the crwth.

CRUZADO, a gold coin of Portugal, struck under Alphonso V., about the year 1457, when Pope Calixtus III. sent thither the bull for a crusade against the infidels. This coin received its name from the cross impressed upon it. There are current Portuguese coins of this name. See MONEY.

CRYOLITE, alumine fluatée alkaline, *Haüy;* cryone, halloide, *Haidinger.*

This rare mineral is of a snow-white colour. It was originally brought by a missionary from Greenland to Copenhagen, where, from its resemblance to the common varieties of the sulphate of barytes, it lay neglected for many years. At length Abildgard, attracted by its peculiar ponderosity, was induced to undertake its examination, in the course of which fluoric acid, hitherto known only as a component of fluor spar, presented itself along with alumine; but as a considerable residue remained unaccounted for, Klaproth repeated the investigation, and discovered the presence of thirty-six per cent. of soda.

Of the geognostic relations of this interesting mineral nothing was known till the late Sir Charles Giesecke visited the locality, which he found situated on the west coast of the peninsula, in a fiord or arm of the sea, denominated Arksut, near a place called Ivikaet, where it occurs in two contemporaneous beds disposed in gneiss, nearly parallel to each other, and at no great distance.

Fragments of cryolite obtained by cleavage are too often called crystals; but nothing of the kind has hitherto been observed. Its cleavage, however, is very distinct after being well soaked in water: it is threefold, two of these forming rectangular prisms with very smooth surfaces, while the third is at right angles to these, and rougher. Its great fusibility, for it yields even to the flame of a candle, suggested to Abildgard the name of cryolite, taken from κρύος, *ice,* and λίθος, *a stone,* which it has always retained. It contains, according to—

	Klaproth.	Vauquelin.
Soda	36	32
Alumine	23·5	21
Fluoric acid and water	40·5	47

and possesses a specific gravity of 2·949.

CRYOPHORUS (κρύος, *frost,* φορέω, *to bear*), a name given by Dr Wollaston to an instrument of his invention, which serves to illustrate the theory of heat. The form of this instrument may be readily conceived without a figure. It is a glass tube, bent at each end, the bent parts terminating in hollow glass balls, D and E. The ball D is half filled with water. A vacuum is produced in the tube and ball E, by boiling the water in the ball D, whilst the capillary aperture in the ball E, through which the steam is issuing, is held in the flame of a lamp till the steam becomes

Crypt ‖ Crystallization.

weak enough to allow the melted glass to collapse and seal up the capillary aperture. The apparatus is now allowed to cool, when the ball D will be half full of water, and the ball E, and the rest of the apparatus, will contain transparent watery vapour. If now the ball E be placed in a freezing mixture of salt and snow, the water in the ball D will be speedily frozen. The cold of the freezing mixture produces this effect by condensing the aqueous vapour in the ball E, and thereby producing a vacuum in the part not occupied by the water; thus taking off the pressure from the water in D, so as to allow another portion of that water to assume the state of vapour, a change of form attended with a reduction of heat, or a production of cold. That sensible cold accompanies the passage of a liquid to the state of vapour, may be seen by swinging a thermometer at the end of a string, the bulb having been previously wetted with sulphuric ether: the rapid evaporation of the ether causes the mercury to contract to the volume which it has at the freezing of water, or even lower.

The phenomenon exhibited by the cryophorus is of the same nature as that produced on a great scale by means of the air-pump in Professor Leslie's experiment, as described under HEAT.

CRYPT (Lat. *crypta*, from κρύπτω, to *conceal*), a subterraneous cell or vault. The word is particularly used to designate that part of ancient churches and abbeys appropriated to the monuments of deceased persons. Ciampini, in describing the outside of the Vatican, speaks of the *cryptæ* of St Andrew, St Paul, and others. Vitruvius applies the term *crypta* to a part of a building answering nearly to our cellar; and Juvenal applies it to a *cloaca*. Hence also *crypto-porticus*, a subterraneous place arched or vaulted, as an under-work or passage in old walls. The term is sometimes used with less propriety for any passage or corridor.

CRYPTA is likewise used by some of our ancient writers for a subterranean chapel or oratory.

CRYPTOGAMIA (κρυπτός, *concealed*, and γάμος, *marriage*), the twenty-fourth class in the Linnæan system, comprehending those plants whose organs of fructification from their minuteness are obscure or concealed within the fruit.

CRYPTOGRAPHY, the art of writing in secret characters, or with sympathetic ink. Amongst the methods which Ovid recommends to young women when they wish to write secretly to their lovers, is that of writing with new milk, and of making the writing legible by sprinkling it with coal dust or soot; from which it appears that the use of sympathetic ink was not unknown to the ancients.

Crystal ‖ Crystallization.

> Tuta quoque est, fallitque oculos, e lacte recenti
> Litera: carbonis pulvere tange; leges.—*Art. Amor.* iii.

Ausonius proposes the same means to Paulinus in the two following verses:

> Lacte incide notas; arescens charta tenebit
> Semper inaspicuas; prodentur scripta favillis.—*Epist.* xxiii.

Other glutinous juices besides milk may be employed for the same purpose. Pliny (xxvi. 8) recommends the milky juice of certain plants, and particularly that of lettuce.

It is well known that several metallic solutions may be employed for this purpose; and that letters written with these, on being exposed to the action of certain vapours, become visible. This effect was perhaps accidentally discovered; but it does not appear to be of great antiquity. In a book *De Secretis*, compiled by Wecker from Porta, Cardan, and some other old writers, and printed in 1592, there is no mention of it; nor is it even noticed by Caneparius in his book *De Atramentis*, printed in 1619. The first receipt given for the preparation of a sympathetic ink is in a book by Peter Borrel, printed at Paris in 1653, where it is called "magnetic water which acts at a distance." See INK, *Sympathetic.*

CRYSTAL, in its original import, signifies *ice*, from the Greek κρύος, *frost*. It was afterwards applied to rock-crystal, or crystallized siliceous earth; for the ancients, according to Pliny, regarded that body as water which had been congealed by the action of cold.

CRYSTALLINE, composed of or resembling crystal; clear, transparent.

CRYSTALLINE Heavens, in *Ancient Astronomy*, two imaginary spheres between the *primum mobile* and the firmament, in the Ptolemaic system, which supposed the heavens to be solid, and only susceptible of a single motion. See ASTRONOMY.

CRYSTALLINE Lens. See ANATOMY, vol. iii., p. 44.

CRYSTALLIZATION.

Definition.

CRYSTALLIZATION is the symmetrical arrangement of the particles of a body when it passes from the liquid to the solid form. This arrangement is determined by the mutual action of the small solids of which the body is composed; and these solids are separated from the liquid by their force of cohesion. Crystallization is one of the most remarkable effects of cohesion. The qualities of a solid in which the force of cohesion is more easily overcome in one direction than another, its brittleness, elasticity, and ductility, depend on this arrangement of its particles.

Bodies that crystallize must be susceptible of solution or fusion.

Solid bodies are either found in irregular masses, or exhibit certain determinate forms by the process of crystallization. Those substances which are capable of assuming regular figures uniformly affect the same form; subject, however, to certain deviations, from the operation of particular circumstances. Those bodies only can assume the form of crystals which are susceptible of being reduced to the fluid state. This is the usual method of crystallizing saline substances. The substance to be crystallized is dissolved in a sufficient quantity of water to retain it in solution. This is slowly evaporated; and as the bulk of the fluid is diminished, the particles are brought nearer to each other, when they combine together by the force of cohesion, and form crystals. Some saline bodies, which dissolve but in small proportion in cold water, are found to be very soluble in hot water. But when this water cools, it is no longer capable of holding them in solution. The particles then gradually approach each other, and arrange themselves in certain determinate forms; or, in other words, they crystallize. Many of the saline bodies which crystallize in this manner combine with a considerable portion of water. This is called the *water of crystallization.* Other saline substances are equally soluble in hot and cold water. These substances do not crystallize by cooling the fluid; they assume regular forms only by diminishing its quantity. This is effected by means of evaporation from the application of heat. In salts which are crystallized in these circumstances, the proportion of water which enters into combination is small.

There are some classes of bodies which assume regular forms, but are not soluble in any liquid. Such, for instance, are metallic substances, glass, and some other bodies. Substances of this nature are crystallized by being previously subjected to fusion; and thus having combined with caloric, they are reduced to the liquid state, and the particles being separated from each other, are left at liberty to arrange themselves in regular forms, or to crystallize, as the body cools.

Introduction. But what is the cause which operates in determining the regular arrangement of the particles of bodies in these circumstances? or what is the cause of the same bodies in the same circumstances assuming regular figures? The ancient philosophers supposed that the elements of bodies consisted of certain regular geometrical figures; but it does not appear that they applied this theory to explain crystallization. The schoolmen ascribed the regular figure of crystals to their substantial forms; and others supposed that it depended merely on the aggregation of the particles, but without explaining to what this aggregation was owing, or the reason of the regular figures thus produced. Conjectures about the cause.

Newton's. According to Sir Isaac Newton and Boscovich, the particles of bodies held in solution in a fluid are arranged at regular distances and in regular order; and when the force of cohesion between the particles and the fluid is diminished, it is increased between the particles themselves. Thus they separate from the fluid, and combine together in groups which are composed of the particles nearest to each other. If we suppose that the particles composing the same body have the same figure, the aggregation of any determinate number of such particles will produce similar figures.

Bergman's. Bergman is of opinion that the particles of saline substances possess a double tendency: by the one they arrange themselves in the form of spiculæ; and by the other these spiculæ arrange themselves at certain angles of inclination, and according to the difference of these angles, different forms of crystals are produced. These effects are ascribed by the ingenious author to the mutual attraction which exists between the particles, which, according to the peculiar figures of the atoms, at one time arranges them in the form of spiculæ, and then combines the spiculæ thus formed under different angles of inclination. But this arrangement of the particles, or tendency to arrangement, assigned by Bergman as a cause, is only explaining the phenomenon by itself; whilst the cause of the tendency is yet unexplained. Nor will Newton's hypothesis be found more satisfactory; for if the particles of a body, after being equally diffused in a fluid, are brought together by a general attraction, it will follow that every saline body should crystallize in the same manner.

Haüy's. According to the ingenious theory proposed by Haüy, the integrant particles always combine in the same body in the same way; the same faces and the same edges are always attracted towards each other. But these faces and edges are different in different crystals; and hence originates that variety of forms which different bodies assuming regular figures by crystallization exhibit. But why are the same edges and the same faces attracted in the same way? This still wants explanation. If it be ascribed, as some have supposed, to a certain degree of polarity existing among the particles, it might enable us to account for the regular figures of bodies produced by the process of crystallization. For by the effects of this agent we might suppose that different parts of the particles of bodies are endowed with different forces, one an attractive, and another a repulsive force; and by the action of these two forces, the same arrangement of the particles will uniformly take place; for when one part of a particle is attracted, the other will be invariably repelled, and thus the same faces and edges will always be disposed in the same way. But it ought to be observed that the existence of this power, however satisfactorily it may account for the phenomena, has by no means been proved; and even if its existence were completely established, the difficulty still remains how this polarity is to be explained.

Without entering further into these speculations, we propose, in the two following sections, to present our readers with a comprehensive view of the formation and structure of crystallized bodies. In the first section we shall treat of the phenomena of crystallization, the means of conducting this process to obtain the most perfect crystals, and the modifications of which each of the forms is susceptible. In the second we shall give a short view of the theory of the structure of crystals. Phenomena.

SECTION I.

OF THE PHENOMENA OF CRYSTALLIZATION, AND THE MODIFICATIONS TO WHICH IT IS SUBJECT.

The most complete set of observations which has yet appeared on this branch of practical chemistry has been made by M. Leblanc; and to his ingenious memoir[1] we must acknowledge ourselves indebted for much of what we now lay before our readers on this interesting subject. The art, he observes, of managing or conducting the crystallization of salts, is in a great measure new; for it has hitherto attracted but little attention. To insure success in obtaining perfect crystals, the process must be conducted in flat-bottomed vessels; and vessels of glass or porcelain are found preferable to those of any other materials for this purpose. The salt employed should be in a state of purity; and to favour the increase and regular form of the crystals, they should be placed at a distance from each other in the vessels containing the solution. To these necessary precautions, it may be added, that the vessels in which the evaporation goes on should be at perfect rest; and that it is requisite to observe the density, or specific gravity at which the solution begins to yield crystals. Conditions.

The particles of any saline body cannot come into contact and form crystals, as long as the force of affinity between these particles and the fluid in which they are held in solution is greater than the mutual affinity of the particles among themselves. A salt, for instance, which begins to crystallize at a certain specific gravity of its solution in water, will afford no crystals when that specific gravity is diminished; for then the particles of the salt are removed to a greater distance from each other; and while, by this distance, the force of their mutual attraction is diminished, the attraction between these particles and the water in which they are dissolved is increased by the increase of the quantity of the solvent. But, on the other hand, if a solution which begins to crystallize at a certain specific gravity is more concentrated, the crystals which are thus obtained are greatly multiplied, but they are heaped together in confused masses, exhibiting no regular forms. Thus, a solution which has been scarcely reduced to that degree of concentration at which it begins to crystallize, being poured while hot into the proper vessel for carrying on the process, or left at rest in the same vessel in which the solution is made, to cool slowly, will yield a small number of crystals, which will have no other defects than such as are occasioned by their contact with the vessel. Even perfect crystals will sometimes be found among the smaller ones. When the concentration of the solution has not been carried too far, or not further than what is effected by slow cooling, not only have the embryo crystals less bulk, but the particles having come into contact slowly and without confusion, they possess a greater degree of transparency. After a certain period, which varies according to the species of salt which is subjected to the operation, small crystals may be distinctly observed. These are to be carefully detached from each other, and placed in a different position. Being placed by Preparation of the solution

[1] *Journal de Physique*, tome lv. p. 300.

Phenomena.

this management on a different side, the defects occasioned by their contact with the vessel are very soon repaired. From the crystals treated in this way the finest and most perfect are to be obtained. This operation of changing the position of the crystal from one side to the other ought to be repeated at least once every day, if we wish to obtain the completest crystals.

At the end of a certain period the small crystals are to be removed, that the fluid may be more concentrated, either by a new evaporation, or by dissolving a new portion of the same salt. After the new solution has cooled, and the crystals which have formed in it are separated, if it has been too much concentrated, or too great a portion of salt has been added, the crystals of the first solution are then to be introduced and treated in the same way as formerly.

Management of crystals.

When the crystals have acquired a sufficient volume to be handled, and to enable us to choose such as we wish should increase to the largest size, either as simple or complete crystals, or as exhibiting varieties from position or particular circumstances, the individual crystals are then to be separated, and solutions are to be prepared for them, and brought to such a degree of concentration as to afford crystals in a mass; which latter being removed, the single crystals are introduced into these solutions, which are now in a proper state to favour their increase. The crystals may either be previously disposed in the vessel, and then the solution may be poured on, or having first introduced the latter, they may be afterwards distributed on the bottom of the vessel. And thus by continuing the same process, by taking care to change frequently the position of the crystal from one side to the other, and by keeping up the solution to a proper degree of strength, we may obtain crystals of any bulk we choose.

When the quantity of particles, which in a certain state of concentration continue to be mutually attracted, has diminished in consequence of their accumulation on the crystals which are formed, at a certain stage of this diminution the crystals cease to enlarge or increase in bulk; on the contrary, if they are left in the fluid, it happens that they begin to dissolve. It is usually on the corners and angles that this decrease takes place; and in some salts it seems to go on piecemeal, so as to present distinct layers of the particles; for in this case lines parallel to the sides may be observed, and these are disposed like steps of stairs. Should the accident which is here alluded to be allowed to go on too far, it may often require a long time to repair it; but it is in general easy to avoid this inconvenience, by watching the progress of the operation and the increase of the crystals. If their corners or angles are observed to become less sharp, they must be removed till the fluid is further concentrated, or they must be introduced into a new solution of the same salt of the proper degree of strength. To prepare the new solution for the increase of the crystals, a quantity of the same salt is to be dissolved in a given portion of water, so that it shall be fully saturated. It is then allowed to cool and crystallize. The crystals being separated, the remaining solution is to be employed in such quantity as may be judged necessary to replace that in which the diminution of the crystals had commenced.

Sometimes it happens, from want of necessary precaution, that the new solution in which the process is to be conducted, either being too much saturated, or being disturbed by pouring from one vessel to another, exhibits many other points of attraction besides the crystals whose increase is proposed. In this case a great number of small crystals make their appearance, and cover the surface of the former with a kind of incrustation. The small crystals, provided they are taken in time, may be removed without injury to the others; if not they will be unavoidably spoiled.

Phenomena.

Their position must be changed.

When the crystals have reached such a size as that they may be placed one by one without being in contact with each other, we must still continue frequently to change their position. This may be done with a spatula, a glass rod, or indeed any instrument which will communicate nothing to the fluid. In this way the sides of the crystal which are alternately in contact with the bottom of the vessel will increase in equal proportion, and it will always remain complete.

It is chiefly in salts which furnish elongated prisms that the influence of position may be most distinctly seen. If, for instance, a crystal, before it has acquired much volume, be found to rest on one of its bases as well as on one of its sides, it will be observed to be compressed in the direction from base to base; and it will appear to be only a regular segment of the crystal, which, having been placed on one of its sides, has obtained a great bulk. If we take a six-sided prism whose summits are obliquely truncated, and if it be placed on one of its sides, it will enlarge in a greater or less degree, but always in such a manner that the distance from one base to the other shall never be less than the distance between the sides. But if the position be on one of its bases, then its principal increase will be in the direction of the sides, and it will appear to be compressed between the bases. At first sight a crystal treated in this way will seem different from the former. For the corners form the summits of apparent pyramids which are separated by four-sided prisms. This circumstance affords a sufficient explanation of one of the causes which produce varieties in the appearance of a crystal with regard to its relative extent; it shows that there is no foundation for the opinion of a supposed balance between the particles of the salt and that of the solvent; and it shows also, that if the force of attraction be the efficient cause of the saline particles coming into contact, the force of gravitation acts at the same time, and modifies in a greater or less degree the effects of the first.

According to these observations, and the different states in which crystallized substances are found, it has been supposed that we might conclude that the force of adhesion between the particles of the salt and those of the solvent varies according to circumstances, which depend on the degree of tendency to combination between the bodies, and the relative weight or bulk of the parts of which these bodies are composed. If a crystal in the incipient stage of its increase be placed upon one of its bases, it enlarges in the direction of its sides; but if it be reversed and placed upon one of its sides, it enlarges in the dimensions of an elongated prism.

An insulated crystal, placed on one of its sides on a smooth surface, and left undisturbed to enlarge in size, presents on this part a kind of hollow, which corresponds exactly with the side which it replaces. Here the saline particles which cannot reach this surface are distributed on the neighbouring parts with which they come in contact; with this additional circumstance, that the edges of the surface on which the crystal rests increase in proportion, but without allowing the liquid to have access to this surface.

The hollows which are formed at the surface of liquids differ sometimes from each other even in the same salt. If we suppose that a particle forms the incipient point of the hollow, the latter will assume a configuration corresponding to the side of the particle presented to the surface of the liquid; but the part which it touches increases also; and if by any circumstance a change of position shall happen, the hollow, thus necessarily formed according to the arrangement of the part which corresponds exactly to the surface of the liquid, will change its form, because the new position of the side presented differs from the first.

Phenomena.

When a neutral salt, in a state of purity, and after being crystallized, ceases to produce any effect on vegetable blues, it is not supposed that any of its constituent principles is in excess. But if in this state it is found to combine with other bodies, in such a manner as to produce solid and well-defined crystals, we must admit that there exists an affinity between the salt and the body with which it has combined.

Compound combination.

This subject, Leblanc observes of the supra-composition, or compound combination as it might perhaps be called, of which several salts are susceptible, has not hitherto occupied the attention of chemical philosophers. Some, indeed, have been pointed out by Bergman and others; but it has been remarked that these affinities are probably much more extensive than has commonly been supposed, not only with regard to neutral salts with each other, but also to neutral salts with other bodies. Of this kind of combination is not to be reckoned that of one of the constituent parts of a salt being in excess, which frequently takes place in some salts, and is found to be more or less permanent. This circumstance seems to prove that certain salts have two different points in the combination of their constituent parts. Let us see what has been observed in this respect of the sulphate of alumina, which will perhaps explain the reason why this salt is almost always found in nature in the acidulous state. It is known that the more that alum approaches to the state of saturation by an additional portion of base, the less solid the new combination becomes; and in all cases, after a certain time, which is longer or shorter according to circumstances, the portion which was added separates. It will perhaps appear in the sequel, that this tendency to combination which is constantly in action, producing an immense multitude of different individuals, resides not only among the properties of the simple principles, but also in those which belong to all the compounds.

Many of the sulphates are always found in the acidulous state; and all of them seem to be susceptible of combination with a new quantity of the same base, till they reach the point of saturation. For example, the sulphate of copper, in the state in which it is usually found, crystallizes in eight-sided oblique prisms, terminated by sides according to the obliquity of the prism. But if another portion of base be added, the crystals assume the form of pyramids of several faces, separated by four-sided prisms. The acidulous sulphate of zinc gives crystals of six-sided prisms, which are often very regular; but an addition of base produces a great change, for then the crystals are in the rhomboidal form, and very little different from the cube. Alum, in its ordinary state of combination, crystallizes in the form of a regular octahedron; but in the intermediate proportions between this state and that of saturation it assumes the form of a cube.

Haüy, as will be afterwards noticed, has demonstrated that the form of the primitive molecules is the same in all crystals of the same salt; and he has shown by calculation that the variations arise from the laws of decrement in the layers which surround the nucleus; but that the order according to which the secondary forms are produced may be interrupted whether this form be complete or not; and the crystal may then, according to circumstances, return to its primitive form, or to some of those which are derived from it. But from the experiments of Leblanc, he thinks that these changes always depend on new conditions in the state of the fluid, as a different proportion of the principles of which the salt is composed.

Crystals modified by the solution.

If a crystal of octahedral alum be placed in a solution which forms cubic crystals of the same salt, the former will assume the cubic form, by giving up a series of molecules from the summits of the solid angles, so that the layers will continue to decrease on the triangular faces till the crystal has completed its new form. In this process, the change may be stopped at any period, and crystals of every modification of form may be obtained. From this it follows that the centre of each of the faces of the octahedron corresponds to a solid angle of the cube in which it is inscribed. But if a cubical crystal be introduced into the solution which yields the octahedron, its return to this latter form proceeds in the same order by the subtraction of a series of molecules from the solid angles of the cube. It often happens, however, at the same time, that the subtraction of the molecules extends to the corners of the crystal; so that the layers of superposition decrease all at once according to the order of the formation of the octahedron, and the dodecahedron with rhomboidal surfaces. This circumstance seems to suggest the possibility of obtaining crystals of alum of this latter form; but it seems to depend on a particular proportion, which is not easily determined.

Phenomena.

Thus we learn from experiment that salts which exhibit different forms of crystals can be made to assume each of these at pleasure. This phenomenon, which has not been much attended to, seems to merit particular investigation. The transition from one form to another may be explained according to the laws of diminution, by the successive and regular subtraction of series of molecules; so that the form being actually obtained, the restoration of the preceding form is easily explicable on the principle of restitution alone. It may be observed, that during this kind of metamorphosis, both operations, namely, that by which the crystal receives on the one hand a new form, and that by which, on the other hand, it increases on all its sides, constantly take place.

Crystals differently affected at different heights in the fluid.

The particles of a salt which are in solution in a fluid are attracted by it, particle by particle, without any separation or decomposition; but it is necessary that there should be a balance of the attracting forces between the salt and the solvent. This is demonstrated by the following experiment: A vessel two feet in height and two inches in diameter was filled with a solution of a proper degree of concentration for the growth of crystals, which were suspended at different heights from the bottom of the vessel to the surface of the fluid; and it was observed that the increase of the crystal was in proportion to its depth in the vessel, that which was nearest the bottom increasing most rapidly. When the liquid was deprived of saline particles by their accumulation on the crystals, by rest, and sometimes even by the influence of the atmosphere, the crystals decreased by similar gradations to those of their increase; so that it at last reached that state when the crystals near the surface of the liquid were dissolved, whilst those towards the bottom continued to increase; and sometimes it happened that the crystals at the bottom of the vessel continued to increase on the surface which was in contact with it, whilst the opposite upper surface was in a state of dissolution.

All the experiments which were made on salts of different degrees of specific gravity accord with this observation; and the difference in the degrees of saturation of the waters of the ocean, which depends on the difference of depth, seems to be in favour of this opinion. It is confirmed by the analysis of sea-water by Bergman and others, which was taken up in different places and at different depths. It receives still further confirmation from a practice of the inhabitants of Salines, in Bearn, in estimating the degree of strength of a salt spring. An egg is thrown into the waters of the spring, and the whole water which covers the surface of the egg is thrown away, as it is not of a sufficient degree of concentration.

It is well known that a cold temperature is most con-

Phenomena.

venient for the crystallization of salts. But it is not at the period when the salt begins to crystallize that it is most convenient to carry on the process; for then it sometimes happens, from too great concentration of the fluid, that the crystallization is too rapid and confused.

Two classes of saline substances.

Hitherto saline substances, which are susceptible of regular crystallization, have been divided into two classes, according to the peculiarities in the formation of their crystals. The one class comprehends those crystals which are formed by cooling the fluid in which the solution is made; the other class includes those which are produced only during the evaporation of the solution. This distinction is no doubt well founded; but there are some exceptions to it which are necessary to be attended to in conducting the process of crystallization. If a saline solution which is too much saturated be cooled, it furnishes a mass of crystals which are confused and irregular, and which present no determinate form except on those sides which are in contact with the liquid. If in this state the remaining liquid is poured off, it will yield another set of crystals, but in very small number; and there are some salts which continue to form crystals after being several times successively treated in this way, the number of the crystals still diminishing from the first degree of concentration. It will be found too that this will take place whether the process be carried on in the open air or in close vessels. It follows from this that the increase or the formation of crystals in this case depends solely on the mutual attraction of the particles, or on the attraction between the particles and the crystal; an attraction or affinity which is not destroyed by the cooling of the fluid, but is probably regulated by the distance of the particles, and the degree of force or affinity which exists between the particles and the solvent. In some saline solutions the increase of the crystals goes on in this manner for a long time. It is only in the interval between the cooling of the liquid to the temperature of the atmosphere, and that period when its degree of concentration is so diminished that the increase of the crystals ceases, that the latter proceeds with the degree of perfection of which it is susceptible.

Some saline solutions attract moisture.

It is not a property peculiar to dry substances to absorb moisture from the atmosphere. Liquids saturated with certain salts seem also to possess this property; for in some saline solutions the liquids assume a solvent power which never fails to attack the crystals, and not only to prevent their increase, but to diminish the bulk which they had acquired. This accident can only be obviated by regulating the state of the atmosphere in which the evaporating vessels are placed, and preserving it free from any excess of moisture. From causes which produce a contrary effect, the evaporation becomes too rapid: this circumstance also requires to be attended to and properly regulated to insure the full success of the operation.

From the preceding observations it will appear that solutions of salts which are susceptible of crystallization have certain degrees of concentration which are necessary for the formation of crystals, and that they must be reduced nearly to that degree in which they begin to yield crystals before it can be expected that they will afford proper results. It is therefore necessary to attend particularly to the degree of concentration which each salt requires for the regular formation of its crystals, and to obtain them with that degree of transparency of which they are susceptible. We have seen that in the formation of crystals they may be removed from one vessel to another, and from one solution to another; and that, in proportion to the slowness of the process, they become more beautiful and more perfect. These operations, it may be added, require much patience and attention; but at the same time the observer is fully compensated for his trouble by perceiving the progress of the crystallization, and by the interest which is excited in all its stages. Phenomena.

It is essential to know that neither the crystals formed during the artificial evaporation, nor those which are produced during the cooling of the solution, are proper to be made choice of for being increased and brought forward to the most perfect crystals. When a solution has become cold, that is to say, when it has acquired the temperature of the atmosphere, and is deprived of the excess of saline particles which it held in combination during its increase of temperature, it is still in a condition to yield crystals, and, as long as the distances between the particles are not too great, to allow of mutual attraction. A solution saturated to excess affords on cooling a confused mass of crystals; but after the fluid has been poured off, it will still produce more crystals, though in smaller number. The degree of concentration of the solution before it yielded the last product may be considered as the term of saturation most proper to be employed for the species of salt which is thus treated. But by the repetition of these operations, and the observation of their progress, it will not be difficult to discover the proper proportions between the salt and the solvent.

It seems to be a mistake to suppose with some that the crystals which are placed in favourable circumstances for becoming larger and more perfect are injured by coming in contact with each other during their increase. It is undoubtedly better that they should be kept separate; but it does not appear that they are hurt by touching each other, if the number in the vessel be not too great, and they are not heaped or pressed together. In that crystallization which results from the cooling of a solution too much saturated, the crystals are always confused and interlaced with each other; the molecules which are arranged in this kind of disorder also experience a kind of irregular distribution; and it may be observed that in this case the summits only of the crystals which are elevated from the kind of cake which is formed on the surfaces of the vessel containing the solution, present regular and determinate forms. The mass in which these crystals are implanted is a confused heap.

Cavities on crystals.

No cavities have been observed on the faces of crystals excepting those which are formed on the surface of fluids. Those which are produced on that side of a crystal which rests on the bottom of the vessel are more common in other salts. This phenomenon seems to merit more attention than has yet been bestowed upon it, as it explains easily the introduction of extraneous bodies which are sometimes detected in the interior of crystals. For when a cavity of this kind has acquired a certain depth, it is capable of receiving part of any foreign substance, and of being filled up by the change of position of the same crystal, retaining at the same time the extraneous matter. By a little art and dexterity these fortuitous circumstances may be favoured, so that phenomena exhibited by such occurrences may be traced and observed at the pleasure of the operator. Experiments have been made with the view of ascertaining whether an extraneous substance could be substituted as the nucleus of a crystal; but from the result of these experiments it does not appear that the particles of any salt have a tendency to combine with any foreign matter, and to form regular crystals. The portions of the salt which were attached to the extraneous substance were always separate and independent crystals.

There are some saline substances which retain in their solution an excess of particles even after cooling, and which being strongly agitated, instantly deposit so great a number of small crystals as to render the solution turbid. The introduction of crystals of the same salt, it is

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well known, as in the case of a solution of Glauber's salt, promotes this sudden crystallization or separation of the excess of the salt. If in this state of the solution crystals are immersed with the view of having them large and regular, they are certain of being spoiled by the accumulation of a great number of small crystals on their surface, unless, when this happens, the precaution of immediately washing them with pure water is observed.

It may be remarked also, that when the solution is diminished below a certain degree of saturation, the crystals not only cease to increase, but are also again in some measure dissolved—the corners and angles reduced and rounded. And if the crystals in this state be introduced into a solution of sufficient strength to promote their increase, supernumerary faces and truncatures, as they are denominated in technical language, are formed on the rounded corners and angles. But these faces always disappear as the increase of the crystals proceeds, and are replaced by corners and angles, which become at last sharp and distinct.

By attention to preserve the solutions of salt in perfect purity, we shall be more certain of obtaining the most beautiful and transparent crystals. Some fluids, after a certain time, are observed to deposit substances which are foreign to the salt held in solution, and were dissolved along with it. These substances sometimes appear in the form of earthy matters, which precipitate to the bottom of the vessel; in other cases they are diffused in the form of flakes, and sometimes they rise and swim on the surface. In all these cases the crystals whose formation and increase are going forward must be removed, and the liquor must be filtrated before they are replaced.

Variations in crystals.

A saline substance which is capable of crystallization possesses, in the state of minute division in which it is in solution, or in the condition of the molecules which compose it, a determinate property which is uniform and constant, and in which resides essentially the power of uniting in a certain symmetrical manner, and thus constructing regular solids. The results also are uniform and constant when the process is carefully conducted; but it is necessary to distinguish with accuracy the circumstances which accompany the operation, and may occasion a deviation from this uniformity. The sulphate of iron, for instance, usually crystallizes in the form of rhomboids; but sometimes it has been found to assume that of an irregular octahedron. And although it may be true that an elongated octahedron may be classed with prismatic crystals, it does not on that account belong less to the octahedral form; but it seems probable that these different varieties, in the forms of crystals, depend on some changes which take place in the solutions themselves. The iron in the present case is constantly receiving new portions of oxygen from the atmosphere, and in this new combination it is precipitated in the fluid; this, therefore, occasions a change in the constituents of the salt.

Several sulphates are found to combine readily with each other: those of iron and copper are of this description, and the result of the compound crystal is always a rhomboid. It seems to be doubtful whether this should be considered as a case of simple interposition of one salt with the other.

When a liquid which holds saline bodies in solution is evaporated to a certain degree, a crust forms on the surface, acquires a certain thickness, and when this is removed it is renewed. The point at which the liquid exhibits this appearance is known in chemistry by the appellation of *evaporation to a pellicle*. When it has reached this point, the solution is in a state of complete saturation; and the smallest additional quantity of fluid cannot be withdrawn without a corresponding quantity of salt assuming the solid form.

Formation of dendrites.

On this principle Robinet has attempted to account for the formation of *dendrites*, or the arborescent appearance and efflorescence of some salts. Almost all the different appearances of fucus or sea-weed, he observes, are covered in drying with an efflorescence of white matter. In some species this white matter was observed to possess a saccharine quality. A number of large roots of the *fucus palmatus* was hung up in the shade, and ten days had elapsed without the appearance of any thing on the surface. After that period it became white, and it was soon covered with a light downy substance, the filaments of which gradually increased to a considerable length. When this downy matter was brushed off with a feather, it was renewed till the plants were completely dry. This substance, it appeared on examination, was of a saccharine nature, mixed with a small portion of common salt and a great quantity of mucilaginous matter. By solution and crystallization, the sugar was separated from the other substances.

In comparing the circumstances of this efflorescence with those of the formation of the pellicle, in the progress of evaporation, the former seems to be a modification of the latter. In a vessel which contains a liquid saturated with a salt, the surface subjected to evaporation has no sooner assumed a solid form, than the surface immediately inferior is exposed to the action of the same causes, and produces the same effect; and this effect continues till the crust has become so thick or so compact, as to prevent the contact of air, and then the evaporation ceases. But, on the contrary, in the fucus, the air acting only on the surface of the plant, the liquid which it contains cannot undergo the process of evaporation without coming to the surface. The attraction of the matter of the plant tends to promote this motion; for as the liquid is equally diffused throughout its whole mass, it rises constantly to the surface, in proportion as this surface is dried by the surrounding air; and it would appear that this is the process in the dessication of all thick and massy bodies. Now, the saline matter which, in the present case, is in the state of efflorescence, having the same power of attraction on the liquid, the rudiments of each filament constitute, at the instant of their formation, part of the whole mass or body of the plant. They participate, therefore, of the same degree of moisture as that of the plant, and it is on their surface that the evaporation and crystallization of saline matter chiefly take place.

The mechanism of the dendritical or arborescent form of saline bodies seems to be in this way capable of explanation. The whole saline mass, which extends to the edges of the vessel, and even redescends externally, is constantly in the humid state as long as any liquid remains in the vessel. It may be supposed that the matter of the sides of the vessel determines, by its attraction, the external circle of the surface of the liquid to rise above the surface; a phenomenon which is sufficiently obvious, especially in narrow vessels. This portion of liquid, which is more completely subjected to evaporation, gives origin to a circle of saline matter, which appears thus raised above the surface of the liquid, and which being the first rudiments of the dendrites, contributes afterwards to its increase in the way which has been already explained. Thus the vegetation of salts bears a striking resemblance to the process of efflorescence, or the formation of the downy matter on the surface of the fucus.

Efflorescence.

There is yet another kind of crystallization which seems to depend on the same cause. This is the saline efflorescence which occurs in different places on the surface of the globe, and is frequently in such quantity as to become an important object of manufacture. Without extending our observations to the efflorescence of soda on the surface

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of the soil in Egypt, or that of nitre in Asiatic countries, we may refer to the production of muriate of soda, or common salt, in different parts of Europe, and in those places which are covered with the waters of the ocean during high tides. The waters of the sea, with which the sandy shores are twice periodically moistened in the course of a month, are far distant from the point of saturation which determines crystallization. They rarely contain more than three parts of salt in a hundred, and the sand, at the degree of moisture in which it is left by the sea, is not impregnated with a sufficient quantity of saline matter to be worthy the labour of manufacturing; but during the interval between the tides these circumstances are greatly changed. The dry air of summer, by evaporating the moisture on the surface, allows the matter of the sand to attract towards the surface a similar portion of water, which was in the lower part of the soil, and which always tends to diffuse itself equally through the whole mass. This liquid, carrying with it the salt, which it holds in solution, increases the quantity of saline matter which exists on the surface; and the process continues without interruption as long as there is no fall of rain. It reaches at last a certain point, at which the water subjected to evaporation is saturated with the salt; and this process cannot proceed further without the deposition of crystals of the salt, which discover themselves by their shining appearance. After some days the sand on the surface is collected, and about six times the quantity of saline matter is found in the same proportion of sand that it contained when it was first moistened by the sea water.[1]

Crust on the bottom of vessels.

Another phenomenon which takes place during the process of artificial evaporation should not pass unnoticed. This is the formation of a saline crust at the bottom of the vessels in which the process is conducted. This seems to be the immediate effect of ebullition; for when the temperature of the liquid is kept under the boiling point, no such effect is produced. This crust is composed of all the saline substances which are held in solution in the liquid; and even these substances are found combined in the same proportion in which they actually exist in the solution. Whatever be the attraction of these substances for water, or whether they even possess a deliquescent property, they are not the less disposed to enter into combination during the formation of the solid crust on the bottom of vessels in which the process of evaporation is conducted with a temperature equal to the boiling point. A slight degree of attention will satisfy us that the formation of this crust depends on the particular circumstances of the evaporation in the case of ebullition. It must be obvious, that in this case the stratum of liquid which is in immediate contact with the vessel receives the caloric which penetrates its sides, is charged with it beyond its capacity, changes its state, and assumes the gaseous form, and by this change having entirely lost its solvent power, whatever saline matter is held in solution must assume the solid state in contact with the sides of the vessel, and consequently adhere to it. Thus it happens, according to a very judicious observation, that in different saline solutions, the results of which have been compared, these scales or crusts are more abundant in proportion as the degree of saturation is diminished.[2]

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SECTION II.

OF THE THEORY OF THE STRUCTURE OF CRYSTALS.

In the former section we have given a view of the phenomena of crystallization. The regular forms which bodies assume by means of this process, have occupied no small share of the attention of naturalists and chemical philosophers. The researches and investigations of Bergman, Romé de l'Isle, and Haüy, have been particularly directed this way. Bergman, in his twelfth Dissertation,[3] treats of the variety of the forms of crystals, of the various figures derived from the spathaceous form, of the structure of the most minute parts, and of the different modes in which crystals are generated. Romé de l'Isle has arranged crystals into six species, derived from the varieties of form: 1. Tetrahedron; 2. Cube; 3. Octahedron; 4. Parallelopiped; 5. Rhomboidal octahedron; 6. Dodecahedron. But the ingenious researches of Haüy on this subject have been followed by the completest and most successful investigation of the theory of the structure of crystals which has yet appeared. Of this theory, an account of which the reader will find in the *Annales de Chimie*, tome xvii. and in his *Traité de Minéralogie*, tome i. we now propose to give a comprehensive view.

This theory, the author observes, cannot be fully understood without the aid of analytical calculations; for, besides the convenience of analysis, including in the same formula a great number of different problems, it is by means of it alone that the theory can assume the character of absolute certainty in arriving at the same results which are obtained by observation. But notwithstanding these considerations, it seemed to be better for those who have not a competent knowledge of the science of calculation to prefer the method of simple reasoning, but accompanied with geometrical figures, which are so useful in giving a distinct conception of the arrangement of the small solids which combine together to form a crystal. This arrangement is denominated *structure*, in opposition to the term *organization*, which expresses the more complicated mechanism of vegetables and animals. This method may perhaps be less direct, and less precise and expeditious, and it may require attention to those details which are passed over in the analytical method to reach its object more speedily; it has, however, this advantage, that the mind by its means perceives better the connection of the different parts under consideration, and can more readily comprehend the facts with which it is furnished.

I. MECHANICAL DIVISION OF CRYSTALS.

The same mineral substance, it is known, is susceptible of several different forms, well defined, some of which do not appear, at first sight, to have any common point of resemblance to indicate their relation. If, for instance, we compare the regular hexahedral prism of calcareous spar with the rhomboid of the same mineral,[4] whose

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[1] Common salt is manufactured in this way on the sandy shores of the Solway Frith, in Annandale in Scotland. These flat shores are covered with the waters of the ocean during spring tides; and in the interval of these tides the evaporation by the heat of the sun and the action of the air is so considerable, as to leave the sand impregnated with a quantity of salt sufficient to defray the expense and trouble of manufacturing it by filtration and boiling.

[2] *Journal de Physique*, lviii. 124.

[3] *Physical and Chemical Essays.*

[4] The name of *rhomboid* is given by the author to a parallelopiped *a*, *e* (fig. 4), terminated by six equal and similar rhombuses In every rhomboid, two of the solid angles, such as *a*, *e*, opposed to each other, are formed by the junction of three equal plane angles; each of the six solid angles is formed by a plane angle equal to each of the three preceding, and by two other angles of a different measure, but equal to each other. The points *a*, *e*, are the summits, the line *ae* is the axis. In any one of the rhombuses *ab*, *df* which compose the surface, the angle *a*, contiguous to the summit, is called the superior angle, the angle *d* the inferior angle, and

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large angle is about 101½°, we should be led to believe that each of these two forms is quite distinct from the other. But this point of relation, which escapes notice when we consider only the external form, becomes sensible when we attend to the intimate mechanism of the structure. Here the author gives an historical view of the progress of his researches, and traces the steps which led him to the discovery of what became as it were the key of his whole theory.

He had in his hand a hexahedral prism of calcareous spar, similar to that mentioned above, and which had been detached from a group of the same crystals. The fracture presented a very smooth surface, situated obliquely, like the trapezium *psut* (fig. 1), and which had an angle of 135°, both with the remainder *abcsph* of the base, and with the remainder *tuef* of the plane *inef*. Observing that the cuneiform segment *psutin*, which this fracture separated from the crystal, had for its vertex one of the edges of the base, namely the edge *in*, he attempted to separate a second segment in that part to which the contiguous edge *cn* belonged. For this purpose he employed the blade of a knife, directed with the same degree of obliquity as the trapezium *psut*, and aided by the stroke of a hammer. This attempt failed; but having tried the same operation towards the next edge *bc*, a new trapezium similar to the first came into view. The fourth edge *ab* resisted the instrument, but the following, *ah*, readily yielded to mechanical division, and presented a third trapezium, having as fine a polish as the other two. The sixth edge *ih*, it is scarcely necessary to observe, could not be divided, any more than the fourth and the second.

Plate CXCVII.

Proceeding then to the inferior base *defgkr*, it was soon found that the edges of this base, which admitted of divisions similar to the preceding, were not the edges *ef*, *dr*, *gk*, which corresponded to those which could be divided towards the upper part, but the intermediate edges *de*, *vy*, *gf*. The trapezium *lqyv* shows the section made below the edge *kr*. This section is obviously parallel to that of the trapezium *psut*; and the four other sections are in like manner parallel, two and two. Now, these different sections being in the direction of the natural joints of the laminæ, it was easy to obtain others parallel to each of them, but it was found impossible to divide the crystal in any other direction. Following this mechanical division according to the parallelism stated above, new sections were obtained, always nearer to the axis of the prism; and when the sections were carried so far as to make the remainder of the two bases disappear, the prism was transformed into a solid OX (fig. 2), terminated by twelve pentagons, parallel two to two, of which those of the extremities, namely, SAOIR, GIODE, BAODC, on the one side, and KNPQF, MNPXU, ZQPXY, on the other, were the results of the mechanical division, and had their common vertices O, P, situated in the centres of the bases of the prism, fig. 1. The six lateral pentagons RSUXY, ZYRIG, &c. (fig. 2), were the remainders of the planes of the same prism.

In proportion as the sections were multiplied always parallel to the preceding, the lateral pentagons diminished in height; and at a certain term the points R, G being confounded with the points Y, Z, the points S, R with the points U, Y, &c. there remained no more of these pentagons, but the triangles YIZ, UXY, &c. (fig. 3.) Beyond that term the sections coming to pass over the surface of these triangles diminished gradually in extent, till at last the same triangles were lost, and then the solid obtained from the hexahedral prism appeared to be a rhomboid *ae* (fig. 4) exactly similar to that which is commonly denominated *Iceland spar*.

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So unexpected a result led the ingenious author to the examination of other calcareous crystals in a similar manner, all of which yielded to mechanical division in such a way that when the external surfaces had disappeared, the nucleus which remained was always a rhomboid, of the same form as the first. All that was necessary was to discover the direction of the sections which conducted to the central rhomboid.

To extract, for instance, this rhomboid from the spar which is usually denominated *lenticular*, and which is itself a much more obtuse rhomboid, having its large plane angle equal to 114° 18′ 56″, it was necessary to begin with the two vertices, and to make the sections pass through the small diagonals of the faces. But if it is wished, on the contrary, to get at the nucleus of the rhomboidal spar with acute vertices, the direction of the sections of the planes must be parallel to the edges contiguous to the summits, and in such a manner that each of them shall be equally inclined to the faces which it cuts.

These results are the more worthy of attention, as it would seem at first, that in the process of crystallization, after the rhomboid has been once adopted with regard to a determined species of mineral, it ought always to reproduce it with the same angles. But the paradox which arises from this diversity of appearance is explained by the double use of the rhomboidal form, which serves here to disguise itself, and conceals fixed and constant characters under a variable external appearance.

If we take a crystal of a different nature, such as a cube of *fluor spar*, the nucleus will have a different form. This will be, in the present case, an octahedron, which we shall obtain by taking off the eight solid angles of the cube. Heavy spar will produce for a nucleus a right prism with rhomboidal bases; feldspar, an oblique-angled parallelopiped, but not rhomboidal; apatite or beryl, a right six-sided prism; the adamantine spar a rhomboid, a little acute; blende, a dodecahedron, with rhomboidal planes; iron of the island of Elba, a cube, &c.: and each of these forms will be constant in relation to the whole species, so that its angles will undergo no variation which is appreciable; and if we attempt to divide the crystal in any other direction, we shall not be able to find any joint; we shall only obtain indeterminate fragments; it will rather be broken than divided.

These solids inscribed each in all the crystals of the same species, ought to be regarded as the true primitive forms on which all the other forms depend. All minerals, it is true, are not susceptible of mechanical division, but the number is greater than it appeared at first sight; and with regard to those crystals in which the attempts to discover the natural joints have failed, it has been remarked that their surface striated in a certain direction, or the relation of their different forms, among those which belong to the same substance, frequently presented indications of their structure, and by reasoning from their analogy with other divisible crystals, we may determine this structure, at least with a good deal of probability.

All deviations from the primitive form are called by Haüy *secondary forms*. But the number of these forms has certain limits, which can be determined by theory,

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the angles *b* and *f* are the lateral angles. The sides *ab*, *af*, are the superior edges, and the sides *bd*, *df*, the inferior edges: *bf* is the horizontal diagonal, and *ad* the oblique diagonal. The rhomboid is obtuse or acute, according as the angles of the summits are obtuse or acute. The cube is the limit of the rhomboids.

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according to the laws which regulate the structure of crystals.

The solid of the primitive form, which is obtained by means of the operation described above, may be further subdivided in a direction parallel to its different faces. All the surrounding matter is equally divisible by sections parallel to the faces of the primitive form. Hence it follows, that the parts detached by the aid of all these sections are similar, and only differ in their volume, which continually decreases in proportion to the extent of the division. Those, however, must be excepted, which are near to the faces of the secondary solid; for these faces not being parallel to those of the primitive form, the fragments which have one of their facets taken in the same faces, cannot exactly resemble those which are detached towards the middle of the crystal. For instance, the fragments of the hexahedral prism (fig. 1), whose external facets make part of the bases, or of the planes, have not, in this respect, the same figure with those which are situated nearer to the centre, all of whose facets are parallel to the sections *psut, lqyv;* but the difficulty which presents itself at first sight, in consequence of that diversity, is removed by the help of the theory, and the whole are reduced to a unity of form.

But the division of the crystal into small similar solids has a certain limit, beyond which we should arrive at particles so small that they are no longer divisible, without destroying the nature of the substance, or decomposing it. At this term the investigation stops, and to the small solids, which we might insulate if our organs and instruments were sufficiently delicate, Haüy has given the name of *integrant* or *integral molecules.* He thinks it probable that these molecules are those which were suspended in the fluid in which the crystallization took place. In general it may be observed that, with the aid of these molecules, the theory reduces to simple laws the different forms of crystals, and arrives at results which exactly represent those of nature.

When the nucleus is a parallelopiped, that is, a solid having six parallel faces, two to two, like the cube, the rhomboid, &c. and this solid admits of no other divisions than those which are made in the direction of its faces, it is obvious that the molecules which result from the subdivision, whether of the nucleus or of the surrounding matter, are similar to this nucleus. In other cases, the form of the molecules is different from that of the nucleus. There are, besides, other crystals which afford, by means of mechanical division, particles of different figures combined together through the whole extent of these crystals. The ingenious author of the theory has thrown out some conjectures on the manner of resolving the difficulty which these kinds of mixed structures present; and at any rate, he observes that it does not in any degree affect the stability of the theory.

II. LAWS OF DECREMENT.

1. *Decrements at the Edges.*

The primitive form, and that of the integrant molecules, being determined, after the dissection of the crystals, we must investigate the laws according to which these molecules were combined, to produce around the primitive form those kinds of coverings which terminated so regularly, and from which resulted polyhedra so different from each other, although originally of the same substance. Now, such is the mechanism of the structure subject to these laws, that all the parts of the secondary crystal superadded to the nucleus are formed of laminæ, which decrease regularly by subtractions of one or more ranges of integral molecules, so that theory determines the number of these rows, and by a necessary consequence the exact form of the secondary crystal.

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To have a distinct idea of these laws, let us take a very simple and elementary example. Conceive EP (fig. 5) to represent a dodecahedron whose faces are equal and similar rhombuses, and that this dodecahedron is a secondary form, having a cube for its nucleus or primitive form. By the inspection of fig. 6, the position of this cube in the crystal may be easily conceived. The small diagonals DC, CG, GF, FD of the four faces of the dodecahedron, being united round the same solid angle, form a square CDFG. Now there are six solid angles, composed of the four planes, namely, the angles L, O, E, N, R, P (fig. 5), and consequently, if sections are made to pass through the small diagonals of the faces which compose the solid angles, six squares will be successively uncovered. These squares will be the faces of the primitive cube, of which three are represented at fig. 6, namely, CDFG, ABCD, BCGH.

This cube would evidently be an assemblage of cubic integral molecules, and it would be necessary that each of the pyramids, such as LDCGF (fig. 6), which rest on the faces, should be itself composed of cubes equal to each other, and to those which form the nucleus. To have a more distinct conception of this arrangement, let us compose an artificial dodecahedron of a certain number of small cubes, the arrangement of which will be an imitation of the process of nature in disposing the molecules in the formation of the dodecahedron.

Let ABGF (fig. 7) be a cube composed of 729 small cubes equal to each other, in which case each face of the whole cube will include eighty-one squares, that is, nine on each side, which will be the external faces of as many partial cubes representing the molecules. This cube will be the nucleus of the dodecahedron which is to be constructed. On one of the faces, as ABCD, of the cube, apply a square lamina, composed of cubes equal to those which form the nucleus, but having towards each a row of cubes less than if it were on a level with the contiguous faces BCGH, DCGF, &c. This lamina will be composed of forty-nine cubes, that is, seven on each side, so that if the inferior base be *onfg* (fig. 8), this base will fall exactly on the square marked with the same letters in fig. 7. Above this first lamina let a second be applied, composed of twenty-five cubes, five on each side, so that if *lmpu* (fig. 9) represent its inferior base, this base will correspond exactly with the square marked with the same letters in fig. 7. If in like manner a third lamina be applied to the second, which is composed only of nine cubes, that is, three on each side, so that *vxyz* (fig. 10), being the inferior base, shall correspond with the square marked with the same letters in fig. 7; and if on the middle square *r* of the preceding lamina the small cube *r* (fig. 11) be placed, this will represent the last lamina.

When this operation is completed, it will appear that there is formed on the face ABCD (fig. 7) a four-sided pyramid, of which this face is the base, and the cube *r* (fig. 11) is the summit. And if the same operation be continued on the other five sides of the cube, we shall have six four-sided pyramids resting on the six faces of the nucleus, which is enveloped with them on all sides. But as the different rows of laminæ composing these pyramids project beyond each other for a certain way, as appears on fig. 12, where the parts raised above the planes BCD, BCG represent the two pyramids which rest on the faces ABCD, BCGH (fig. 7), the faces of the pyramids will not form continued planes; for they will be alternately re-entering and salient, in some measure imitating a stair with four sides.

Let us now suppose that the nucleus is composed of a

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number of almost imperceptible cubes incomparably greater, and that the laminæ applied on the different faces, which may be called the laminæ of superposition, continue to increase towards their four edges by subtractions of one range of cubes equal to those of the nucleus, the number of these laminæ will be incomparably greater than in the preceding hypothesis; and at the same time the cavities or furrows which they form, as they alternately become salient or re-entering, will be almost imperceptible; and indeed it might be supposed that the cubes of which the crystal is composed are so small as to become quite imperceptible to our senses, and the faces of the pyramids to be perfectly smooth.

Now DCBE (fig. 12) being the pyramid which rests on the face ABCD (fig. 7), and CBOG (fig. 12) the pyramid applied to the face BCGH (fig. 7), if we consider that every thing is uniform from E to O (fig. 12) in the manner in which the laminæ of superposition mutually project beyond each other, we may readily conceive that the face CEB of the first pyramid ought to be exactly in the same plane as the face COB of the contiguous pyramid, so that the union of these two faces should form a rhombus ECOB. But we have, for the six pyramids, twenty-four triangles similar to CEB, which consequently will be reduced to twelve rhombuses, from which results a dodecahedron similar to what is represented in fig. 5 and 6.

The cube, before it arrives at the form of the dodecahedron, passes through a multitude of intermediate modifications, of which one is shown at fig. 13. The squares *paeo, klqu, mnts*, &c. correspond to the squares ABCD, DCGF, CBHG, &c. (fig. 6), and form the superior basis of as many pyramids, incomplete from the deficiency of the laminæ with which they ought to terminate. The rhombuses EDLC, ECOB (fig. 5), by a necessary consequence, are reduced to simple hexagons *ae* C *lk* D, *eo* B *nm* C (fig. 13), and the surface of the secondary crystal is composed of twelve of these hexagons and six squares. This is the case with the boracic spar (the borate of magnesia and lime), with the exception of some facets which surmount the solid angles, and which depend on a different law of decrement.

If the diminution of the laminæ of superposition proceeded in a more rapid ratio; for example, if each lamina had had on its circumference two, three, or four rows of cubes less than the inferior lamina, the pyramids produced on the nucleus by this diminution being more depressed, and their contiguous faces being no longer on a level, the surface of the secondary solid would have been composed of twenty-four isosceles triangles, all inclined to each other. *Decrement on the edges* is that which takes place parallel to the edges of the nucleus, and it ought to be distinguished from another kind of decrease, to be afterwards mentioned.

2. *Examples of Decrease on the Edges.*

Iron Pyrites, or Dodecahedral Sulphuret of Iron.

Geometric Character.—Inclination of any one of the pentagons, as DPRFS (fig. 19), to the pentagon CPRGL, which has the same base PR, 126° 56′ 8″. Angles of the pentagon CPRGL, L = 121° 35′ 17″; C or G = 106° 35′ 57″ 30‴; P or R = 102° 36′ 19″.

Let us conceive again a cubic nucleus, whose different edges are lines of departure to the same number of decrements which take place at the same time in two different ways; that is, by the subtraction of two rows parallel to the edges AB, CD (fig. 7), and of one row parallel to the edges AB, BC. Let it be supposed also that each lamina being only equal in thickness to a small cube of the side AB and CD, is, on the contrary, equal to double the thickness of the side AD and BC. Fig. 14 represents this disposition with regard to the decrements which proceed from the lines DC, BC (fig. 7). It is plain, that on account of the more rapid decrease in proceeding from DC or AB, than from BC or AD, the faces produced in the first case will be more inclined to the plane ABCD, while the faces produced in the second will remain as it were behind, so that the pyramid will no longer be terminated by a single cube E, as in fig. 12, which, on account of its minuteness, seems to be only a point, but by the row of cubes MNST (fig. 14), which, supposing these cubes to be infinitely small, will present the appearance of a simple ridge. By a necessary consequence, the pyramid will have for its faces two trapeziums, such as DMNC, resulting from the first decrement, and two isosceles triangles, such as CNB, which will be the effect of the second decrement.[1]

Let us suppose further, that with regard to the laminæ of superposition, which arise on the face BCGH (fig. 7), the decrements follow the same laws, but in cross directions; in such a way that the more rapid of the two may take place in proceeding from BC, or from GH, towards the vertex of the pyramid, and the slower decrement in proceeding from CG, or BH, towards the same vertex. The pyramid which results from these decrements will be placed in a direction opposite to that which rests on ABCD, and will have the position represented at fig. 17, where the edge KL, which terminates the pyramid, instead of being parallel to CD, like the edge MN (fig. 14 and 15), is, on the contrary, parallel to BC. We shall then conceive what is to be done, that the pyramid which will rest on DC, GF (fig. 7) may be turned as it is represented in fig. 16, and may have its terminating edge PR parallel to CG (fig. 7). The pyramids which will rest on three other faces of the cube will stand like that which arises on the opposite face.

But as the decrements which produce the triangle CNB (fig. 15) make a continuity with those from which results the trapezium CBKL (fig. 17), these two figures will be in the same plane, and will form a pentagon CNBKL (fig. 18). For the same reason the triangle DPC (fig. 16) will be on a level with the trapezium DMNC (fig. 15); and, by applying the same reasoning to the other pyramids, it will be conceived that the six pyramids having for their whole faces twelve trapeziums and twelve triangles, the surface of the secondary solid will be composed of twelve pentagons, which will correspond to the twelve rhombuses of fig. 5, but with this difference, that they will have other inclinations. This solid is represented at fig. 19, and with its cubic nucleus at fig. 20, where it may be seen how to proceed in the extraction of this nucleus. If, for example, a section be made passing through the points D, C, G, F, the pyramid which rests on the face DCGF of the nucleus will be detached, and by this section the latter will be uncovered.

Among the crystals belonging to the sulphuret of iron, or the arseniate of cobalt, there is found a dodecahedron, having the faces equal and similar pentagons, and having for its nucleus a cube in the position above described.

[1] Here the face which corresponds to ABCD (fig. 7) has twenty-five squares on each side, as may be seen in fig. 14. The structure of this pyramid may be imitated artificially, by regulating the arrangement and number of the cubes represented in the same figure.

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But there are an infinite number of possible dodecahedra, which may have for faces equal and similar pentagons, and differ from each other by the respective inclinations of their faces. Of all these dodecahedra, the one whose structure would be subjected to these laws gives 126° 56′ 8″ as the angle formed by the inclination of any two of its faces DPRFS, CPRGL (fig. 19) at the edge of junction PR, as might be shown by calculation. Some mineralogists, overlooking the use of geometry in the consideration of crystals, have confounded the dodecahedron of pyrites with the same regular geometrical figure in which all the sides and angles of each pentagon are equal; but there is a striking difference between these two dodecahedra. The regular dodecahedron gives only 116° 33′ 54″ as the inclination of its respective pentagons, making a difference of nearly $1\frac{1}{4}$° between it and the other. And indeed the regular dodecahedron cannot be produced by any law of decrement whatsoever, however compound it may be supposed, in regard to a cubic nucleus, and, as may be demonstrated generally, for a nucleus of any form. There are then two kinds of dodecahedra, one whose faces are rhombuses, and another whose faces are pentagons, produced upon a cubical nucleus, in consequence of two simple and regular laws of decrement, in a direction parallel to the edges of the nucleus. By varying these laws in different other ways, a multitude of new polyhedra having the same nucleus may be constructed.

Obtuse or Lenticular Calcareous Spar (fig. 22).

Geometric Character.—Inclination of the rhombus *nad′b′*, to the rhombus *af′d′*, 134° 25′ 36″. Angles of the rhombus *nad′b′*; *a* or *b′* = 114° 18′ 56″; *n* or *d′* = 65° 41′ 4″.

This variety arises from a decrement by a single row on both sides of the edges *ab*, *ag*, *af* (fig. 23), and *eo*, *ed*, *ex*, contiguous to the summits *a*, *e*, of the nucleus. An idea may be formed of its structure by comparing it with that of the dodecahedron whose planes form rhombuses (fig. 5 and 12), originating from the cube (fig. 7); and by supposing that the laminæ, instead of decreasing at the same time on all the edges, decrease only to those contiguous, three by three, to the angle C and its opposite. The faces formed in that case will be reduced to six, which, by prolonging themselves, according to the law of continuity, so as to intersect each other, will compose the surface of a rhomboid analogous to the one which we are now treating of, excepting that it will have other angles, on account of the cubical form of its integral molecule.

From this it may be conceived that the diagonals drawn from *a* to *b′* (fig. 22), from *a* to *g′*, from *a* to *f′*, &c. on the secondary rhomboid, will be confounded with the edges *ab*, *ag*, *af* (fig. 23) of the nucleus, which serve as lines of departure for the decrements; and hence, to extract this nucleus, the planes of the sections must pass along these diagonals, as has been already remarked.

Common Topaz (fig. 25).

Geometric Character.—The inclination of the trapezoid *srtm* to the adjacent plane *rtey*, 136°; of the same plane to *kryz*, 124° 26′; of the plane *tmge* to *mlig*, 93°.

The primitive form of the topaz is that of a right-angled, four-sided prism *hy* (fig. 24), the bases of which are rhombuses, having the angle *h* or *r* = 124° 26′. According to theory, in regard to the integrant molecule, the height *ry* is to the side *rn* nearly in the ratio of three to two. The pyramidal summit of the topaz results from a decrement by two rows of small prisms on the edges *xr*, *rn*, *nh*, *hx* of the superior base of the primitive form. The planes *tmge*, *lmge* (fig. 25) on one side, and *bkzp*, *budp* on the other, arise from a decrement by three rows on each side of the edges, *nv*, *xq* (fig. 24), which decrement remains suspended at a certain term, and leaves four rectangles *trye*, *kryx*, *lhcı*, *uhcd* (fig. 25), parallel to the planes of the primitive form. The effect of this decrement is shown at fig. 26, where the rhombus *hnrx* is the same as fig. 24; and all the small rhombs by which it is subdivided, or which are exterior to it, represent the bases of so many molecules. The lines *xd*, *xz*, *ni*, *ne*, are directed according to the law of decrement already explained, and the lines *cd*, *ci*, *yz*, *ye*, correspond to the planes of the prism, which are not subject to this law.

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3. *Decrement on the Angles.*

This position of the rhomboidal nucleus inclosed in the regular hexahedral prism of the calcareous spar being discovered, did not directly lead to the determination of the laws of those decrements of secondary crystals. More simple intermediate steps were necessary. To conceive the method of investigating these new decrements, it may be remarked that the same substances which exhibit the dodecahedron with pentagonal planes originating from the cubes (fig. 19 and 20), and which might assume the form of the dodecahedron whose planes are rombuses (fig. 5 and 6), are found also under that of the regular octahedron. But if the laminæ of superposition decrease only on the edges of the two opposite faces of this cube, as on those of the superior base ABCD (fig. 6), and of the inferior base, we shall in general have two pyramids applied on these bases. And if we suppose the effect of the law of decrements continued in the space situated between the bases of the cube, we shall arrive at an octahedron, whose angles will vary as there is a greater or smaller number of rows subtracted. But no law, however complicated, can give equilateral triangles as the faces of this octahedron.

On the other hand, by dividing a regular octahedron originating from a cube, the cubic nucleus will appear to be so situated in this octahedron that each of its six solid angles corresponds to the centre of one of the faces of the octahedron; but this could not be the case by supposing a decrement on the edges. The law of decrement accomplishes its ends, in such cases, by a different progress from that which conducts to the forms already described.

Let ABCD (fig. 27) be the superior or inferior surface of a lamina composed of small cubes, whose bases are represented by the squares which subdivide the whole square. The series of cubes to which the squares *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, belong, are on the diagonal drawn from A to C; and they form one string (fig. 28), which will not differ from the string of the cubes *a*, *n*, *g*, *r′*, *s′*, *t′*, *u′*, *z′*, *x′* (fig. 27), lying in the direction of the edge AD, excepting that in the former the cubes touch only by one of their edges, and in the latter by one of their faces. There are also, throughout the whole extent of the lamina, strings of cubes parallel to the diagonal. The series of letters *q*, *v*, *k*, *u*, *x*, *y*, *z*, shows one, and the letters *n*, *t*, *l*, *m*, *p*, *o*, *r*, *s*, show another string.

The laminæ of superposition, it may be conceived, project beyond each other one or more rows of cubes in a direction parallel to the diagonal. In like manner may be constructed around the cubic nucleus, solids of different figures, by placing successively above the different faces of this nucleus laminæ which may arise in the form of pyramids, and which will experience this kind of decrement. The faces of these solids will be roughened by an infinite number of salient angles formed by the exterior

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points of the composing cubes. This follows from the angular figure which is continually presented by the edges of the laminæ of superposition. But these points being on a level, the cubes may be supposed to be so small that the faces of the solid will appear smooth and continued planes.

Around the cube ABGF (fig. 29), as a nucleus, let a secondary solid be constructed, in which the lamina of superposition shall decrease on all sides by a single row of cubes, in a direction parallel to the diagonals; and let ABCD (fig. 30), the superior base of the nucleus, be subdivided in eighty-one small squares, representing the exterior faces of an equal number of molecules. Fig. 31 represents the superior surface of the first lamina, which ought to be placed above ABCD (fig. 30) in such a manner that the point *a'* may correspond to the point *a*, the point *b'* to the point *b*, the point *c'* to the point *c*, and the point *d'* to the point *d*. By this disposition the squares A*a*, B*b*, C*c*, D*d* (fig. 30) remain uncovered, which will fulfil the above law of decrement; and the borders QV, ON, IL, GF (fig. 31) project by one row beyond the borders AB, AD, CD, BC (fig. 29), which is necessary, that the nucleus may be enveloped towards these edges. For if the edges of the lamina represented (fig. 31), as well as the following, coincided with the lines ST, EZ, YX, MU, on which supposition they would be on a level with AD, AB, CD, BC (fig. 30), they would form re-entering angles towards the analogous parts of the crystal. Thus in the laminæ applied on ABCD (fig. 29), all the edges answering to CD would be on a level with CDFG, of which they would form a prolongation; and in the laminæ applied on DCFG all the edges analogous to the same ridge CD would be on a level with ABCD, from which necessarily results a re-entering angle opposite to the salient angle formed by the two faces ABCD and CDFG. But by the laws which determine the formation of simple crystals, re-entering angles appear to be excluded. The solid will then increase in those parts to which the decrement does not extend. But this decrement alone being sufficient to determine the form of the secondary crystal, all the other variations which intervene only in a subsidiary manner may be set aside, excepting in the construction of artificial crystals, and in exhibiting the details relating to the structure.

The superior face of the second lamina will be like A'G'L'K' (fig. 32), and this lamina must be placed above the preceding, in such a manner that the points *a''*, *b''*, *c''*, *d''*, may correspond with the points *a'*, *b'*, *c'*, *d'* (fig. 31), which will leave uncovered the squares having their exterior angles situated in Q, S, E, O, V, T, M, G, &c., and continuing to produce the decrement by one row. The solid increases towards the analogous edges at AB, BC, CD, AD (fig. 30), since between A' and L', for instance (fig. 32), there are thirteen squares, but between QV and LI (fig. 31) there are only eleven.

The large faces of the laminæ of superposition which were hitherto octagons QVGFILNO (fig. 31) having arrived at the figure of the square A'G'L'K' (fig. 32), will, after passing that term, decrease on all sides at the same time, and the following lamina will have for its superior face the square B'M'I'S' (fig. 33), less in every direction by one row than the square A'G'L'K' (fig. 32). Let this square be disposed above the preceding, so that the points *c'*, *f'*, *g'*, *h'* (fig. 33) may correspond with the points *c*, *f*, *g*, *h* (fig. 32). Fig. 34, 35, 36, and 37 represent the four laminæ which ought to rise successively above the preceding, the same letters being made to correspond. The last lamina is reduced to one cube *z'* (fig. 39), which should correspond with the same letter (fig. 37).

Thus it follows, that the laminæ of superposition applied on the base ABCD (fig. 29 and 30) produce, by the total of their decreasing edges, four faces, which in proceeding from the points A, B, C, D, incline one to another in the form of a pyramidal summit. These edges, it may be remarked, have lengths which begin by increasing as in fig. 30 and 32, and which then proceed decreasing. Thus the faces produced by the same edges increase at first, and afterwards decrease in breadth, so that they become quadrilaterals. One of these is represented at fig. 39, in which the inferior angle C is confounded with the angle C (fig 29) of the nucleus; and the diagonal LQ represents the edge L'G' of the lamina A'G'L'K' (fig. 32), which is the most extended in the direction of that edge. And the number of laminæ of superposition producing the triangle LCQ (fig. 39) being less than that of the laminæ producing the triangle LZQ, since there is here only one lamina preceding the lamina A'G'L'K' (fig. 32), while there are six which follow it as far as the cube *z* (fig. 38) inclusively, the triangle LZQ (fig. 39) composed of the sum of the edges of these latter laminæ, will have a much greater height than the inferior triangle LCQ, as it is expressed in the figure.

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The surface of the secondary solid, then, will be formed of twenty-four quadrilaterals, disposed three and three around each solid angle of the nucleus. But decreasing by one row, the three quadrilaterals belonging to each solid angle, such as C (fig. 29) will be in the same plane, forming an equilateral triangle ZIN (fig. 40). The twenty-four quadrilaterals, then, will produce eight equilateral triangles. One of these is represented at fig. 41, showing the arrangement of the cubes that concur to form it; and the secondary solid will be a regular octahedron. This octahedron is represented at fig. 42, inclosing the cubic nucleus, so that each of its solid angles corresponds to the centre of one of the triangles IZN, IPN, PIS, SIZ, &c. of the octahedron. To extract this nucleus, it would be necessary to divide the octahedron in its eight solid angles, by sections parallel to the opposite edges. This is the structure of octahedral sulphuret of lead or galena.

Such then is an example of decrements on the angles which take place in a direction parallel to the diagonals. By this denomination may be expressed precisely the result of each decrement, by denoting the angle which serves it as a point of departure.

Acute Calcareous Spar (fig. 43).

Geometric Character.—Inclination of *pzry* to *puoy*, 78° 27′ 47″; and to *irzs*, 101° 32′ 13″. Angles of the rhombus *pzry*, *p* or *r* = 75° 31′ 20″; *z* or *y* = 104° 28′ 40″. Inclination of the oblique diagonal drawn from *p* to *r* with the edge *pu*, 71° 35′ 54″.

Geometric Properties.—The angles of the rhombus are equal to the respective inclinations of the faces of the nucleus, and reciprocally. The angles of the principal quadrilateral, or that which passes through two opposite oblique diagonals *pr*, *ui*, and through the intermediate edges *pu*, *ir*, are the same as on the nucleus.

To conceive the structure of this rhomboid, suppose that *abdf* (fig. 44) represents the face of the nucleus marked with the same letters (fig. 4), subdivided into a multitude of partial rhombuses, which are the exterior faces of so many molecules. Suppose further that the laminæ of superposition, applied on this face, decrease by one row towards the lateral angles *abd*, *afd*, in such a manner that on the first the two rhombuses *bhkl*, *fmin* are uncovered; that on the second the uncovered rhombuses are those traversed by the diagonals *co*, *uy*, on the third those traversed by the diagonals *st*, *qz*, &c.; in which case the decreasing edges will successively correspond with these diago-

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nals. By this law of decrement two faces will be produced, which, proceeding from the angles *bf*, will rise in the form of a roof above the rhombus *abdf*, and will meet on a common edge situated immediately above the diagonal *ad*, and which will be parallel to it; and as there are six rhombuses which undergo like decrements on the primitive form, the faces produced will be twelve in number. But, by the law of decrement by one row, the two faces which have the same angle *b*, *f*, *g*, &c. (fig. 4) for the point of departure will be in the same plane; thus reducing the twelve faces to six, and transforming the secondary crystal into an acute rhomboid *pi* (fig. 43). In this rhomboid the edges *pz*, *py*, *pu*, are situated each as the oblique diagonals of the nucleus, or those which would be drawn from *a* to *d*, from *a* to *x*, from *a* to *c*, &c. (fig. 4.)

Crystals of this variety are found near Lyons in France; and the freestone of Fontainebleau, commonly called *crystallized freestone*, which is nothing else than calcareous spar mixed with particles of quartz, exhibits the same form. The crystals of this stone yield to mechanical division, and have their natural joinings, like those of pure spar, situated in the planes parallel to the edges *pz*, *py*, *pu*, &c. (fig. 43), and which would pass at an equal distance from these edges.

Rhomboidal Iron Ore (fig. 45).

Geometric Character.—Inclination of BCRP to BCOA or OCRS, 146° 26′ 33″; angles of the rhombus BCRP, C or P = 117° 2′ 9″; B or R = 62° 57′ 51″.

The laminæ composing this rhomboid decrease by two rows on the angles *bcr*, *ocr*, *bco*, &c. (fig. 46), which concur with the formation of the two solid angles *cn* of a cubic nucleus. The faces produced, instead of being on a level, three and three, around these angles, as in the case of decrement by a single row, incline one to the other, and extend above the faces of the nucleus in such a manner that their diagonals are parallel to the horizontal diagonals of the same faces. The cube here answers the purpose of a rhomboid, which should have its summits in *c* and *n*, in which case there would be only one axis passing through the summits. In the dodecahedron, on the other hand, with pentagonal planes (fig. 19), the cube performs the functions of a rectangular parallelopipedon, and then three different axes may be conceived, each of which passes through the middle of the two opposite faces. When the cube begins to perform the one or the other in regard to one species of mineral, it is observed to continue that function in all the varieties of that species.

The crystals of rhomboidal iron are found among those of the iron ore of the island of Elba. It is uncommon, however, for the law of decrement to attain to its boundary, and for the rhomboid not to be modified by facets parallel to the faces of the nucleus. If the decrement which produces the rhomboid took place at the same time on the eight solid angles of the cube, there would result a polyhedron of twenty-four facets, of which nature are the crystals found at the Calton-hill, Edinburgh, which have been considered as zeolites.

4. *Intermediate Decrements.*

In some crystals the decrements on the angles do not take place in lines parallel to the diagonals, but parallel to lines situated between the diagonals and the edges. This happens when the subtractions are made by double, triple, &c. rows of molecules. In figure 55, which is an instance of these subtractions, the molecules composing the row represented by the figure are so arranged as if, of two, only one was formed. To reduce this case under that of the common decrements on the angles, we have only to conceive the crystal composed of parallelopipeds, having their bases equal to the small rectangles *abcd*, *edfg*, *hgil*, &c. The name of intermediate decrement is given to this kind of diminution.

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Syntactic Iron Ore (fig. 42).

Geometric Character.—Respective inclination of the trapeziums *bego*, *nqgo* of the rising pyramids = 135° 34′ 31″; of the edges *cg*, *gq*, 129° 31′ 16″. Angles of the trapezium *bego*, *b* or *c* = 103° 48′ 35″; *o* or *g* = 76° 11′ 25″.

This variety of iron ore is found at Framont, in Les Vosges. It commonly appears under the form of two opposite pyramids, and some groups reflect from the surface the prismatic colours. These crystals, classed by De l'Isle among the modifications of the dodecahedron with isosceles triangular planes, have for nucleus a cube performing the functions of the rhomboid. The two regular hexagons by which they are terminated arise from a decrement by a single row of cubic molecules on the angles *c*, *n* (fig. 46) of the nucleus.

To comprehend the effect of this law, combined with the preceding, and which produces the lateral trapeziums, let it be supposed that *cbpr* (fig. 49) represents the same square as fig. 46, subdivided into small squares, which are the external faces of so many molecules. Taking these molecules by pairs, so that they form rectangular parallelopipeds, having for bases the oblong squares *bngh*, *hgm*G, &c. and imagine that the subtractions are made by two rows of these double molecules, the edges of the laminæ of superposition will be successively ranged in lines, as PG, TL, R*p*, S*p*, *kz*, *yz*, &c. and the sum of all these edges will produce two faces, which departing from the angles *b*, *r*, will converge, the one towards the other, and will unite themselves on a common ridge, situated above the diagonal *cp*, but inclined to that diagonal. The complete result of this decrement, then, is twelve faces; and it is shown by calculation, that the six superior faces being prolonged to the point where they meet the six lower faces, will form with them the surface of a dodecahedron, composed of two right pyramids united at their bases. By the effect of the first law, these pyramids are here incomplete, which gives the hexagon *abcdru* (fig. 48) and its opposite.

5. *Mixed Decrements.*

The decrements in other crystals, either on the edges or on the angles, vary according to laws, the proportion of which can only be expressed by the fraction $\frac{2}{3}$ or $\frac{3}{4}$. It may happen, for instance, that each lamina exceeds the following by two rows parallel to the edges, and that it may, at the same time, have an altitude triple that of a simple molecule. A vertical geometrical section of one of the kinds of pyramids resulting from this decrement is represented at fig. 54. The effects of this decrement may be readily conceived by considering that AB is a horizontal line taken on the upper base of the nucleus, *bazr* the section of the first lamina of superposition, *qfen* that of the second. These are called *mixed decrements*, which exhibit this new kind of exception from the simplest laws. They, as well as the intermediary ones, rarely exist anywhere else, and they have been particularly discovered in certain metallic substances. The application of the ordinary laws, Haüy observes, to a variety of these substances, presented such errors in the value of the angles as led him to believe that they were inconsistent with theory. But extending his theory, he arrived at results so correct as re-

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moved every doubt of the existence of the laws on which these results depended.

All the changes to which crystals are subjected depend on the laws of structure which have been explained, and others of a similar kind. The decrements sometimes take place at the same time on all the edges, as in the dodecahedron having rhombuses for its planes, or on all the angles, as in the octahedron originating from a cube. Sometimes they take place only on certain edges of certain angles. There is sometimes a uniformity between them, so that it is one single law by one, two, three rows, &c. which acts on the different edges or the different angles. Sometimes the law varies from one edge to the other, or from one angle to the other. This happens particularly when the form of the nucleus is not symmetrical, as, for instance, when it is a parallelopiped, whose faces differ by their respective inclinations, or the measure of their angles. In some cases there is a concurrence of the decrements on the edges with those on the angles to produce the same form, and sometimes the same edge or the same angle is subjected to several laws of decrement succeeding each other. The secondary crystal in some cases has faces parallel to those of the primitive form, and which combine with the faces produced by the decrements to modify the figure of the crystal. Simple secondary forms are those which arise from a single law of decrement, the effect of which entirely conceals the nucleus. Compound secondary forms arise from several simultaneous laws of decrement, or from one single law not having attained to its extent; so that there remain faces parallel to those of the nucleus, which concur with the faces produced by the decrement to diversify the form of the crystal. If, amidst this diversity of laws, sometimes insulated, sometimes united by more or less complicated combinations, the number of the rows subtracted were itself extremely variable; if, for instance, these decrements were by twelve, twenty, or thirty rows, or more, which is possible, the number of forms which might exist in each kind of mineral would be immense. But the power by which the subtractions are effected seems to be very limited in its action. Its extent rarely exceeds one or two rows of molecules. Beyond four rows only one variety of calcareous spar has been discovered. The structure of this variety depends on a decrement by six rows; but this seems to be a rare occurrence in nature. Yet although the laws of crystallization are limited to two of the simplest, that is, those which produce subtractions by one or two rows, calcareous spar is susceptible of 2044 different forms, a number exceeding more than fifty times that of the forms at present known; and, admitting into the combination decrements by three and four rows, calculation will give 8,388,604 possible forms of the same substance, and by the operation of either mixed or intermediate decrements this number will be greatly augmented.

The striæ observed on the surface of many crystals is another proof in favour of the theory; for they always have directions parallel to the projecting edges of the laminæ of superposition, which mutually go beyond each other, if the regularity of the process has not been disturbed. It must not however be supposed that the inequalities arising from the decrements must be always sensible if the form of the crystals be complete; for the molecules being extremely minute, the surface will appear finely polished, and no striæ will be perceptible. In some secondary crystals, therefore, they are not to be seen, while they are quite distinct in others of the same nature and form. In the latter case, the action of the causes producing crystallization has not enjoyed all the necessary conditions; the operation has been interrupted; and the law of continuity not having been observed, there have remained on the surface of the crystal perceptible vacancies. These deviations have this advantage, that they point out the direction according to which the striæ are arranged in lines, and thus contribute to discover the real mechanism of the structure.

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The small vacuities which the edges of the laminæ of superposition leave on the surface of even the most perfect secondary crystals, by their re-entering and salient angles, show that the fragments obtained by division, the external facets of which form part of the faces of the secondary crystal, are not like those drawn from the interior part; for this apparent diversity arises from these facets being composed of a multitude of small planes, really inclined to each other, but which being very minute, present the appearance of one plane. And if the division could reach its utmost bounds, these fragments would be resolved into molecules similar to each other, and to those situated towards the centre. It happens, too, that molecules of different figures arrange themselves in such a manner as to produce similar polyhedra in different kinds of minerals. Thus the dodecahedron with rhombuses for its planes, which is obtained by combining cubic molecules, exists in granite, with a structure composed of small tetrahedra, having isosceles triangular faces. It exists also in sparry fluor, where there is also an assemblage of tetrahedra, but regular, that is to say, the faces of which are equilateral triangles.

We now proceed to give examples of compound secondary forms.

Prismatic Calcareous Spar (fig. 1).

The bases of this prism are produced in consequence of a decrement, by a single row on the angles of the summits *baf, gaf, bag, dex, dec, cex* (fig 4), of the primitive form. The six planes result from a decrement by two rows on the angles *bdf, fxg, bcg, dfx, dbc, egx,* opposite to the preceding. Let *abdf* (fig. 50) be the same face of the nucleus as fig. 4. The decreasing edges situated towards the angle of the summit *a* will successively correspond with the lines *hi, kl,* &c. and those which look towards the inferior angle *d,* will have the positions pointed out by *mn, op;* but as the first decrement takes place by one row, it is proved that the face which results from it is perpendicular to the axis; and calculation shows, in like manner, that the second decrement taking place by two rows produces planes parallel to the axis, and thus the secondary solid is a regular hexahedral prism.

To develope further the structure of this prism, it may be remarked, that in the production of any one, *abcmh* (fig. 1), of the two bases, the effect of one only of the three decrements which take place around the solid angle *a* (fig. 4) may be considered, for example, of that which takes place on the angle *baf,* supposing that the laminæ applied on the two other faces *fagx, bagc,* do not decrease, but to assist the result of the principal decrement which takes place in regard to the angle *baf.* Here these auxiliary decrements are quite similar to that whose effect they are supposed to prolong.

The case will be totally different, by applying the same observation to the decrements which are affected by two rows on the inferior angles *dbf, dfx, fxg,* &c. and which produce the six planes of the prism. If, for example, we consider the effect of the decrement on the angle *dfx,* it is necessary also that the laminæ applied on the faces *afdb, afxg* (fig. 4), should experience towards their lateral angles *afd, afx,* adjacent to the angle *dfx,* variations which second the effect of the generating decrement. Here, however, these variations are intermediary decrements by rows of double molecules.

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Amphitrigonous Iron Ore. Fig. 51 shows this crystal in a horizontal projection, and fig. 52 in perspective.

Geometric Character.—Respective inclination of the triangles *gcn*, *gcd*, &c. from the same summit, 146° 26′ 33″; of the lateral triangles *bgu*, *bgq*, to the adjacent pentagons, such as *gutmn*, 154° 45′ 39″.

This is the common form of the iron ore of the island of Elba. It results from a decrement by two rows on the angles *c*, *n* (fig. 46), to the summits of a cubic nucleus, which produces the isosceles triangles *gcn*, *gcd*, *ncd* (fig. 51 and 52), and of a second decrement by three rows on the lateral angles *cbq*, *crp*, *crs*, &c. which produce the triangles *mnr*, *rnk*, *ugb*, *ggb*, &c. These two decrements stop at a certain term, so that there remain faces parallel to those of the nucleus, viz. the pentagons *gutmn*, *hdnkl*, &c. (fig. 50). The first decrement is similar to that which produces the rhomboidal iron ore. The second has this property, that if its effects were complete, it would give a dodecahedron of isosceles triangles, or composed of two right pyramids united at their bases. The triangles of the summits are frequently furrowed by striæ parallel to the bases *gn*, *dn*, *gd*, of these triangles, and which point out the direction of the decrement.

Analogical Calcareous Spar (HAÜY), fig. 53.

Geometric Character.—Inclination of any one, *imeh*, of the trapezoids of the summits to the corresponding vertical trapezoid *ecpg*, 116° 33′ 54″; angles of the same trapezoid $i = 114° 18′ 56″$; $e = 75° 31′ 20″$; *m* or $h = 85° 4′ 52″$. Angles of the trapezoid *ehog*, $e = 90°$; $o = 127° 25′ 53″$; $g = 67° 47′ 44″$; $h = 74° 46′ 23″$; of the trapezoid *cegp*, $e = 60°$; $p = 98° 12′ 46″$; *c* or $g = 100° 53′ 37″$.

Geometric Properties.—1. In each vertical trapezoid, the triangle *ceg* is equilateral. 2. The height *ex* of this triangle is double the height *px* of the opposite triangle *cpg*. 3. In the trapezoid *ehog*, and the other similarly situated, the angle *heg* is a right angle. 4. If the diagonal *gh* be drawn, the triangle *heg* will be similar to any one *aof* (fig. 4) of those which would be produced by drawing in the primitive rhombus the two diagonals *bf*, *ad*. 5. If in the trapezoid *emih*, or any other situated at the summits, the diagonals *ei*, *mh* be drawn, the height *el* of the inferior triangle *meh* will be double the height *il* of the superior triangle *mih*. 6. The triangle *mih* is similar to half of the rhombus of every obtuse spar divided by the horizontal diagonal, and the triangle *meh* is similar to half of the rhombus of the acute spar divided in the same manner.

The numerous analogies connecting this variety with different crystalline forms, whether considering certain angles formed by planes, or certain triangles obtained by drawing the diagonals of the trapezoids, led the author of this theory to give it the name of *analogical spar*. It is derived from three other varieties, viz. very obtuse spar, by the trapezoids *emih*, *fiht*, &c.; metastatic spar, by the trapezoids *cmdc*, *ehog*, *ohtz*, &c.; and the prismatic spar, by the trapezoids *back*, *cegp*, &c. which are consequently parallel to the axis. The trapezoids *imeh*, *fiht*, &c. are often separated by an intermediary ridge from the vertical trapezoids *cegp*, *gozr*, &c. In that case the trapezoids *edne*, *geho*, &c. are changed into pentagons.

Icosahedral Sulphuret of Iron (fig. 55).

Geometric Character.—Respective inclinations of the isosceles triangles PLR, PSR, 126° 52′ 11″; of any one PNL of the equilateral triangles to each adjacent isosceles triangle, PLR, or LNK, 140° 46′ 17″. Angles of the isosceles triangle PLR, $L = 48° 11′ 20″$, P or R $= 65° 54′ 20″$.

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This variety is the result of a combination of the law which produces the octahedron originating from a cube (fig. 42), with that which takes place for the dodecahedron with pentagonal planes (fig. 19 and 20). The first law produces the eight equilateral triangles which correspond with the solid angles of the nucleus; and the second produces twelve isosceles triangles, situated two and two above the six faces of the same nucleus. If a dodecahedron similar to that of fig. 20 were converted geometrically into this icosahedron, it would be sufficient to make the planes of eight sections pass through it in the following manner; viz. one through the angles P, N, L (fig. 19), another through the angles P, M, S, a third through the angles L, R, U, &c. By comparing the figures 19 and 55, the relation between the polyhedra will be seen by the correspondence of the letters; but this is merely an artificial operation; for it may be observed, that the nucleus of the icosahedra which would be obtained, would be much smaller than that of the dodecahedron, since the solid angles of the latter nucleus would be confounded with the angles D, C, G, &c. (fig. 20), of the dodecahedron; but the other nucleus would have its solid angles situated in the middle of the equilateral triangles MPS, NPL, URL (fig. 55).

The icosahedron of the sulphuret of iron, which is not very common, has been confounded with the regular geometrical icosahedron, which has all its angles equilateral. Theory shows that the existence of the latter icosahedron is equally impossible in mineralogy as the geometrical dodecahedron. Among the five regular polyhedra of geometry, viz. the cube, the tetrahedron, the octahedron, the dodecahedron, and the icosahedron, the three former can only exist among minerals according to the laws of crystallization.

Polynomous Petunze (HAÜY), fig. 56.

Geometric Character.—Respective inclination of the narrow planes, *onkm*, *cfhg*, to the adjacent planes on each side, 150°; of the planes *ctFg*, *PomN* to those contiguous to them by the edges *t*F, PN, 120°; of the heptagon *pGcldez* to the enneagon *BzebnoPrs*, 99° 41′ 8″; of the trapezium *dafc*, both to the plane *nbafhilk*, and to the heptagon *pGtcdez*, 135°; of the facet *deab*, or ABz*p*, to the same pentagon, 124° 15′ 15″.

Haüy had not observed the petunze crystallized under its primitive form. This form, such as it is given by the mechanical division of secondary crystals, is that of an oblique prism of four planes (fig. 58), two of which, such as GOAD, RBHN, are perpendicular to the bases ADNH, OGRB; the other two, viz. BOAH, RGDN, make with the former, angles of 120° at the ridge OA, RN, and angles of 60° towards the opposite ridges BH, GD. These planes are inclined to the bases at that place of the ridges GO, BR, 111° 29′ 43″, and at the opposite ridges 68° 30′ 17″. This form is at the same time that of the molecule. By theory, the two parallelograms GOAD, OGRB, as well as their parallels, are equal in extent; and the parallelogram BOAH, or its opposite, RGDN, is double each of the preceding. This may serve to explain the roughness of the sections made in the direction BOAH, when compared with those in the directions of the small parallelograms, the latter being always smooth and brilliant. If, however, the diagonal OR be drawn, it will be found perpendicular to OA and RN; or it will be situated horizontally, by supposing that the ridges OA, BH have a vertical position.

This mineral exhibits the most complicated variety

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which the author has observed among this kind of crystals. To comprehend its structure, suppose that *bpyr* (fig. 57) represents a section of the nucleus AR (fig. 58), made by a plane perpendicular to the parallelograms GOAD, BOAH, and subdivided into a multitude of small parallelograms, which are the analogous sections of so many molecules. Here the side *yr* (fig. 57), which is the same section of the cutting plane as GOAD, is greater than it ought to be in regard to the side *cr* (fig. 57), which is the same section as BOAH (fig. 58). But these dimensions are suited to those of the secondary crystal, and here occasion no difficulty, because it may be supposed that the primitive form has been extended more in one direction than in another; for this form is to be considered only as a convenient datum for the explanation of the structure, and the crystal consists merely in an assemblage of similar molecules; so that it is the dimensions of these molecules which remain invariable.

By comparing fig. 56 and 57 it will be found, 1. That the plane *fabnkhh* (fig. 56), and its opposite, which correspond to *mn*, *dg* (fig. 57), are parallel to two planes of the nucleus, viz. GOAD, BRNH (fig. 58), and therefore do not result from any law of decrement; 2. that the plane P*om*N, and its opposite (fig. 56), which correspond to *ao*, *eg* (fig. 57), are also parallel to two of the planes of the nucleus, viz. BOAH, RGDN (fig. 58); 3. that the plane *onkm*, and its opposite (fig. 56), which correspond to *on*, *eg* (fig. 57), result from a decrement by two rows parallel to the ridges AO, NR (fig. 58); 4. that the plane *cfgh*, and its opposite (fig. 56), result from a decrement by four rows parallel to the ridges GD, BH (fig. 58), which decrement takes place on the other side of these ridges. From this it may be seen that decrements different in their measure give rise to planes similarly situated, such as *onkm* and *cfgh* (fig. 56), which is a consequence of the particular figure of the molecules. With regard to the faces of the summit, the heptagon *pGtcdez* (fig. 56) is situated parallel to the base BRGO (fig. 58). The enneagon B*sr*P*onbez* (fig. 56) is produced in consequence of a decrement by one row on the angle OBR (fig. 58), or parallel to the diagonal OR; which decrement does not attain to its full extent, and leaves subsisting the neighbouring heptagon parallel to the base BRGO. It may be conceived, from what has been said on the position of the diagonal OR, why the line *ez* (fig. 56), which separates the two large faces of the summit, is situated horizontally, by supposing that the planes have a vertical position.

The trapeziums *dafc*, A*p*GC, are the result of a decrement by one row on the ridges GO, BR (fig. 58). The facet *deba* (fig. 56) arises from a decrement by two rows parallel to the ridge BO (fig. 58). With regard to the other facet AB*zp*, which has the same position as the preceding, in relation to the opposite part of the crystal, it results from an intermediary law, by a row of double molecules on the angle OBR (fig. 58). The rhombuses *bclh*, *klsu* (fig. 59) represent the horizontal sections of two of these double molecules taken in the same row, and whose relation to the rest of the arrangement will become sensible by comparing these rhombuses with those marked with the same letters in fig. 57. This variety of crystals is subject to a change of dimensions; the faces *pGtcdez*, *fabnklih*, and their opposites, which are at right angles to each other, are elongated in the direction of their breadth, exhibiting the appearance of a quadrilateral, rectangular prism, the summits of which would be formed by the faces situated towards the ridges PN, F*t*. Crystals of this variety, which are opaque, and of a whitish, yellowish, and sometimes reddish colour, are found in granites; some are in groups, and some, but more rarely, are met with in single crystals.

III. NUMBER OF PRIMITIVE FORMS.

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In the examples which have been given, the author of the theory has chosen the parallelopiped for a nucleus, on account of the simplicity of its form. He has hitherto found that all the primitive forms may be reduced to six. 1. The parallelopiped in general, which comprehends the cube, the rhomboid, and all the solids terminated by six faces parallel two and two; 2. the regular tetrahedron; 3. the octahedron with triangular faces; 4. the hexagonal prism; 5. the dodecahedron with rhomboidal planes; 6. the dodecahedron with isosceles triangular faces.

Among these forms there are some found as nucleus, which have the measure of their angles the same in different kinds of minerals. It is to be considered that these nuclei are composed, in the first instance, of elementary molecules, and that it is possible that the same form of nucleus may be produced in one species by elements of a certain nature, and in another species by different elements combined in a different manner, as we see integrant molecules, some cubic and some tetrahedral, produce similar secondary forms by the operation of different laws of decrement. But it may be observed that all the forms which have hitherto occurred as nuclei on the different species, are such as have a particular character of perfection and regularity, as the cube, the regular octahedron, and the dodecahedron with equal and similar rhombuses for its faces.

IV. FORMS OF THE INTEGRAL MOLECULES.

The primitive form is that which is obtained by sections made on all the similar parts of the secondary crystals; and these sections, continued parallel to themselves, conduct to a determination of the form of the integral molecules, of which the whole crystal is the assemblage. There is no crystal from which a nucleus in the form of a parallelopiped may not be extracted, by making the limitation to six selections, parallel two and two. In a great number of substances, this parallelopiped is the last term of the mechanical division, and consequently the real nucleus; but in some minerals this parallelopiped is divisible, as well as the rest of the crystal, by further sections made in the different directions of the faces, from which results a new solid, which will be the nucleus, if all the parts of the secondary crystal superadded to this nucleus are similarly situated. When the mechanical division conducts to a parallelopiped, divisible only by sections parallel to its six faces, the molecules are parallelopipeds similar to the nucleus; but in all other cases their form differs from that of the nucleus. This may be illustrated by an example.

Let *achsno* (fig. 60) be a cube, having two of its solid angles *a*, *s* situated on the same vertical line; this line will be the axis of the cube, and the points *a* and *s* will be its summits. Let it be supposed that this cube is divisible by sections, each of which, such as *ahn*, passes through one of the summits *a*, and by two oblique diagonals *ah*, *an*, contiguous to the summit. By this section the solid angle *s* will be detached; and as there are six solid angles, situated laterally, viz. *i*, *h*, *c*, *r*, *o*, *n*, the six sections will produce an acute rhomboid, the summits of which will be confounded with those of the cube. At fig. 61 this rhomboid is represented as existing in the cube in such a manner that its six lateral solid angles *b*, *d*, *f*, *p*, *g*, *e*, correspond with the middle of the faces *achi*, *crsh*, *hins*, &c. of the cube; but each of the angles at the summits *bag*, *dsf*, *psf*, &c. of the acute rhomboid, are $= 60°$, from which it follows that the lateral angles *abf*, *agf*, &c. are $= 120°$. Besides, it is proved by theory that the cube is the result of a decrement which takes place by a single

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row of small rhomboids, similar to the acute rhomboid on the six oblique ridges *ab, ag, ae, sd, sf, sp*. This decrement produces two faces, one on each side of each of these ridges, making in the whole twelve faces, but as the two faces having the same line of ridge for their departure are on the same plane, by the nature of the decrement the twelve faces will be reduced to six, which are squares, so that the secondary solid is a cube.

Suppose that the cube (fig. 60) admits, in regard to its summits *a, s*, two new divisions similar to the preceding six, one of which passes through the points *c, i, o*, and the other through the points *h, n, r*. The first will also pass through the points *b, g, e*, and the second through the points *d, f, p* (fig. 61 and 62) of the rhomboid; from which it follows that these two divisions will each detach a regular tetrahedron *bage*, or *dsfp* (fig. 62); so that the rhomboid will be found converted into a regular octahedron *ef* (fig. 63), which will be the real nucleus of the cube; for it is produced by divisions similarly made in relation to the eight solid angles of the cube. If we suppose the same cube to be divisible throughout its whole extent by analogous sections, it is clear that each of the small rhomboids, of which it is the assemblage, will be found in like manner subdivided into an octahedron, and two regular tetrahedrons, applied on the two opposite faces of the octahedron. By taking the octahedron for a nucleus, a cube may be constructed round it, by regular subtractions of small complete rhomboids. If, for example, we suppose decrements, by a single row of these rhomboids, having *b* for the point of their departure, and made in a direction parallel to the inferior edges *gf, eg, de, df*, of the four triangles which unite to form the solid angle *b*, there will result four faces, which will be found on a level, and, like the octahedron with six solid angles, similar decrements around the other five angles will produce twenty faces, which taken four and four will be equally on a level, making in the whole six distinct faces, situated as those of the cube (fig. 60). The result will be exactly the same as in the case of the rhomboid, considered as nucleus.

In whatever way we proceed to subdivide, either the cube, the rhombus, or the octahedron, we shall always have solids of two forms, that is to say, octahedrons and tetrahedrons, without being able to reduce the result of the division to unity. But the molecules of a crystal being similar, Haüy thinks it probable that the structure was as it were interspersed with a multitude of small vacuities, occupied either with the water of crystallization, or some other substance; so that, if it were possible to carry the division to its limits, one of those two kinds of solids would disappear, and the whole crystal would be found composed only of molecules of the other form. This view is the more admissible, as each octahedron being enveloped with eight tetrahedrons, and each tetrahedron being in like manner enveloped with four octahedrons, whichever of these forms may be supposed to be suppressed, the remaining solids will join exactly by their edges; so that in this respect there will be continuity and uniformity throughout the whole extent of the mass. It may be readily conceived how each octahedron is enveloped with tetrahedrons. By attending to the division of the cube only by the six sections which give the rhomboid, we may depart at pleasure from any two, *a, s; o, h; c, n; i, r*, of the eight solid angles, provided that these two angles be opposite to each other. But by departing from the angles *a, s*, the rhomboid will be in the position shown at fig. 62. If, on the contrary, we depart from the solid angles *o, h*, these angles will become the summits of a new rhomboid (fig. 64), composed of the same octahedron as that of fig. 63, with two new tetrahedrons applied on the faces *bdf, egp* (fig. 64), which were unoccupied on the rhomboid of fig. 60. Fig. 65 represents the case in which the two tetrahedrons repose on the faces *dbe, fgp* of the octahedron; and fig. 56 represents the case in which they would rest on the faces *bfg, dep*. Hence, whatever may be the two solid angles of the cube assumed for the points of departure, we shall always have the same octahedron, with two tetrahedrons contiguous by their summits to these two solid angles; and there being eight of these solid angles, the central octahedron will be circumscribed with eight tetrahedrons, which will rest upon its faces. By continuing the division always parallel to the first sections, the same effect will always take place. Each face of the octahedron, however small it may be supposed to be, adheres to a face of the tetrahedron, and reciprocally; and each tetrahedron is enveloped with four octahedrons.

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The structure which is here explained is that of fluate of lime, or fluor spar. By dividing a cube of this substance, we may at pleasure extract rhomboids which have the angles formed by their planes equal to 120°, or regular octahedrons, or tetrahedrons equally regular. In some other substances, as rock crystal, carbonate of lead, &c. which being mechanically divided beyond the term at which we should have a rhomboid or a parallelopiped, parts of various different forms are obtained, and arranged together even in a more complicated manner than in fluor spar. In consequence of these mixed structures, there is some uncertainty respecting the real figure of the integral molecules which belong to these substances. It is observed, however, that the tetrahedron is always one of those solids which concur in the formation of small rhomboids or parallelopipeds that would be extracted from the crystal by a first division. But, on the other hand, there are substances which, being divided in every possible direction, resolve themselves only into tetrahedrons. Garnet, blendes, and tourmaline, belong to this number.

Several minerals are divisible into right triangular prisms. Such is the apatite, the primitive form of which is a regular right hexahedral prism, divisible parallel to its bases and its planes, from which necessarily result right prisms with three planes. Fig. 67 represents one of the bases of the hexahedral prism, divided into small equilateral triangles, which are the bases of so many molecules, and which being taken two and two, form quadrilateral prisms, with rhombuses for their bases.

By adopting then the tetrahedron, in the doubtful cases already mentioned, all the forms of integral molecules may in general be reduced to three, which are remarkable for their simplicity, viz. the parallelopiped, the simplest of all the solids, having parallel faces two and two; the triangular prism, the simplest of all prisms; and the tetrahedron, which is the simplest of pyramids. This simplicity may furnish a reason for the preference given to the tetrahedron in fluor spar, and the other substances which have been mentioned as examples. But the ingenious author of the theory cautiously declines to speak decisively on the subject, as the want of direct and precise observations, he observes, leaves to theory only conjectures and probabilities.

But the essential object is, that the different forms to which these mixed structures lead are arranged in such a manner that their assemblage is equivalent to a sum of small parallelopipeds, as has been seen to be the case in regard to fluor spar; and that the laminæ of superposition applied on the nucleus decrease by subtractions of one or more rows of these parallelopipeds. The basis of the theory exists, therefore, independently of the choice which might be made of any of the forms obtained by the mechanical division.

With the help of this result, the decrements to which

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crystals are subject, whatever be their primitive forms, are found reducible to those which take place in substances where this form, as well as that of the molecules, are indivisible parallelopipeds; and the theory has this advantage of being able to generalise its object, by connecting with one fact that multitude of facts which, on account of their diversity, seem to be little susceptible of being brought to one common point. But what has been said will be still more illustrated by examples of the manner in which we may reduce to the theory of the parallelopiped, that of the forms which are different from that solid.

Crystals whose Molecules are Tetrahedrons, with Isosceles Triangular Faces.

GARNET.

1. *Primitive Garnet* (fig. 68).

Geometric Character.—Respective inclinations of any two of the faces of the dodecahedron, 120°. Angles of the rhombus CLGH, C or G = 109° 28′ 16″; L or H = 78° 31′ 44″.

Notwithstanding the vitreous appearance in general exhibited on the fractures of garnets of the primitive form, laminæ may be perceived on them, situated parallel to the rhombuses which compose their surface. Let us suppose the dodecahedron divided in the direction of its laminæ, and, for the greater simplicity, let us suppose the sections to pass through the centre. One of these sections, viz. that which will be parallel to the two rhombuses DLFN, BHOR, will concur with a hexagon, which would pass through the points E, C, G, P, I, A, by making the tour of the crystal. A second section parallel to the two rhombuses GLPF, BEAR, will coincide with another hexagon shown by the points D, C, H, O, I, N. And if the division be continued parallel to the other eight rhombuses, taken two and two, it will be found that the planes of the sections will be confounded with four new hexagons analogous to the preceding. But by resuming all these hexagons, it will appear that their sides correspond, some of them with the small diagonals of the rhombuses of the dodecahedron, viz. those which would be drawn from C to G, from A to I, from C to B, &c. and others would correspond with the different ridges EC, GP, PI, EA, &c.

I. The planes then of the sections passing through the sides and through the small diagonals of the twelve rhombuses, will subdivide the whole surface into twenty-four isosceles triangles, which will be the halves of these rhombuses. 2. Since the planes of the sections pass also through the centre of the crystal, they will detach twenty-four pyramids with three faces; the bases of which, if we choose, will be the external triangles that make part of the surface of the dodecahedron, and of which the summits will be united in the centre.

Besides, if we take, for example, the six tetrahedrons, which have for external faces the halves of the three rhombuses CEDL, CLGH, CEBH, these six tetrahedrons will form a rhomboid, represented by fig. 77, and in which the three inferior rhombuses DLGS, GHBS, DEBS, result from three divisions, which pass, one through the hexagon DLGORA (fig. 68), the second through the hexagon GHBANF, and the third through the hexagon BEDFPO. Fig. 69 also represents the two tetrahedrons, the bases of which make part of the rhombus CLGH. One of these is marked with the letters L, C, G, S, and the other with the letters H, C, G, S. And by applying what has been said to the other nine rhombuses, which are united, three and three, around the points F, A, H (fig. 69), we shall have three new rhomboids; from which it follows, that the twenty-four tetrahedrons, considered six and six, form four rhomboids; so that the dodecahedron may be conceived as being itself immediately composed of these four rhomboids, and in the last analysis of twenty-four tetrahedrons.

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It may be observed, that the dodecahedron having eight solid angles, each formed with three planes, they might have been considered as the assemblage of the four rhomboids, which would have for exterior summits the four angles G, B, D, A; from which it follows, that any one of the faces, such as CLGO, is common to two rhomboids, one of which would have its summit in C, and the other in G, and which would themselves have a common part in the interior of the crystal.

We may remark further, that a line GS (fig. 69) drawn from any one G (fig. 68) of the solid angles composed of three planes, as far as the centre of the dodecahedron, is at the same time the axis of the rhomboid, which would have its summit in C (fig. 66 and 68). The composing rhomboids then have this property, that their axis is equal to the sides of the rhombus. From which, with a little attention, we may conclude, that in each tetrahedron, such as CLGS (fig. 69), all the faces are equal and similar isosceles triangles.

If the division of the dodecahedron be continued by sections passing between those which we have supposed to be directed towards the centre, and which should be parallel to them, we should obtain tetrahedrons always smaller, and arranged in such a manner that, taking them in groups of six, they would form rhomboids of a bulk proportioned to their own.

The tetrahedrons, which would be the term of the division, were it possible to reach it, ought to be considered as the real molecules of the garnet. But it will be seen, that in the passage to the secondary forms, the laminæ of superposition which envelope the nucleus really decrease by rows of small rhomboids, each of which is the assemblage of these tetrahedrons.

The sulphuret of zinc, or blende, has the same structure as the garnet. Haüy informs us that he has divided fragments of this substance by very clean sections, in such a manner as to obtain successively the dodecahedron, the rhomboid, and the tetrahedron.

2. *Trapezoidal Garnet* (fig. 70).

Geometric Character.—Respective inclination of the trapezoids, united three and three around the same solid angle D, C, G, &c. 131° 48′ 33″; of the trapezoids united four and four around the same solid angle *u*, *x*, *r*, &c. 131° 48′ 36″. Angles of any one of the trapezoids *m*D*u* L, L = 78° 27′ 46″; D = 117° 2′ 8″; *m* or *u* = 82° 15′ 3″. The value of the angle L is the same as that of the acute angle of the nucleus of calcareous spar.

This variety is the result of a series of laminæ, decreasing at the four edges, on all the faces of the primitive dodecahedron. For the more simplicity, let us first consider the effect of this decrement in regard to the rhombus CLGH (fig. 68). We have just seen that this rhombus was supposed to belong in common to two rhomboids, which should have for summits, one the point C, and the other the point G. Let us suppose that the laminæ applied on this rhombus decrease towards their four edges by subtractions of a single row of small rhomboids, in such a manner that, in regard to the two edges CL, CH, circumstances are the same as if the rhombus belonged to the rhomboid which has its summit in C; and that in regard to the other two edges GL, GH, the effect is the same as if the rhombus belonged to the rhomboid which has its summit in G. This disposition is admissible here in con-

Structure of Crystals.

sequence of the particular structure of the dodecahedron, which permits us to obtain small rhomboids, some of which have their faces parallel to the faces of that with its summit in C, and the rest to that having its summit in G.[1]

The results of the four decrements being thus quite similar to each other, the laminæ of superposition, applied on the rhombus CLGH, and on each of the other rhombuses of the dodecahedron, will form as many right quadrangular pyramids, which will have for bases these same rhombuses. Fig. 71 represents the pyramids which rest on the three rhombuses CLDE, CEBH, CGHB (fig. 68), and which have for summits the points *m, e, s* (fig. 68); but on account of the decrement by a simple row, the adjacent triangular faces, such as E*m*C, E*s*C of the two pyramids that belong to the rhombuses CLDE, CEBH, are on a level, and form a quadrilateral E*m*C*s*. But we had twelve pyramids, and consequently forty-eight triangles. These divided by two give twenty-four quadrilaterals, which will compose the surface of the secondary crystal. But because the rhomboidal bases of the two pyramids extend more, in proceeding from L to E, or from H to E, than in proceeding from D to C, or from B to C, the sides *m*E, E*s* of the quadrilateral will be longer than the sides C*m*, C*s*. And besides, *m*E will be equal to E*s*, and C*m* equal to C*s*. Thus the quadrilaterals will be trapezoids which have their sides equal two and two. There is no crystalline form in which the striæ, when they do exist, show in a more sensible manner the mechanism of the structure than in this variety of garnet. We may here see the series of decreasing rhombuses which form each of the pyramids CLDE*m*, CEBH*s*, &c. (fig. 71), and sometimes the furrows are so deep that they produce a kind of stair, the steps of which have a more particular polish and brilliancy than those of the facets, which are parallel to the faces CEDL, CHBE of the nucleus.

If the decrements stop abruptly at a certain term, so that the pyramids are not terminated, the twenty-four trapezoids will be reduced to elongated hexagons, which will intercept twelve rhombuses parallel to the faces of the nucleus. To this variety Haüy has given the name of *intermediary garnet.*

In the sulphuret of zinc the regular octahedron is the result of a decrement by a row around the eight solid angles, composed of three planes, viz. C, B, O, G, F, D, A, I (fig. 68). The same substance also assumes the form of a regular tetrahedron, by the help of a decrement by one row on four only of the eight solid angles before mentioned, such as C, O, F, A. The structure of this tetrahedron is remarkable, as it presents an assemblage of other tetrahedrons with isosceles faces.

Crystals whose Molecules are Triangular Prisms.

Oriental.

Haüy has thus denominated the gem which is known under the different names of *ruby, sapphire, oriental topaz,* according as the colour is red, blue, or yellow. The different varieties of this gem have not been accurately described, and the nature of the particular angles of each has not been precisely indicated, on account of the rare occurrence of regularly formed crystals, or, when such have been found, on account of their being defaced by being water-worn, or otherwise injured. But from some crystals which were sufficiently characterized, Haüy obtained the following results:

Structure of Crystals.

1. *Primitive Oriental.*

This mineral crystallizes in the form of a regular hexahedral prism, which is divisible parallel to its bases. According to theory, which points out other joinings parallel to the planes, the molecule is an equilateral triangular prism. The height of this prism, calculated by theory, is a little less than three times the height of the triangle of the base.

2. *Elongated Oriental* (fig. 72).

Geometric Character.—Respective inclinations of the triangles IAS, IBS, 139° 54′ Angles of the triangle IAS, A = 22° 54′, I or S = 78° 47′.

This form is the result of a decrement by a simple row of small quadrangular prisms on all the edges of the bases of the nucleus. Let *qd* (fig. 67) be the superior base, subdivided into small triangles, which represent the analogous bases of so many molecules. The edges of the laminæ of superposition will correspond successively to the hexagons *hilmnr, ekuxyv,* &c.; from which it follows that the subtractions take place by rows of small parallelopipeds of quadrangular prisms composed each of two triangular prisms.

3. *Minor Oriental.*

Geometric Character.—Dodecahedron formed of two right pyramids less elongated than those of the preceding variety. The triangles corresponding to IAS, IBS are inclined to each other 122° 36′. In each of these triangles the angle of the summit is 31°, and each of the angles at the base is 74° 30′.

The law of which this variety is the result differs from that which produces the preceding, as it determines a mixed decrement by three rows in breadth and two rows in height.

4. *Enneagonal Oriental* (fig. 73).

Geometric Character.—Inclination of each small triangle, such as *cqi,* to the adjacent base *aciplbged,* 122° 18′.

This is the elongated oriental, whose summits are replaced by two faces parallel to the bases of the nucleus, with the addition of six small isosceles triangles *cqi, lbf, vzm,* &c. the three superior of which are alternate in position with the three inferior. These triangles are the result of a decrement, by three rows of small quadrangular prisms on the three angles of the superior base of the nucleus, such as *b, d, g* (fig. 67), and on the intermediate angles of the inferior base. It may be readily conceived that, in the decrement which takes place, for example, on the angle *g,* the three rows which remain unoccupied between that angle and the corresponding edge of the first lamina of superposition are, 1. the small rhombus *goip,* which alone forms the first row; 2. the two rhombuses *osti, pzdi;* 3. the three rhombuses situated on the same line behind the two preceding.

Crystals of this gem are chiefly found in the kingdom of Pegu. Some have been found in France, which have received the name of sapphires of Puy. They have been also found at a little distance from Velay, on the banks of a rivulet near the village of Expailly, where they are mixed with garnets and hyacinths. These have all the characters of the stone which is denominated *oriental sapphire.*

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[1] Theory, the author observes, has conducted him to another result, which is, that the sum of the nucleus and laminæ of superposition, taken together in proportion as the latter are applied one upon the other, is always equal to a sum of rhomboids; though at first view it does not appear that this should be the case, according to the figure of these laminæ, which represent rising pyramids.

Ctesias || Ctesiphon.

V. DIFFERENCE BETWEEN STRUCTURE AND INCREMENT.

In what has been said respecting the decrements to which the laminæ of superposition are subjected, the author observes that it was his view only to unfold the laws of structure; and he adds, that he is far from believing that in the formation of a dodecahedral crystal, or one of any other form, having a cube for a nucleus, the crystallization has originally produced that nucleus such as it is extracted from the dodecahedron, by the successive application of all the laminæ of superposition with which it is covered. It seems proved, on the contrary, that from the first moment the crystal is already a very small dodecahedron, containing a cubical nucleus proportioned to its small size, and that the crystal afterwards increases by degrees without changing its form, by new layers which envelope it on all sides, so that the nucleus increases also, preserving always the same relation with the whole dodecahedron.

An example taken from a plane figure will make this more striking; and what is said respecting this figure may be easily applied to a solid, since a plane figure may be always conceived as a section of a solid. Let ERFN (fig. 74) be an arrangement of small squares, in which the square ABCD, composed of forty-nine partial squares, represents a section of the nucleus, and the extreme squares R, S, G, A, I, L, &c. that of the kind of stair formed by the laminæ of superposition. It may be readily conceived that the arrangement began with the square ABCD, and that different files of small squares were afterwards applied on each of the sides of the central square; for example, on the side AB, first the five squares comprehended between I and M, next the three squares comprehended between L and O, and then the square E. This increment corresponds with that which would take place if the dodecahedron began by being a cube proportioned to its bulk, and which increased afterwards with the addition of continually decreasing laminæ.

But, on the other hand, the arrangement may be conceived to be such as is represented in fig. 76, in which the square *abcd* is composed of only nine molecules, and bears upon each of its sides only one square *e*, *n*, *f*, or *r*; and that afterwards, by means of the application of new squares arranged round the former, the assortment has become that of fig. 75, where the central square *a' b' c' d'* is formed of twenty-five small squares, and bears on each side of its sides a file of three squares plus a terminating square *e' n' f'*, or *r'*; and that, in short, by a farther application, the assortment of fig. 75 is converted into that of fig. 74. These different transitions will give some notion of the manner in which secondary crystals may increase in bulk, and yet retain their form; and from this it will appear that the structure is combined with that augmentation of bulk, so that the law according to which all the laminæ applied in the nucleus of the crystal, when arrived at its greatest dimensions, successively decrease in departing from this nucleus, existed already in the rising crystal. Ctesiphon || Cuba.

Such is the ingenious theory of the structure of crystals, which, the author observes, is in this similar to other theories, that it sets out from a principal fact, on which it makes all facts of the same kind to depend, and which are only as it were corollaries. This fact is the decrement of the laminæ superadded to the primitive form; and it is by bringing back this decrement to simple and regular laws, susceptible of accurate calculation, that theory arrives at results, the truth of which is proved by the mechanical division of crystals, and by observation of their angles.

We have now laid before our readers a complete account of the atomic crystallographic system of Haüy. Since the publication of the beautiful views of that great observer, other systems have appeared, such as those of Weiss, Mohs, Naumann, and Brookes, which have been adopted in various systems of mineralogy, and are conceived by some to facilitate the description of mineral species.

CTESIAS, a Greek physician and historian, who flourished in the fifth century B.C. He was born of an Asclepiad family at Cnidus in Caria, and was in the early part of his life private physician to Artaxerxes Mnemon. According to Diodorus, he rose to this appointment after having been taken prisoner at the battle of Cunaxa; but it is more probable that he was attracted to Persia by the liberal encouragement there given to professors of the medical art. Ctesias was the author of several historical works, including a history of Persia and of India, a treatise on rivers, another treatise on the Persian revenues, and probably also of a work on medicine.

CTESIBIUS, an Alexandrian mathematician, who flourished about 250 B.C. He is famous as the inventor of several ingenious hydraulic machines, including a clepsydra, a water-organ, and a particular kind of force-pump. He is also said to have written several mathematical treatises, which are however now lost. See HYDRODYNAMICS.

CTESIPHON, in *Ancient Geography*, a large city in the south of Assyria, on the left bank of the Tigris, said to have been founded by a Parthian, Varanes by name, but of whose history nothing is now known. Ctesiphon first rose into importance when the adjoining city of Seleucia began to decay; and on account of its mild and agreeable climate was selected by the Parthian kings as a winter residence, while they spent their summers at Ecbatana. On the fall of the Parthian empire, Ctesiphon began to decline, but on the re-establishment of Persia, under the Sassanidæ, it once more rose into importance. At the time when it fell into the hands of the Roman emperor Severus, its population must have been very great, as from it alone 100,000 prisoners were carried off. Under the Eastern empire Ctesiphon was a strongly fortified place. The time and manner of its destruction are unknown. Remains of the city have been recently discovered at a place called by the Arabs *Al Maidan*.

CTESIPHON, or more properly Chersiphron, a Cretan artist who furnished designs for the great temple of Diana at Ephesus, and invented a machine for transporting the columns of that famous structure. He flourished about 560 B.C.

CUB, the young of certain quadrupeds, as of the bear and the fox; a whelp.

CUBA, the largest and richest of the West India islands, and the most important colony of Spain, was discovered by Columbus on 28th Oct. 1492, during his first voyage. It was first called *Juana* in honour of Prince John, son of Ferdinand and Isabella; but after Ferdinand's death it received the name of *Fernandina*. It was subsequently designated *Santiago*, from the patron saint of Spain; and still later Ave Maria, in honour of the Virgin. Its present name is that by which it was known among the natives at the time of its discovery. It was then divided into nine independent principalities, under as many *caciques*. The aborigines are described as living in a state of happy tranquillity among themselves, and possessing a religion devoid of rites and ceremonies, but inculcating a belief in the existence of a great and beneficent Being, and the immortality of the

Cuba. soul. Cuba was twice visited by Columbus after its discovery—in April 1494, and again in 1502. In 1511 his son Diego Columbus, for the purpose of colonizing the island, fitted out an expedition, consisting of above 300 men, under Diego Velasquez, who had accompanied his father on his second voyage. Their first settlement was Baracoa, and in 1514 they founded Santiago and Trinidad. In July 1515 was planted a town called *San Cristoval de la Havaña*, which name was transferred in 1519 to the present capital, the first named place being now called Batabano. In 1538 Havaña was reduced to ashes by a French privateer; and to prevent a similar disaster in future the *Castillo de la Fuerza*, a fortress which still exists, was built by Hernando de Soto, Governor of Cuba, and afterwards famous for his explorations in the southern and western regions of the United States, as well as for the discovery of the Mississippi. In 1554 the French again attacked and destroyed Havaña. The early settlers devoted themselves principally to the rearing of cattle; but about 1580 the cultivation of tobacco and the sugar-cane was commenced, and this led to the introduction of the system of negro slavery. Previous to 1600 two other fortresses were built for the defence of Havaña—the Moro, and the Punta, which are still in existence. For about a century and a half after this period the island was kept in a state of almost perpetual fear of invasion from the French, English, Dutch, or the pirates infesting these seas; and several ineffectual efforts were made to reduce it. About 1665 the walls of Havaña were commenced. In 1762 Havaña was taken by an English fleet and army under Lord Albemarle, the former consisting of more than 200 vessels of all classes, and the latter of 14,041 men, while the Spanish army numbered 27,610 men. The defence was exceedingly obstinate: the English commenced operations on the 6th of June; but it was not until the 30th of July that the Moro Castle surrendered; and on the 14th August the city capitulated. The spoil divided among the captors amounted to L.736,185. The following year Cuba was restored to the Spaniards, and from that time its progress has been rapid; indeed this restoration is regarded by native writers as the true era whence its importance and prosperity are to be dated. The administration of Las Casas, who arrived as captain-general in 1790, is represented by all Spanish writers as a brilliant epoch in Cuban history. He promoted with indefatigable perseverance a series of public works of the first utility; introduced the culture of indigo; extended the commercial importance of the island by removing as far as his authority extended the trammels imposed upon it by the old system of privilege and restriction. By his judicious administration the tranquillity of the island was maintained uninterrupted at the time of the revolution in St Domingo; although, as is generally believed, a conspiracy was formed at the instigation of the French among the free people of colour in Cuba. In 1802 Jesu Maria, a populous suburb of Havaña, was destroyed by a fire, which deprived 11,400 people of their habitations. On the deposition of the royal family of Spain by Napoleon (the news of which arrived in July 1808), every member of the Cabildo took oath to preserve the island for the deposed sovereign, and declared war against Napoleon. Since that time the island has been presided over by a succession of governor-generals from Spain, some of whom have conducted themselves honourably, while the names of others are loaded with infamy.

The island of Cuba is long and narrow, somewhat in the form of an irregular crescent with its convex side towards the north. It divides the entrance to the Gulf of Mexico into two passages, that to the N.W. being 32½ leagues wide at the narrowest part, between the points of Hicacos in Cuba and Tancha on the Florida coast; and the S.W. passage 38 leagues wide between the Cabo de San Antonio of Cuba, and the Cabo de Catoche, the most salient extremity of the peninsula of Yucatan. Cuba lies between 74. and 85. W. Long.; and 19. and 23. N. Lat. Its length, following a curved line through its centre, is 790 miles, and its greatest breadth (from Cape Maternillos to Mota Cove) is 107 miles. The area is estimated at 31,468 square miles, or, including the other small islands attached to it, 32,807 square miles. The coast of Cuba is generally low and flat, and is surrounded by numerous islands and reefs, which render the approach both difficult and dangerous to those not acquainted with the proper channels. The low nature of the coast subjects it to frequent floods and inundations; and especially on the north side of the island there are many large lagunes from which a considerable quantity of salt is obtained. No island, however, in proportion to its size, has a greater number of excellent harbours, many of them accessible even to ships of the line. A range of mountains extends from one end of the island to the other, dividing it into two unequal portions, of which the northern is generally the narrower. The highest are those at the S.E. extremity of the island, to the N.W. of Santiago de Cuba, and have, according to Humboldt, an elevation of 1200 toises, or 7673 English feet. This Cordillera is one great calcareous mass, resting on a schistose formation. The summits are for the most part rocky and naked, occasionally interrupted by more gentle undulations. The central and western parts of the island contain two formations of compact limestone, one of clayey sandstone, and another of gypsum. The limestone formations abound in caverns. The secondary formations, east of Havaña, are pierced by syenitic and euphotide rocks united in groups. The syenite strata are intercolated with serpentine, and inclined to the N.W. In some places petroleum runs out of rents in the serpentine; and abundant springs of this fluid are also found in the eastern part of the island. The rivers in general are necessarily short, and flow toward the north and south. The largest is the Cauto, rising in the Sierra del Cobre, and falling into the bay of Buena Esperanza on the southern coast, after a course of 50 leagues, for 20 of which it is navigable, though at low water obstructed by bars. The Sagua le Grande rises in the Sierra del Escambray, passes Santo Domingo, and falls into the sea in front of the Boca de Maravillas, being navigable for five leagues. The principal of the other rivers are the Sagua le Chica, the North and South Iatibonica, the Cuyaguateje, Sasa, Agobama, and the Hanabana. On some of the rivers are beautiful cascades, while several of them flow during part of their courses under ground. Cuba.

The climate of the western half of the island presents many inequalities of temperature, arising from that portion of the island being situated along the northern limit of the torrid zone, and from the proximity of the American continent. The seasons are divided into rainy and dry, but the line of demarcation is not very clearly defined. The warmest months are July and August, when the mean temperature is from 82° to 84° Fahr.; the coldest are December and January, when the mean temperature is about 78°. The mean annual temperature at Havaña is about 73·5° Fahr. During the rainy season the heat would be insupportable but for the regular alternation of the land and sea breezes. Snow never falls in Cuba, but hail and hoar-frost are not uncommon in the winter season; and at an elevation of 300 or 400 feet above the level of the sea, ice is often seen several lines in thickness during the prevalence of north winds. Hurricanes are not so frequent here as in Hayti and the other West Indian Islands, and seldom do much damage on shore. They occur during the autumn from August to October.

The only peculiar quadruped known in the island is the *jutia* or *hutia*, an animal shaped like a rat, and from 12 to 18 inches in length exclusive of the tail. It is of a clear black colour, inhabits the hollows and clefts of trees, and feeds on leaves and fruits. Its flesh is insipid, but is

Cuba. sometimes eaten. A few deer are found about the swamps, but they are supposed to have been introduced from the continent. The woods abound in wild dogs and cats, sprung from these animals in a domestic state, and differing from them only in habits and size. They are very destructive to poultry and cattle. Of domestic animals, the ox, the horse, and the pig, are the most valuable, and form a large proportion of the wealth of the island: the sheep, goats, and mules, are less numerous. The manati frequents the shores. The domestic fowls include geese, turkeys, peacocks, and pigeons. The indigenous birds are distinguished by the beauty of their plumage, and are very numerous, including upwards of 200 species. Birds of prey are few. The vulture and turkey-buzzard are protected by law and custom, on account of their services in the removal of offal. The rivers, bays, and inlets, are well supplied with fish. Oysters and other shell-fish are numerous, but of inferior quality. The reefs and shallows, and the sandy portion of the beach, abound in turtle; and the crocodile, cayman, and the iguana, are common. Large numbers of land-crabs are frequently seen crossing the island: they travel over the land every spring, when the rains commence from the sea on the north to the Caribbean Sea on the south. Snakes are not numerous; the *maja*—12 or 14 feet in length, and 18 or 20 inches in circumference—is the largest, but is harmless; the *juba*, which is about 6 feet long, is venomous. Among the insects may be specially noticed the bee and phosphorescent fly. These flies are very numerous, and much used among the poorer inhabitants. Fifteen or twenty of them confined in a calabash pierced with holes are frequently used during the night to serve as a sort of lantern. The noxious insects are the nigua or jigger, a species of ant called vivajagua, the family of mosquitoes, the sand-fly, the scorpion (less poisonous than that of Europe), and spiders, whose bite is malignant enough to produce fever.

The forests of Cuba are of vast extent, and so dense as to be almost impenetrable. Mahogany and other hard woods are indigenous, and several sorts are well adapted for ship-building. The palm is the queen of the Cuban forests, and the most valuable tree on the island. The most common species, the *Palma real* (*Oreodoxia regia*), the cocoa tree, and the African palm, are found in all parts. The fruits of Cuba are those common to the tropics, of which the pine-apple and orange are the most esteemed. Of the alimentary plants, the *platano* or plantain is by far the most important. Next in order come the sweet and bitter *yuca* or *cassava*; the sweet root being eaten as a vegetable, and the bitter converted into bread after its poisonous juice has been extracted. The sweet potato, and other farinaceous roots, are also common. Indian corn is indigenous, and rice is extensively cultivated.

The mineral riches of the island have not yet been explored to any considerable extent. Though gold and silver have undoubtedly been found in the island, the quantity has never been sufficient to repay the labour of search. Gold was sent to Spain from this island by the early settlers, but it was more probably the accumulated wealth of the aborigines in previous centuries, wrested from them by tyranny and rapine at the period of the conquest, than the product of honest labour on the part of the colonists. Traces of auriferous sand are found in the rivers Holguin, Escawbray, &c. Some specimens of the finest gold have been obtained in recent times from the workings of Agabama and Sagua la Grande, but at an expense of time and labour that could not remunerate the parties engaged in it. In 1827 silver and copper were discovered in the jurisdiction of Villa Clara, and the first ores gave no less than 7 oz. of pure silver to the quintal (= 107¾ lbs.) of ore; but they have become less productive, probably from not being properly worked. The copper mines near Santiago, in the eastern part of the island, are of great extent, and very rich, employing nearly 900 persons, and yielding an ordinary average of about 27 per cent. of pure metal. They were wrought with some success during the seventeenth century, but had been abandoned for more than 100 years. About the year 1830 Mr Hardy, a landed proprietor in the island, happened, when on a visit to that part, to carry off some of the refuse of the old workings in order to subject them to analysis, the result of which was, that the metal was found so rich as amply to repay the expense of sending it to England for smelting. Several other mining companies have since been established; and the amount of copper ore exported in 1850 was 552,288 quintals, or nearly 25,100 tons. Of the 35,683 tons of copper ore imported in 1851 into the United Kingdom, 20,825 tons came from Cuba. Coal of a highly bituminous character, affording a strong heat, and leaving very little solid residue in the form of ashes or cinders, is very abundant. In some places it degenerates into a form resembling asphaltum, and near the coast it is often found in a semi-liquid state like petroleum or naphtha. In the quarries near Havaña a thick slate is found, fit for floors and pavements. Marbles and jaspers of various colours, and susceptible of a high polish, are found in many parts of the island, and particularly in the Isle of Pines. It is generally believed that iron exists in various parts of Cuba, and many parts of the great Cordillera undoubtedly contain rocks of a ferruginous nature; but from the difficulty of access, the scarcity of fuel, and the want of capital, no extensive mining operations have been engaged in. Native loadstone, however, has been found in various parts, and chalybeate springs are numerous. Cuba.

The chief agricultural products of Cuba are sugar, coffee, and tobacco. The cultivation of these has advanced with great rapidity since 1809, when the ports of the island were more freely opened to foreigners. The following are the quantities of sugar exported from Cuba, in various quinquennial periods, from 1785 to 1850:—In 1785–90, 1,238,304 cwt.; 1795–1800, 2,604,340 cwt.; 1820–25, 5,570,490 cwt.; 1830–35, 8,963,972 cwt.; 1835–40, 11,524,726 cwt.; 1840–45, 14,612,512 cwt.; 1845–50, 21,224,936 cwt. The cultivation of coffee advanced for a time with equal or even greater rapidity than that of sugar; but latterly, from the low prices of coffee, the cultivation of sugar has become the more profitable, and in a great measure supplanted coffee. In 1840, the exportation of coffee was 54,516,988 lb. avoir.; and in 1851, only 11,907,904 lb. avoir. Tobacco is indigenous in Cuba, and its excellent quality is celebrated in all parts of the world. In 1850, 8,117,742 lb. avoir. of leaf tobacco, and 27,045,150 lb. avoir. of manufactured, were exported. Among the other productions are Indian corn, rice, beans, plantains, cotton, cocoa, pine-apples, lemons, oranges, limes, figs, melons, &c. Of the manufactures, the principal are the making of sugar, molasses, rum, and cigars, and the preparation of coffee and wax.

The ports of the island licensed for foreign trade are Havaña, Santiago, Puerto Prince, Matanzas, Trinidad, Baracoa, Gibara, Cienfuegos, and Manzanillá. The average annual amount of the exports and imports, from 1841 to 1845, was respectively L.4,681,737 and L.5,020,755; and from 1846 to 1850, L.5,656,403 and L.5,906,014. The domestic products exported in 1850 amounted to L.5,217,319. Of the imports into Cuba in 1850, those from Spain amounted to 29·81 per cent.; from the United States 22·96; from England 21·10; Germany 7·27; France 6·03; Spanish America 6·91. Exports, 11·98 per cent. to Spain; 32·61 to United States; 27·55 to England; 7·30 to Germany; 7·27 to France; 2·26 to Spanish America.

Education is in a remarkably backward state in Cuba. According to the latest and most favourable accounts, the number of schools was only 222, and of pupils 9082: of these 6025 were male, and 2417 female whites; and 460 coloured males, and 180 coloured females. The number of

Cuba. free children between the ages of five and fifteen was 99,599. No grants in aid of public instruction are given out of the public treasury, and those who are unable to pay for education are left dependent upon private efforts. Of the above-mentioned pupils, 3757 were receiving instruction gratuitously—540 being educated by the *Sociedad Economica*, 2111 by local subscriptions; while the remaining 1106 were gratuitously instructed by the teachers. It was announced in the *Diario de la Marina* of January 1852, that the government was about to establish nineteen primary free schools in Havaña, Matanzas, and Puerto Prince, and two normal schools in Havaña; but we are not aware that they have yet been organized. The royal university of Havaña has medical and law schools. A six years' study of medicine, and a classical education, are necessary for graduation in these sciences. Among the other educational institutions are the royal seminary of *San Carlos y San Ambrosio*, founded in 1773; a girls' seminary, founded in 1691; a free school of sculpture and painting, founded by the *Sociedad Economica;* a free mercantile school; and private institutions. A museum of natural history was established at Havaña in 1838, and a botanical garden outside the walls in 1844. The *Sociedad Economica*, formerly called the *Sociedad Patriotica*, has for its object the advancement of education, agriculture, commerce, and popular industry. It publishes monthly a journal of its labours, and has a public library and branches in nine of the principal towns.

The Roman Catholic is the only religion tolerated by government. An effort was made a few years ago by England to obtain permission to erect a Protestant church at Havaña, but without success. None can hold property or engage in any business in Cuba, without first acknowledging in writing that he is an apostolical Roman Catholic; but those who have tender consciences leave out the word "Roman," and the omission is winked at. Religion and morality, indeed, like education, are here at a very low ebb. The author of *Cuba and the Cubans*, himself a Catholic and a Cuban, says—"Nowhere is presented a more dark and distressing picture of unbelief, corruption, and immorality." At the present day a brief mass, irreverently hurried through, and witnessed by a very few, is all that attests the Sabbath in Cuba. During service, all seem intent on showing, by their undisguised disrespect, that they are neither believers, nor ashamed of their unbelief. The very priests themselves exhibit the same painful picture of an all-pervading, all-demoralizing infidelity; and the country curates may, as a class, be set down as examples of all that is corrupt, all that is disgusting in low and brutal vice. In the church itself there is no expounding, no reading even of the Gospel; no consolations are carried to the dying, as in the charitable communities that abound in other countries, whether Catholic or Protestant. At first there was but one diocese, which included not only the whole island, but also Louisiana and the two Floridas, all under one bishop. In 1788 Cuba was divided into two dioceses, each embracing half the island. The eastern diocese, or that of Santiago de Cuba, was in 1804 erected into an archbishopric, while that of Havaña still remains under a bishop. The diocese of Havaña embraces 44 parochial churches, and 79 auxiliary ones, and the archbishopric only 27 parochial churches and auxiliaries. The revenues of the church are derived from tithes on the products of the island (sugar estates established since 1805 being alone exempted), the fees of christenings, marriages, deaths, &c. The amount of tithes collected in 1847 is estimated at L.55,714; and adding to this the estimated amount of the fees, the total revenue of the church may be calculated at about L.130,200.

The island is divided into several distinct jurisdictions, as the civil, judicial, military, ecclesiastical, &c. The military is divided into two departments, a western and an eastern, each embracing half the island. There was a third department, the central; but that was suppressed in 1851, and it is said that the suppression also of the eastern department is in contemplation. Each department is under a commander-general, and is divided into sections, each under a commander-of-arms; the sections are subdivided into *partidos* and *cuartones*, each of the former being under a petty judge with the title of captain, and each of the latter under a leader of patrol. Politically, Cuba is divided into two provinces,—the western, or that of Havaña,—and the eastern, or that of Santiago. The judicial division contains two jurisdictions—the royal pretorian audience of Havaña, and the royal audience of Puerto Prince. The maritime division comprises five provinces, which are subdivided into districts, each of the former having a commander, and each of the latter an adjutant. The ecclesiastical divisions have been already noticed. The captain-general is invested with almost unlimited powers, and is responsible only to the sovereign of Spain: he is the supreme head of the civil, military, and ecclesiastical jurisdictions of the island; his decisions are final, and his word is law. At Matanzas, Trinidad, Puerto Prince, and Cienfuegos, there are officers with the title of governor, whose duties, however, are of a judicial nature, extending to disputed points of every sort, civil, criminal, or military; and subordinate to them are eight lieutenancies, called *capitanias à guerra*. In all the cities and towns are municipal bodies, styled *ayuntamientos perpetuos*, exercising judicial functions. There are also in the rural districts *jueces pedaneos*, a sort of itinerant village judges or justices of the peace appointed by the local governors. All judges and other judicial functionaries are paid by fees instead of salaries; and the petty officers of the government, dependent on their fees, prey like so many wolves upon the unprotected within their jurisdiction.

The crown revenues of the island are the *rentas maritimas*, including duties on imports, exports, and tonnage, and the local or municipal duties levied at some of the custom-houses; the *impuestas interiores*, including the tax on home manufactures, sale of papal bulls and stamped paper, the profits derived from the lottery, and the impost on cock-fights; deductions from the *rentas ecclesiasticas*, particularly those called the royal ninths and the consolidated fund, the sinking fund, the *media annata*, and the annual and monthly revenues of the clergy; personal deductions, such as from the pay of public functionaries, and the price of exemption from military service; miscellaneous receipts, as the produce of the sale of royal lands, the rents of vacant livings and of unclaimed estates, the produce of vendible offices; and casual receipts, including deposits, confiscations, donations, and the recovery of arrears. The total revenue received from these sources in 1849 was L.2,638,397; and in 1850, L.2,551,808.

The circulating medium of Cuba, like that of Spain, is composed entirely of the precious metals; paper money is unknown. The coins in use are the Spanish doblon, or *onza de oro*, which is a legal tender for 17 hard dollars, and at the ordinary rate of exchange of $8\frac{4}{17}$ per cent. is worth L.3, 10s. 10d. sterling; and the subdivisions of the doblon, the half, the quarter, the eighth, and the sixteenth—the last being equivalent to a dollar and half a real. The Mexican, Colombian, and other South American doblons are a legal tender for 16 hard dollars, equal to L.3, 6s. 8d. sterling, and are sometimes in demand for exportation at a premium: their divisions are worth eight, four, two, and one dollar respectively. Of silver coins, the Spanish dollar and its divisions, and also Mexican, United States, and South American dollars, are legal tenders at their nominal value.

The roads of Cuba are generally in a very wretched condition. Several railways have been established: the oldest, opened in 1838, extends from Havaña to Guines, a distance of 45 miles, and has branches to Batabano, San Antonio, and Los Palos. A railway from Regla to the mines of

Cuba. Prosperidad has been abandoned. There are lines in operation from Matanzas to Sabanilla, Cardenas to Bamba, Jucaro to beyond Altamisal, and Puerto Prince to Nuevitas. The coast communication is kept up by steamers which ply regularly between the different ports. The number of coasting vessels that entered the port of Havaña in 1851 was 3523.

It is impossible, from the conflicting accounts of the different writers upon the subject, to arrive at anything like certainty as to the number of inhabitants on the island at the time of its conquest; but it may be estimated at probably from 300,000 to 400,000. There is little doubt, however, that before 1560 the whole of this population had disappeared from the island. The first census of Cuba was taken in 1775, when the population was 170,862. In 1791 it was 272,140. The following table gives the population since that period:—

Year.	Whites.	Free Blacks.	Slaves.	Total.
1811	274,000	114,000	212,000	600,000
1817	290,021	115,691	225,268	630,980
1827	311,051	106,494	286,942	704,487
1841	418,291	152,838	436,495	1,007,624
1846	425,769	149,226	323,759	898,752
1849	457,133	164,410	323,897	945,440

Neither of the two last censuses include the garrison, crews of vessels, or the floating population, so that by adding for that omission 40,000 to the census of 1846 the population would be 938,752, and 54,560 to that of 1849 the whole number of souls in the island would be 1,000,000. The census of 1846 gives the population of the principal towns as follows:—Havaña 106,968, Puerto Prince 19,168, Santiago de Cuba 24,005, Matanzas 16,986, Trinidad 13,222. The population of Havaña in 1849 is given at 142,002, and in 1850 at 150,561.

The population of Cuba, according to the latest official statements, is given in the subjoined table. The total fixed population of the whole island according to this table was in 1853, 1,900,060:—

WESTERN DEPARTMENT.

Jurisdictions	Area in sq leagues	Whites.	Free Coloured.	Slaves	Total.	Pop. of chief towns.
Pinar del Rio	312	21,843	3,824	9,998	35,655	1,500
S. Cristobal	70	11,578	1,923	6,548	20,049	270
Bahia-honda	64	4,124	621	5,494	10,239	570
Mariel	48	15,921	2,849	19,422	38,192	1,296
San Antonio	13	12,284	1,721	10,188	24,193	2,890
Havaña	75	87,916	32,594	26,850	147,360	125,905
Santiago	18	7,194	1,597	4,964	13,755	2,274
Bejucal	16	10,817	1,746	7,938	20,501	2,264
Guanabacoa	14	10,721	3,273	4,322	18,316	8,100
Rosario	26	11,764	2,841	5,428	20,033	450
Guines	95	18,214	2,442	16,918	37,574	3,542
Jaruco	43	10,218	1,875	8,136	20,229	611
Matanzas	72	34,721	4,948	40,728	81,397	26,000
Cardenas	106	27,521	3,824	55,016	86,361	6,173
Sagua	123	14,534	1,173	10,001	25,708	2,510
Cienfuegos	215	17,811	4,124	11,318	33,253	4,708
Santa Clara	113	25,592	8,528	5,301	39,421	6,604
Trinidad	73	15,208	7,324	9,318	31,850	14,119
Remedios	205	15,149	3,821	4,012	22,982	5,270
Sto. Espiritu	321	24,321	6,334	6,816	37,532	9,982
Total	2,028	397,451	98,442	268,717	764,610	

EASTERN DIVISION.

Porto Prince	505	26,893	15,318	9,321	46,532	26,649
Nuevitas	190	2,721	397	1,742	4,860	820
Tunas	229	3,818	1,821	722	6,361	2,004
Manzanilla	116	7,321	11,143	917	19,381	3,050
Holguin	212	19,427	3,271	3,827	26,525	3,754
Bayamo	110	10,721	11,217	2,724	24,662	5,875
Jiguani	59	6,721	4,318	683	11,723	950
Cuba	267	21,524	29,718	34,000	85,242	24,253
Guantanamo	134	1,574	2,281	5,928	9,783	863
Baracoa	123	3,817	3,721	1,842	9,381	2,400
Total	1,945	104,537	78,205	61,708	244,450	

The inhabitants of Cuba are divided into 4 classes,—the native Spaniards, who occupy nearly all the offices of power and trust; the Creoles, who are mostly planters, farmers, or lawyers, and are generally looked upon with contempt by the Spaniards; the third class, composed of free mulattoes and free negroes in about equal parts, who are excluded by law from all civil offices; the slaves, constituting the fourth class, are divided into *bozales*, those recently brought from Africa—the *ladinos*, those imported before the law of 1821 prohibiting the slave trade—and the *criollos*, those born on the island. Cuba has long been notorious for the extent to which the slave trade has been carried on there, and the ineffectual efforts made to suppress it. The English government at length succeeded in 1853 in inducing the Spanish government to pledge itself to adopt measures for its suppression; but as yet little effort has been made to check it. Cuba.

Under a better and more liberal system of government, there can be no doubt that Cuba would speedily attain a much higher state of prosperity and importance than it has yet enjoyed. Great as is its productiveness at present, some writers assert that under a good government it would be increased five-fold; its mineral resources would then be fully developed, and it would be able fully to take advantage of its admirable position to develop its trade. The continuance of the present line of policy in reference to Cuba must undoubtedly in time lead to a revolution which Spain of itself will be unable to quell. Not to mention the heavy taxes with which the natives are burdened, the old exclusive system is here still in full force; offices of trust and emolument are almost without exception bestowed upon persons from Spain; the governor-general is the sole medium of communication between the colonists and the crown; his power is absolute, and from his decrees there is no appeal; and indeed the island has been under martial law since 1825. The governor-generalship is notoriously sought after and bestowed as a means of acquiring or repairing a fortune, and a five years' tenure of office is considered sufficient to realize a fortune of half a million sterling. It is said that in the event of a revolution in the island, Spain relies upon the aid of England and France; but even were these powers to render assistance it would probably be only of a pacific nature, and limited to an attempt to obtain for the island a more liberal and congenial form of government. Indeed we doubt not that any active measures taken by other powers to aid Spain in quelling such a revolution would gladly be seized upon by the United States as an excuse for rendering assistance to the insurgents, and obtaining for Cuba a place in the Union. The United States have long been looking with an acquisitive eye upon this island; and although they may not as a body sympathize with such piratical expeditions as that of Lopez in 1850, yet it cannot be denied that they would gladly possess this island by less dishonest means. The opinion of their government upon this subject may be gathered from a despatch of the late President Adams, in which he says that Cuba has "an importance in the sum of our national interests with which that of no other foreign territory can be compared, and little inferior to that which binds the different members of this Union together;" and "that if an apple severed by the tempest from its native tree could not choose but fall to the ground, so Cuba forcibly disjoined from its own unnatural connection with Spain, and incapable of self support, could gravitate only towards the North American Union; which by the same law of nature could not cast her off from its bosom." The hope of its one day becoming a part of the Union no doubt influenced the States' government in rejecting the "Tripartite Treaty" proposed to it by France and England;—that neither of these three governments should now or at any future time obtain possession of Cuba, and that they bind themselves to discountenance all such attempts to that effect on the part of any power or government whatever. Although from its position, being, as it is called, the "key of the Gulf of Mexico," its occupation by any powerful state might materially affect

Cube ‖ Cubit.

their commercial interests in that part, yet in the same way its being in the possession of the States might materially affect the interests of England and France,—they too are extensively engaged in the Gulf trade, and have also valuable possessions in the neighbourhood of Cuba. Some years ago an attempt was made by the States to enter into negotiations for the purchase of Cuba. They offered one hundred million of dollars as the maximum price; but the answer of the minister of state was, "that it was more than any minister dare to entertain such proposition; that he believed such to be the feeling of the country that sooner than see the island transferred to any power they would prefer seeing it sunk in the ocean." Negotiations are said to have been resumed recently by the States' government for its purchase at the price of one hundred and fifty million of dollars, but it is not yet known with what success. We cannot refrain from here giving the opinion upon the subject of one of the Americans themselves, a writer in Hunt's *Merchants' Magazine* for 1853. "That island is in no sense OURS because of its *situation;* the claim that whatever we deem *important* upon our boundaries, belongs rightfully to us, or is to be acquired in defiance of the rights and interests of others, needs no other refutation than simply to trace it to its result—an assertion of universal proprietorship. In the second place let us remember that the matter is environed with difficulties and dangers, and those most formidable—deeply affecting both our foreign relations and our internal affairs—perhaps our very existence as a nation. Finally, regarding the argument of *interest*, by itself, let us strip it of all the fictitious colourings attached to it. The plea of an interest amounting to a *necessity* is false. After all, we have ground for but a very moderate interest in Cuba. We can be safe and great *without* Cuba. Our Gulf and Mississippi trade is likely, under the ability of self-protection we have now attained, to have just as free passage, inwardly and outwardly, if we do not acquire Cuba, as if we do—and might not be greatly disturbed, even were England its proprietor. With fortifications at Key West and other points on the Florida shore, and a fleet, if need be, in the channel, our merchant vessels would be tolerably secure of a way at all times—quite as much so probably as if we owned Cuba. But if we could claim Cuba on this ground of commercial necessity, ought we not to assent to the propriety of the supposed design of Russia on the Dardanelles? Ought she not, too, to possess the island of Zealand, at the mouth of the Baltic? Should not England also seize the northern coast of France, in order to secure the passage of the English Channel? Has not France an equal right to the south coast of England? And, finally, as to Cuba itself, would not the claim of Mexico be just as good as our own?" It does not follow that because Cuba throws off the yoke of Spain it necessarily puts on that of the United States; indeed the Cubans do not seem to have exhibited any strong desire for a connection with that government. In the event of its separation from Spain, its only proper position seems to be that of a distinct and independent state; and we believe that it has within itself every material for self-government and self-defence.

CUBE (κύβος, a solid square, a die), in *Geometry*, a solid body bounded by six equal squares. In *Arithmetic*, the cube of any number is the product obtained by multiplying that number twice by itself: thus, the cube of 5 is 125, being $5 \times 5 = 25 \times 5 = 125$. The term *cube root* is applied to the number so multiplied; hence in the foregoing example, 5 is the cube root of 125.

CUBEBS, the aromatic pungent berries of *Piper cubeba*, sometimes used in medicine as a stomachic, and in certain forms of gonorrhœa. See BOTANY, vol. v., p. 207.

CUBIT, in *Mensuration*, the length of a man's arm from the elbow to the extremity of the middle finger. The ancient cubit varied among different nations. Arbuthnot gives the Roman cubit at $17\frac{4}{10}$ inches; the cubit of the Scriptures at rather less than 22 inches; and the English cubit at 18 inches.

Cubicularii ‖ Cuddapah.

CUBICULARII. See CHAMBERLAIN.

CUCKOO. See index to ORNITHOLOGY.

CUCUMIS, a genus of cucurbitaceous plants, containing the common cucumber, the melon, water melon, the colocynth plant, &c. See BOTANY.

CUDBEAR, a purple or violet-coloured powder, used in dyeing. It is prepared from a species of lichen. See DYEING.

CUDDALORE, a town of Hindustan, in the south of India, situated on the western shore of the Bay of Bengal, at the estuary of the river Panar. The English East India Company obtained a grant of it from the rajah of Gingee in 1681. Here they constructed a factory, which, in consequence of the increasing trade, they wholly rebuilt and fortified in 1702. The town was taken by the French in 1758; but two years later it was recaptured by Sir Eyre Coote. In 1782, after the destruction of Colonel Braithwaite's detachment by Tippoo, it was forced to surrender to the combined forces of the French and Hyder; when the works were greatly strengthened, and a strong garrison sent to defend them. In 1783 it was besieged by the British, who were repulsed with the loss of 942 killed and wounded, in a desperate attempt to storm the works. A few days later, the French general made a vigorous sortie from the fort and attacked the English trenches, but not a single point was carried, and the French sustained a heavy loss. An incident connected with this attack is thus related by Colonel Wilks. "Among the wounded prisoners was a young French sergeant, who so particularly attracted the notice of Colonel Wangenheim, commandant of the Hanoverian troops in the English service, by his interesting appearance and manners, that he ordered the young man to be conveyed to his own tent, where he was treated with attention and kindness until his recovery and release. Many years afterwards, when the French army under Bernadotte entered Hanover, General Wangenheim, among others, attended the levee of the conqueror. 'You have served a great deal,' said Bernadotte, on his being presented, 'and, as I understand, in India.' 'I have served there.' 'At Cuddalore?' 'I was there.' 'Have you any recollection of a wounded sergeant whom you took under your protection in the course of that service?' The circumstance was not immediately present to the general's mind; but on recollection he resumed:—'I do indeed remember the circumstance, and a very fine young man he was. I have entirely lost sight of him ever since; but it would give me pleasure to hear of his welfare.' 'That young sergeant,' said Bernadotte, 'was the person who has now the honour to address you, who is happy in this public opportunity of acknowledging the obligation, and will omit no means within his power of testifying his gratitude to General Wangenheim.'" The sergeant had become one of the most distinguished generals of France, and subsequently, as is well known, ascended the throne of Sweden. Cuddalore is now comprehended in the British collectorship of Arcot, and is the principal civil station of the district. It is 102 miles S.S.W. from Madras, and 15 S.S.W. from Pondicherry. E. Long. 79. 52.; N. Lat. 11. 44. (E. T.)

CUDDAPAH, in Hindustan, a British district within the jurisdiction of the presidency of Madras; bounded N. by the British districts of Kurnool and Guntoor; E. by Nellore; S.E. by Arcot; S.W. by the native state of Mysore; and W. by Bellary. It lies between 14. and 17. N. Lat.; and 78. and 80. E. Long. Area 12,970 square miles. The surface of the country has a general slope from the western frontier, where it attains an elevation of 1180 feet above the level of the sea, to the eastern boundary of the district, where the average elevation does not exceed 450

Cuddapah ‖ Cudworth.

feet. All the streams which intersect the country are consequently discharged into the Bay of Bengal. Of these the principal is the Northern Pennar, which though a formidable torrent during the monsoon rains, with an average width of 300 feet, is almost wholly dried up in the dry season. The mineral wealth comprised in the hilly parts of the district consists of iron, lead, and copper; while various tracts are impregnated with carbonate of soda, saltpetre, and culinary salt. The population is by no means dense; its amount, which has been officially returned at 1,451,921, furnishing little in excess of 100 to the square mile. Cuddapah came into the possession of the British government in 1800, under the provisions of a treaty concluded with the Nizam, or ruler of Hyderabad, subsequently to the fall of Tippoo and the partition of his dominions.

CUDDAPAH, a town and fortress of the above district. It is mentioned in history in the year 1687, as the residence of a nabob under the kings of Golconda: and on the conquest of that country by the Mohammedans, the same officer was confirmed in his office by Aurungzebe. It is now the residence of a British judge and collector of revenue. Long. 78. 52.; Lat. 14. 28. (E. T.)

CUDWORTH, RALPH, the celebrated antagonist of Hobbes, was born at Aller, Somersetshire, in 1617. When only thirteen, he was entered at Emmanuel College, Cambridge, where he afterwards became a fellow and tutor. Amongst his pupils he numbered the celebrated Sir William Temple. In 1641 he was presented to the rectory of North Cadbury, Somersetshire; and in the year following he published a discourse concerning the true nature of the Lord's Supper, which was quoted with approbation by Bochart, Spencer, Selden, and other learned writers. In 1644 he was appointed master of Clare Hall, and in the following year was elected regius professor of Hebrew. After a temporary absence from Cambridge, caused by pecuniary difficulties with which he seems to have been embarrassed, he was elected master of Christ's College in 1654; and having devoted a large share of his attention to the study of Hebrew literature and antiquities, he was one of the persons named by a committee of parliament to be consulted in regard to the English translation of the Bible. In 1678 appeared his greatest work, the *True Intellectual System of the Universe*, a treatise which aims at confuting on *a priori* principles the system of intellectual atheism, as distinguished from the schemes of immoral theism and fatalistic morality. It was translated into Latin by Mosheim, in 1733. The odium heaped upon Cudworth and all the sect of the Latitude men, as they were called at Cambridge, seems to have deterred him from publishing the two great appendices to the work, in which he discusses the ethical and physical aspects of atheism. Of these one was published by Bishop Chandler in 1731, under the title of a *Treatise on Eternal and Immutable Morality*; but the other still remains in MS. in the British Museum.

Dr Cudworth died at Cambridge in 1688, and was buried in Christ's College. His daughter Damaris, who married Sir Francis Masham, was a lady of considerable genius and learning, and is known as the friend and nurse of Locke in his last illness. Besides the works already mentioned, Cudworth also published a treatise entitled *Deus Justificatus, or the Divine Goodness vindicated and cleared, against the assertors of absolute and inconditionate Reprobation*; a sermon on John ii. 3–4, preached before the House of Commons; and a sermon preached at Lincoln's Inn on 1 Cor. xv. 57. The MSS. preserved in the British Museum comprise treatises on the following subjects:—*A Discourse of Moral Good and Evil*; another *Book of Morality, in which Hobbes's philosophy is explained*; *A Discourse of Liberty and Necessity, in which the grounds of the atheistical philosophy are confuted, and morality vindicated and explained*; another book *De Libero Arbitrio*; *Upon Daniel's Prophecy of the Seventy Weeks, in which all the interpretations of the Jews are considered and refuted, with several of some learned Christians*; *Of the Verity of the Christian Religion against the Jews*; *A Discourse of the Creation of the World and the Immortality of the Soul*; *Hebrew Learning*; and *An Explanation of Hobbes's notion of God, and of the extension of Spirits*. For an estimate of Cudworth's merits, see Second PRELIMINARY DISSERTATION, vol. i., p. 341.

Cuença ‖ Cuirass.

CUENCA, a department of New Castile, Spain. It occupies the eastern part of that ancient kingdom, and forms the northern half of the great southern Castilian plain which is watered by the Guadiana and Incar. The rocky district of Cuença includes the valley of the Incar and its tributary streams; but in the north it is principally watered by tributaries of the Tagus. The forests of the department are proverbial, and rival those of Soria; but, from the difficulty of land carriage, timber is scarce and dear in the unwooded districts. Excessive droughts prevail throughout the whole department, and the heat of summer is relieved only by frequent storms of wind. The soil, where well watered, is fertile, but little attention is paid to agriculture. The rearing of cattle, asses, mules, and sheep is the principal employment of the natives. Olive-oil and wine are but sparingly produced. Manufactures are limited to the coarsest stuffs.

CUENÇA, the capital of the above department, stands near the river Incar at its confluence with a small stream called the Huecar, on a site 3400 feet above the level of the sea, and is distant about nine miles from Madrid. It was once a flourishing town, the focus of the provincial wool-trade, but it has now a population of barely 8000. Its cathedral was founded by Alonzo VIII. in 1177, and is one of the most remarkable in Spain. A few woollen factories and paper mills are all that now remain of its ancient industry.

CUENÇA, an inland town of Ecuador, and capital of a cognominal province. It stands on a plain at an elevation of about 8600 feet, near the hill of Farqui, chosen by the French astronomers as their meridian in 1742. It is a cathedral city, and contains several monasteries, besides a college and other educational institutions. Cuença has an extensive trade in cheese, confectionary, hats, grain and other agricultural produce. Pop. 20,000; of whom a considerable portion are Indians.

CUFF, HENRY, the unfortunate secretary of the unfortunate Earl of Essex, was born at Hinton St George, Somersetshire, about 1560, and descended of a respectable family, who were possessed of considerable estates in that county. In 1576 he was entered of Trinity College, Oxford, where he soon acquired considerable reputation as a Greek scholar and disputant. He also obtained a fellowship in Trinity; but was subsequently expelled for speaking disrespectfully of the founder. He was, however, soon afterwards admitted of Merton College, of which, in 1586, he was elected probationer, and in 1588 fellow. Some time afterwards he was elected professor of Greek, and in 1594 appointed proctor of the university. It is uncertain when he left Oxford; nor do we know the occasion of his introduction to the Earl of Essex. When that nobleman, however, was made lord-lieutenant of Ireland, Cuff was appointed his secretary, and is generally supposed to have advised those violent measures which ended in their mutual destruction. Having been implicated by the confessions of his master, he was tried for high treason, convicted, and executed at Tyburn March 30, 1601. Cuff was the author of two books: the one entitled *The Difference of the Ages of Man's Life*; the other *De Rebus Gestis in Sancto Concilio Nicæno*. The first was published after his death, but the second is still in manuscript.

CUIRASS (French, *cuirasse*), armour for the breast or back. It is commonly applied to a piece of defensive armour made of well-hammered iron plate, used to cover the

Cuirassiers || Cujas.

whole body from the neck to the girdle. By some the word is derived from the Latin *cor*, or Italian *cuore, the heart*, because the cuirass defends that part; but it is more probably from the French *cuir*, or Latin *corium, leather*, because defensive armour was originally made of leather, as well as of quilted linen, twisted hempen cord, &c. The cuirass of iron plate succeeded the hauberk, hacqueton, &c. of mail, about the time of Edward III. A species of cuirass was known under several forms among many ancient nations, as the Egyptians, Persians, Greeks, and Romans. See BREASTPLATE.

CUIRASSIERS, a sort of heavy cavalry armed with cuirasses. The cavalry of this description in the French army, who fought at Waterloo, had, until that time, been thought almost invincible; and such was their reputation for courage and daring, that "brave comme un cuirassier" had become a proverb in the French army. But notwithstanding their gallantry and musket-proof armour, they were completely routed and destroyed by the superior weight and dexterity of the British life-guards; a proof, as it should seem, that the latter required no such protection. Yet, notwithstanding, the cuirass was introduced not long after into the British service.

CUISSES, (French, *cuisse*, the thigh), a kind of plate-armour, used to protect the front of the thighs, as greaves were used to protect the legs.

CUJAS, in Latin CUJACIUS, JACQUES, was born at Toulouse in 1520. His father was a fuller, and his real name Cujaus, but, by way of softening it, he afterwards abridged it into Cujas. But if, when young and poor, he curtailed his name, at a more advanced age, when fortune had become more propitious, he extended it, and then subscribed himself Jacques de Cujas. His happy disposition enabled him to surmount all the difficulties which the obscure condition in which he had been born seemed to throw in the way of his advancement. By his own exertions, and without the assistance of any master, he learned Greek and Latin; and he was instructed in the elements of law by Arnoul Ferrier, then professor at Toulouse, a man who, when called to higher employments, distinguished himself by great talents united to great virtues. Cujas always cherished the most affectionate regard for his master. The knowledge which he had imbibed from Ferrier became, as it were, the germ of that which he himself acquired by the efforts of his own genius, and by his extreme ardour in study. Cujas was employed as tutor to the children of the president Dufaur, who afterwards became a distinguished personage; and for their instruction, as well as that of some other young persons whose education he superintended, he began, in the year 1547, to give lessons on the Institutions of Justinian. Etienne Pasquier, who was present at the first of these, says, that he then discovered a clear and vigorous mind, which gave great promise of future excellence; and Antoine Loisel, who attended the lessons with the greatest assiduity, declares that Cujas prevented him from abandoning the science of law, with which the other doctors had disgusted him by their barbarism. His merit, however, would not seem to have been fully appreciated in his native place. A chair of law having, it is said, become vacant at Toulouse in 1554, Cujas not only failed in obtaining it, but he had the mortification of seeing the preference given to one Forcadel, a person of very moderate abilities, and in all respects confessedly his inferior. The city of Toulouse, however, conceiving its honour to be interested in contesting a fact founded on a well-accredited tradition, and of which the odium could only attach to the individual protectors of ignorance and intrigue, its chief magistrates, on the occasion of placing the bust of Cujas in their gallery in the year 1674, affixed to the inscription a solemn and indignant denial of the imputation cast upon their predecessors. And it has also been remarked, that Cujas makes no mention, in any of his numerous writings, of the injustice which he is alleged to have experienced at the hands of his townsmen; but little weight seems to be due to this observation, because it is not improbable that Cujas might have avoided any allusion to a disagreeable subject. Besides, John Robert of Orleans, with whom Cujas had some keen altercations, meanly reproaches him with having been thrice rejected at Toulouse in his applications for a professorship of law, and Cujas is evidently embarrassed in his reply to the insulting allegation. He says, "that Robert lies at least in regard to two of these alleged rejections, and probably even in regard to the third; that, moreover, after he had been called to Cahors, and then to Bourges, the inhabitants of Toulouse had used the most pressing entreaties to induce him to return among them." The town of Toulouse, however, had the misfortune of not being able to attach to its school a man whose merit, which had for seven years been fully recognised, could not fail to add to the lustre which it had already acquired. But that of Cahors was more fortunate. A chair having become vacant there by the retirement of Govea, in 1554, Cujas was appointed to fill it; and he was followed by almost all his pupils. But he only remained about a year at Cahors; patrons worthy of him having stepped forward to withdraw him from the obscure theatre where he had been content to exert his great talents. Margaret of Valois, duchess of Berri, inheriting the love which her father, Francis I., bore to men of letters, had already given proofs of her discernment in choosing as her chancellor Michel de l'Hôpital, who afterwards, in the highest dignity of the state, exhibited a character so elevated and a patriotism so pure. Wishing to render the school of Bourges, the chief place of her apanage, the most celebrated of all those which had as yet existed, Margaret intrusted L'Hôpital with the choice of professors; and he was not slow in discerning the merit of Cujas, whom he called to Bourges, where he had already placed Baudouin and Duaren, the latter of whom had taught there since the year 1538. Duaren at first received Cujas favourably; but, either from weakness or senility, he soon became jealous of the young professor, and, unable to endure the popularity which the latter almost immediately acquired, he had recourse to every expedient in order to rid himself of so formidable a rival. With this view he stirred up the students against the new professor, and such was the disorder produced in consequence at Bourges, that Cujas was obliged to yield to the storm, and to retire to Valence. But this persecution became useful to him, by inspiring him with such a degree of emulation, that he applied himself with greater vigour to the study of law, which the levity natural to his age would otherwise perhaps have induced him to abandon. Recalled to Bourges by order of the Duchess of Berri, he remained there till 1567, when he returned to Valence, on the invitation of Bertrand de Simiane, lieutenant-general of the king in Dauphiné, and reflected great lustre to the university of that city, to which young men flocked from all quarters in order to study under him. In 1570 Cujas was elected professor in the university of Avignon; but his first wife, who belonged to that city, having recently before this died, Cujas resolved to remain at Valence. But Margaret of Valois, who had now become Duchess of Savoy, persuaded him to repair to Turin, where, however, he only remained a few months. His scholars and friends at Bourges induced him to return thither towards the end of 1575. But the troubles which threatened that city forced him to seek a retreat elsewhere, and his first intention was to proceed to Angers, where the people were most desirous of having him; but the orders of the king called him to Paris, where,

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Cujas. on the requisition of the procureur-general, and the report of M. Anjorrant, the parliament passed an arrêt, by which Cujas, who is declared to be a person of great and singular learning and erudition, is permitted " de faire lecture et profession en droit civil en l'université de Paris;" a species of instruction which was then interdicted in the university, and in fact only established there under Louis XIV. Terrasson has supposed that he himself was the first to publish this arrêt; but it is found, together with some other particulars respecting Cujas, in the remarks of Ménage on the life of Pierre Ayrault. Cujas remained at Paris only about a year, and returned to Bourges, which he never afterwards quitted, in 1577. In 1584 Gregory XIII. who was himself well skilled in the civil and canon law, wished to draw Cujas to Bologna, thinking that something would be wanting to the glory of that city if it did not reckon among its professors a man of so distinguished merit; and Cujas was on the point of yielding to the pressing solicitations of the pontiff; but his attachment for his pupils prevailed over every other consideration, and retained him in France. At the commencement of his works, in the edition of Fabrot, are some very curious verses, composed at Blois, for the purpose of dissuading him from proceeding to Bologna. Who, then, it may be asked, was this man, whom all the countries of Europe sought after, and who, in an age which produced Du Moulin and so many other celebrated jurisconsults, placed himself foremost in the first rank, and eclipsed all his rivals by the superiority of his knowledge and the lustre of his renown? In order to appreciate his works, we must remember the period at which he appeared. The civilization of Europe had barely commenced; and jurisprudence was regarded as the science most proper to accelerate its progress, by diffusing correct notions of reason and justice. But from want of erudition, and from ignorance of criticism, the first interpreters of the Roman law had only a very imperfect knowledge of the system which they professed to expound; and it is mainly to Cujas that the world is indebted for the advancement which the study of this great body of written wisdom has made since his time. The old interpreters had only been able to deduce some general maxims, and some rules of private law, which they applied to the manners, still rude, of the times in which they lived. The minds of men were not as yet prepared for any thing more perfect. They wanted that degree of maturity necessary to receive the light in all its purity. The same thing is observable in the history of ancient Rome. There is as great a distance between the law of the twelve tables and that system which, in the first two or three centuries of our era, the Papinians, the Ulpians, and other geniuses of the first order, created, as between the manners of a semibarbarous people and those of a nation arrived at the highest degree of civilization. It may be said of legislation, indeed, with still greater truth than even of literature, that it is the reflected image of society. In proportion as the civilization of Europe improved, jurisprudence advanced towards perfection; and Cujas came, at a seasonable moment, to lay open its true sources. He had read the works of the old interpreters; but he had derived nothing but disgust from the perusal. Repelled by the barbarism of their language, as much as by the vicious method which they had followed, Cujas resolved to apply himself solely to the text of the Roman laws to illustrate whatever was obscure in them, to restore passages which had been altered by time or the ignorance of copyists, and to fix the true signification of the words which were there employed. In prosecution of this design, the knowledge which he possessed of the ancient languages, and the vast erudition which he had acquired by means of them, were of admirable service to him. Not only did he consult books; he made a still greater use of manuscripts, of which he had collected more than five hundred in his own library. The corrections which he made, not only in books of law, but in a great number of ancient Greek and Latin authors, are immense. He in part collected these, under the title of *Observations and Corrections;* and this work is still a fertile mine, which philologers continually explore with advantage. Nor did he confine his researches to the books compiled by order of Justinian, but extended them to every thing which had the smallest relation to the subject or which entered into the jurisprudence of modern times. He recovered and gave to the world a part of the Theodosian Code, with explanations; and he procured the manuscript of the *Basilica* (a species of abridgment in Greek, which the successors of Justinian had made of his laws), from which manuscript they were afterwards published by Fabrot. Besides, he composed a learned commentary on the *Consuetudines Feudorum*, and on some books of the Decretals. In fact, Cujas was not only a learned man; he was what is far better, a man of profound sagacity. It is by no means uncommon to find writers who, in all sciences, have been able to master some isolated parts; but to embrace the whole in one comprehensive view, to ascend to the fundamental principles from which all the others are derived, and to condense in brief maxims the kernel of all the consequences which flow from them, is a power which has only been given to a small number of privileged men of genius, distinguished from the common herd, who are wholly incapable of such a concentration. This was preeminently the talent of Cujas. In the *Paratitla*, or summaries which he made of the Digest, and particularly of the Code of Justinian, he condensed into short axioms the elementary principles of law, and gave definitions remarkable for their admirable clearness and precision. Hottoman, a distinguished jurisconsult, the rival and the enemy of Cujas, earnestly recommends to his son to take along with him in his journeys these *Paratitla* or summaries, and to study them with indefatigable assiduity. Instead of the semibarbarous jurisprudence of the early interpreters, Cujas substituted that of the most polished ages of Rome; and those who succeeded him have been able to do little more than to confirm his views. All the jurisconsults of Europe indeed are agreed in considering him as the first and greatest of the interpreters of law, one whom none can equal, much less surpass, in the art of teaching and expounding it. " Cujas," said D'Aguesseau, " has spoken the language of law better than any modern, and perhaps as well as any ancient." His lessons, which he never dictated, were continuous discourses, for which he made no other preparation than that of profound meditation on the subjects to be discussed. His scholars, particularly the Germans, wrote down at the moment his discourses, as well as the rapidity of utterance would permit; and afterwards, by comparing their notes together, they suffered but little of what fell from him to escape them. He was impatient of interruption, and upon the least noise he would instantly quit the chair and retire. The use of theses, which has been continued in the modern schools, had already been introduced; but these exercises, so common and so useless at present, entered not into the ordinary plan of the lessons of Cujas. The honour of supporting a thesis under him was the reward of the highest merit, and it was but rarely conferred. Loisel has preserved that which Pierre Pithou composed on quitting the school of Cujas; and it is certainly a very masterly production of its kind. Cujas was strongly attached to his pupils, and Scaliger affirms that he lost, more than four thousand livres by lending money to such of them as were in want. During the thirty years he taught, their

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number was immense, for pupils flocked from all parts of Europe to his school; and many of them, like Scaliger and the brothers Pithou, afterwards became his most intimate friends. None of them who showed distinguished talents escaped his observation; and he advanced the fortunes of several by making known their merits. From his school there issued magistrates of the first rank, and able ministers and negociators, whose talents proved highly serviceable to their country; whilst others carried to the bar and the bench the lights which they had there acquired, and contributed essentially to the great progress which jurisprudence made in the century which followed. Such were the fruits of a life entirely devoted to the public good, and of which no species of ambition ever disturbed the tranquil tenor. Indeed it appears that Cujas never even solicited the honours which he enjoyed. In 1573, during his residence at Valence, Charles XI. appointed him honorary counsellor to the parliament of Grenoble; Henry III., by letters patent, dated at Lyons in 1574, also conferred upon him a small pension, with the titular reversion of the first vacant office; and, by other letters dated the year following, Cujas was permitted to continue his instructions at Valence, and to draw the emoluments of his office of counsellor without discharging its duties. In the year 1582, however, Cujas resigned his office in favour of Charles de Dorne, advocate to the parliament of Grenoble; but this court, annoyed at his quitting Valence, repeatedly refused to accept his resignation, and only received it in consequence of a positive order to that effect. Merit so eminent as his could scarcely fail to excite envy; and he had detractors, whom, however, he crushed by the weight of his reputation. His sentiments and opinions were irreproachable, and, in an age of civil discord, he never varied nor changed. Cujas was sincerely attached to the religion of his fathers; but he steadily refused to take any part in the theological controversies which so greatly agitated the times in which he lived. *Nihil hoc ad edictum prætoris*, "this has nothing to do with the edict of the prætor," was his usual answer to those who spoke to him on the subject. He was far, indeed, from participating in the fury engendered by the league; and his fidelity to Henry IV. remained unshaken, a circumstance which frequently exposed him to danger at Bourges, where the leaguers predominated. But vexation on account of the evils which preyed upon France is supposed to have hastened his death, which happened at Bourges the 4th of October 1590. His library, which was of very considerable extent, containing manuscripts as well as printed books of all kinds, a great number of which were enriched with remarks by his own hand, he ordered by his will to be sold in detail, from an apprehension lest, if it fell into the hands of a single individual, advantage might be taken of his notes by persons who did not understand them, to compose works injurious to his reputation. His wishes were complied with to an extent he had never contemplated; for the booksellers of Lyons, who purchased his manuscripts, employed them to cover rudiments for the schools. In his lifetime he published an edition of his works, printed at Neville in 1577. It is beautiful and exact, but now very scarce, and contains only a part of his works. The same observation applies to the edition of Colombet, published in 1634. Fabrot, however, collected the whole in the edition which he published at Paris, 1658, in 10 vols. folio, and which was reprinted at Naples, 1722, 1727, in 11 vols. folio, and thereafter at Naples and at Venice, 1758, in 10 vols. folio, with an index forming an eleventh volume. In the editions of Naples and Venice there are some additions, not to be found in that of Fabrot, particularly a general table, which will be found very useful, and interpretations of all the Greek words used by Cujas. (Terrasson, *Histoire de la Jurisprudence Romaine*, and *Mélanges d'Histoire, de Littérature, et de Jurisprudence*; Bernardi, *Eloge de Cujas*; Hugo, *Civilistisches Magazin*; Berriat St Prit, *Mémoires de Cujas*, appended to his *Histoire du Droit Romain*; *Biographie Universelle*, art. Cujas.) (J. B—E.)

Culdees ‖ Cullen

CULDEES, in *Ecclesiastical History*, monkish priests who formerly inhabited Scotland, Ireland, and Wales. Being remarkable for their religious exercises, they were called *cultores Dei*, worshippers of God; and hence the word Culdee appears to be derived. They made choice of one of their own fraternity to be their spiritual head, who was afterwards called the Scotch Bishop.

They disavowed the supremacy of the see of Rome, allowed the marriage of priests, denied the advantages of auricular confession, and gave instruction to youth in their seminaries or colleges. In Scotland their principal seats were Iona, Isle of St Serf in Loch Leven, Monymusk in Aberdeenshire, Dunkeld, Abernethy in Fifeshire, and St Andrews. They long maintained their independence, but at length were brought under the Papal yoke.

CULEUS, in *Roman Antiquity*, the largest measure of capacity for things liquid, containing 20 amphoræ or 40 urnæ; equivalent to 115 gallons, 1·6 pints English. Culeus also denoted a sack or bag. Parricides were punished at Rome by being thrown into the Tiber in a sack, along with a cock, an ape, and a viper.

CULLEN, an ancient seaport, parliamentary burgh, and parish of Banffshire. It stands on an eminence overlooking the sea, and is about 13 miles west from Banff. The present town is of comparatively modern date, the only remains of the ancient burgh being a cluster of mean houses called the Fish Town, near the shore. It contains two churches belonging to the Establishment, and a Free church. Most of the inhabitants are engaged in agricultural pursuits, distilling, &c., and about a third in the fisheries. The harbour is good, and there are a few vessels belonging to the port. The exports are chiefly fish and agricultural produce: the imports are merely for local consumption. The burgh, which was first chartered by Robert Bruce, is governed by a provost and nineteen councillors. It unites with Banff, Peterhead, Inverury, and Kintore, in returning one member to parliament. Pop. of parliametary burgh 1697; of royal burgh 3165.

CULLEN, Dr William, an eminent physician and medical teacher, was born in Lanarkshire, Scotland, on the 11th of December 1712. His parents were respectable but not rich, and his father was for some time chief magistrate of the town of Hamilton. Not being able to spare a sufficient sum of money to educate his son at the university, he bound him as an apprentice to a surgeon-apothecary in Glasgow. On the completion of his apprenticeship young Cullen became surgeon to a merchant vessel which traded between London and the West Indies. After making several voyages, he settled as a country practitioner in the parish of Shotts, Lanarkshire, where, in a way creditable to himself, he became acquainted with the Duke of Argyll, who at that time bore the chief political sway in Scotland. Cullen at this time seems to have devoted much of his spare time to chemistry; and the Duke of Argyll, who was at a friend's house in the neighbourhood, and was fond of chemistry, being in want of some apparatus which he could not otherwise procure, was introduced to Cullen, who gained his good opinion, and was not forgotten by the duke when it was in his power to serve him. Shortly afterwards Cullen removed to Hamilton, where he was admitted as a town-councillor in 1737, and served as chief magistrate in the years 1739 and 1740.

While at Hamilton he entered into partnership with the celebrated Dr William Hunter, then a young man. The

Cullen. chief object of the connection was to enable each to pursue and improve his medical education; and they accordingly agreed that they should alternately study during the winter session at some medical school, while the other should carry on the business for the common behoof. Cullen's turn came first, and he passed the winter at the Edinburgh University. Hunter, on the other hand, when his turn came, chose London, where his assiduity and talents recommended him to the notice of Dr Douglas, lecturer on anatomy and midwifery, who appointed him his assistant. Cullen, unwilling to throw any obstacle in the way of his friend's advancement, agreed to cancel the articles of partnership; and he maintained ever after a cordial correspondence with his friend.

While at Hamilton, Cullen married Miss Johnston, the daughter of a clergyman in the neighbourhood, a beautiful and accomplished lady of about his own age, who brought him some money, a matter of no small importance to him at that period; bore him a large family, and, after a long and happy life, died in the summer of 1786, four years before the death of Cullen himself.

While practising at Hamilton, he was called in to prescribe for the Duke of Hamilton, who had been suddenly taken ill; and so much pleased was the duke with young Cullen's ability, attention, and conversation, that from that date he became his patron and friend.

Cullen graduated at the University of Glasgow in Sept. 1746. In the same year, through the influence of the Duke of Hamilton, he was appointed lecturer on chemistry in that university, and he delivered his first of a course of lectures on that science in October. It was here he began to exhibit that rare and precious talent of giving science an attractive form, diffusing clearness over abstruse subjects, generalizing facts, and making the most difficult points intelligible to ordinary capacities. His lectures became exceedingly attractive and popular, while, at the same time, his character and practice as a physician daily increased. In 1751, a vacancy having occurred in the professorship of medicine, Dr Cullen, through the influence of the Duke of Argyll, was appointed by the king to the vacant chair. Here he so much further increased his reputation, that in 1756, on the death of Dr Plummer, professor of chemistry in the University of Edinburgh, the patrons (the magistrates and town-council) unanimously offered the chair to Dr Cullen. He accordingly resigned his appointments in Glasgow in March 1756, and in the month of October of that year commenced his duties in the University of Edinburgh. At the same time he delivered clinical lectures in the Royal Infirmary, which he continued to do till near the close of his career. If Dr Cullen's popularity was great in Glasgow, it increased in Edinburgh; so that when Dr Alston, professor of *materia medica*, died in February 1763, and Dr Cullen was requested by the patrons to finish the course of lectures which had been begun for that session, his popularity was such that the class increased from ten to upwards of one hundred students. He did not read his predecessor's lectures, but gave an entirely new course; and the arrangement and whole treatment of the subject was so lucid and novel, and the generalizations so free and yet so striking, that the publication of an imperfect copy of these lectures, hastily prepared, possibly from students' notes, was hailed with pleasure by the whole medical profession. This publication, however, was so imperfect, that Dr Cullen thought it necessary to publish a more correct edition, which, however, did not make its appearance till 1789, the year before his death.

On the death of Dr White, the professor of the institutes of medicine, in 1766, the patrons offered the chair to Dr Cullen, who accepted it, and resigned that of chemistry in favour of Dr Black, whose talents in that department were already known and appreciated. During the same year Dr Rutherford, professor of the practice of physic in the university, died, and Dr John Gregory having become a candidate for the vacant chair along with Dr Cullen, was appointed thereto by the patrons. It is usually stated that a compromise was entered into between Dr Cullen and Dr Gregory, by which they agreed to lecture every alternate year on the institutes and on the practice of medicine, during their joint lives, reserving to the survivor the power to hold either chair he should prefer. The fact is, that Dr Cullen, on the death of Dr Rutherford, gave a course of lectures on the practice of physic during that same winter (1766); but Dr Gregory, after his appointment to the chair, lectured on the practice of physic during the three successive sessions, 1767, 1768, and 1769, and it was not till the conclusion of this, his third course, that the above arrangement was entered into between these eminent professors. Never, perhaps, was a literary engagement entered into which could have proved more beneficial to the students than this. Both these men possessed great talents, though of a kind extremely dissimilar. Each had certain failings and defects, which the other knew, and endeavoured to counteract. They co-operated, therefore, in the happiest manner to enlarge the understanding and to forward the pursuits of their pupils. But unfortunately this arrangement was brought to a premature close by the sudden death of Dr John Gregory, on the 9th of February 1773, in the forty-ninth year of his age. After this period Dr Cullen confined himself to the delivery of lectures on the practice of physic. This branch of science he continued to teach till a few months before his death, which took place on the 5th of February 1790, in the seventy-seventh year of his age. Cullen.

As a lecturer Cullen was the greatest ornament to the university of Edinburgh, at a time when its lustre shone bright. His lectures were delivered *viva voce*, without having been previously written out. The vigour of his mind was such, that nothing more was necessary than a few short notes to prevent him varying from the general order which he had laid down for the course. This gave to his discourses an ease, a vivacity, a variety and a force which are rarely to be met with in academical discourses; while the particular illustrations were always new, and adapted to the circumstances which attracted the general attention of the day. Dr Cullen considered that the proper business of a preceptor was to put his pupils into a proper train of study, so as to enable them to prosecute those studies at a future period. He did not therefore strive so much to make his pupils versant with the details of any particular subject, as to give them a general view of the whole; to show them what had been already ascertained regarding it, and to point out what still remained to be discovered. In fact, he wished to put them in a train of study which should enable them at a future period to investigate the causes of those difficulties which obstructed the path of medicine, and by their labours advance it to greater perfection. He thus succeeded in stimulating the mental faculties of his students; and instead of labouring himself to supply deficiencies which far exceeded the power of any one man to accomplish, he set thousands to work to fulfil the task, giving to their minds an impetus that sustained them in their labours. His external appearance was striking and pleasing, though not elegant. His countenance was expressive, and his eye lively and penetrating. In person he was tall and thin; but he stooped much, and when he walked he had a contemplative look, and seemed to be insensible to what was passing around him.

Previous to the days of Cullen, and during his early life, the medical philosophy or medical doctrines of Boerhaave were universally taught in the schools. Boerhaave attempted to combine into one system the vital philosophy of Hippocrates (the vis medicatrix naturæ), the chemico-humoral principle of Paracelsus, the mechanical doctrines

Cullera ‖ Culna.

of Bellini, and a few of the other doctrines taught by former medical philosophers. He attributed, however, more to the chemical and mechanical forces than to the powers of life, and of course embraced a large portion of the doctrine of the humoral pathologists. Cullen, seeing that many of the facts then known were irreconcileable with Boerhaave's doctrines, became its warm opponent, especially taking offence at those doctrines which attributed almost every disease to a vitiation of the fluids of the body. Indeed, he might almost be said to have adopted as his motto the celebrated aphorism of Hoffman, "Universa pathologia longe rectius atque facilius *ex vitio motuum microcosmicorum in solidis*, quam ex variis affectionibus vitiosorum humorum, deduci atque explicari possit, adeoque omnis generis nervosi affectionibus sint referendæ." Living at the time he did, when the doctrines of the humoral pathologists were carried to an extreme extent, and witnessing the ravages which disease made on the solid structures of the body, it was not surprising that he should oppose a doctrine which appeared to him to lead to a false practice, and to fatal results, and adopt one which attributed more to the agency of the solids, and very little to that of the fluids of the body. The Cullenian system was certainly an immense improvement on those which preceded it, and has served as a valuable stepping-stone for the rational doctrines which now prevail. He was obliged to introduce the doctrine of a spasm in the extreme vessels in order to account, on his theory, for many of the phenomena of disease; still we cannot refuse to him the honour of having been an able and successful improver in medical science. His classification of diseases was remarkable for its simplicity and clearness. He divided diseases into four great classes—1st, Pyrexiæ or febrile disease, as typhus fever; 2d, Neuroses, or nervous diseases, as epilepsy; 3d, Cachexiæ, or diseases resulting from bad habit of body, as scurvy; and, 4th, Locales, or local diseases, as cancer. His nosological arrangement has served to a considerable extent as the groundwork of modern nosologies, and was a great improvement, both in simplicity and clearness, on the involved productions of his predecessors. Cullen's chief works are, *First Lines of the Practice of Physic*, Edin. 1774, 4 vols. 8vo; and a second edition, published during his life in 1788; *Institutions of Medicine*, Edin. 1770, 12mo; *Synopsis Nosologiæ Methodicæ*, Edin. 1785, 2 vols. 8vo; *Treatise on the Materia Medica*, Edin. 1789, 2 vols. 4to. (J. S—K.)

CULLERA, a seaport-town situated at the mouth of the Xucar, Valencia, Spain. It stands on the outskirts of a fine agricultural district, and carries on a considerable coasting-trade with France and the Mediterranean. It also contains extensive barracks for troops on their march from the coast to the capital. Pop. 7000.

CULLODEN, a desolate tract of moorland, about five miles S.E. from Inverness; celebrated as the scene of the battle (April 16, 1746) which extinguished the hopes of the house of Stuart. See BRITAIN, vol. v., p. 461.

CULM (Lat. *culmus*, a stalk), in *Botany*, the stalk or stem of the grasses, usually jointed and hollow, and supporting the leaves, flower, and fruit. See BOTANY.

CULM (Welsh *culm*), a variety of coal. It is difficult of ignition, but burns for a long time, without flame or smoke, but emitting a disagreeable smell. It does not cake, and it leaves but few ashes. Culm is the *Bitumen oxygenatum* of Linnæus, and the *glanz kohle* of Werner. It is otherwise known as *anthracite*. See COLLIERY.

CULMINATION (Lat. *culmen*, the summit), in *Astronomy*, the transit of a celestial body over the meridian, or the highest point of its diurnal circle.

CULNA, in Hindustan, a town in the British district of Burdwan, presidency of Bengal, on the right bank of the river Hooghly, on the route from Cutwa to the town of Hooghly, 26 miles east of the city of Burdwan. It is the port of the district, and has long been noted for its trade in rice, grain, silk, and cotton. Of late years the traffic of the place has greatly increased, in consequence of its being found a convenient station for steamers plying between Calcutta and the upper provinces. The bazaar consists of 1000 shops, and the population of the town has been returned at 60,000. The rajah of Burdwan has here a splendid mansion. The town forms the station of the Free Church mission, and has an English school containing 120 boys. Lat. 23. 14.; Long. 88. 20. (E. T.)

Culpee ‖ Cumæ

CULPEE, a town of Bengal, district of Hooghly, on the eastern bank of the river Hooghly. It stands 33 miles below Calcutta, at the mouth of a creek that gives shelter to boats from the impetuosity of the tide, which runs there with great violence. Opposite the town is the place of anchorage for large ships which cannot get higher up the river. The shores here are a bed of mud, and the banks of the river are covered with thick jungle. Culpee is considered extremely unhealthy, on account of the swamps and woods by which it is surrounded. E. Long. 88. 18.; N. Lat. 22. 6. (E. T.)

CULROSS, an ancient seaport, royal burgh, and parish of Perthshire, about 22 miles N.N.W. from Edinburgh. It received its charter from James VI. in 1588, and was then prosperously engaged in the export of coal, and the manufacture of patented iron "girdles" and salt. It has still a small pier, accessible however only to fishing-boats; but its trade is now derived from the manufacture of linen and cotton. At the east end of the town are the remains of a chapel dedicated to St Mungo; and the parish church forms part of the chapel of Culross Abbey founded in 1217. Pop. 605.

CULVERIN (Fr. *couleuvrine*, from Lat. *colubrinus*, serpent-like), a name given to a long and slender piece of ordnance, at a time when it was the fashion to apply fanciful appellations to such things, of which *falconet* is another example. A whole culverin was an 18-pounder, and a demi-culverin a 9-pounder.

CULVERT is used generally to denote any arched channel for the passage of water under ground, such as is common in the embankments of railways.

CULVERTAILED, among shipwrights, the same as dovetailed in carpentry; culver being an old name for a dove or pigeon.

CUMÆ, or CUMA, in *Ancient Geography*, the oldest and one of the most important of all the Greek colonies in Italy, was situate on the shore of Campania between the lakes Acherusia and Liternus, and about six miles north of Baiæ. The most generally received opinion is, that Cumæ was founded by a joint colony from the Æolian Cumæ and Chalcis in Eubœa, who agreed that they should call the city by the name of one of the parent states, while it should take rank as a colony of the other. The exact date of its foundation is unknown; but it is certain that Cumæ had attained a high degree of prosperity while Rome was still struggling into existence. In the eighth century B.C. it had extended its power on every side into Campania, and like Sybaris and Crotona had begun to plant flourishing colonies, and establish itself besides as a maritime power. Of its numerous colonies the most prosperous was Neapolis. Evidences of its maritime power were the splendid harbours of Dicæarchia and Misenum. The first event which led to the decline of Cumæ was the establishment of the Etruscan supremacy by sea. A severer blow still was the invasion of Campania by that people and their allies about the year 522 B.C. This attack was repelled, though at a great loss to the Cumæans, chiefly by the ability of Aristodemus, who overthrew the existing government, and established a tyranny, which endured for 20 years. At the end of that period he was driven out of

Cumana ‖ Cumberland.

the city by the nobles, who had once more become powerful. Twenty-two years after that date, the Cumæans, unable any longer of themselves to resist the growing power of the Tuscans, called in the aid of Hiero of Syracuse. With his assistance they defeated their opponents, and secured themselves against attack for many years. In 520 B.C. the Samnites, a more formidable foe than the Tuscans, made themselves masters of Cumæ, put the male citizens to the sword, and established a colony of their own in the city. In 338 B.C. Cumæ was admitted to the Roman franchise, and ever after continued faithful to her alliance with Rome. In the second Punic war Hannibal besieged the town in vain, though it had greatly declined from its original size and strength. In the later ages of the republic it attained a kind of reflected prosperity from the neighbourhood of Baiæ, and other favourite retreats of the Roman nobility; but it is henceforth always talked of as "Vacuæ Cumæ," "Quieta Cuma," in reference to its half-deserted air. In the wars of the Goths and Romans, Cumæ once more became for a short time important, as the last stronghold of the Gothic kings in Italy. In 552 it surrendered to the victorious arms of Narses. Some remains of Cumæ are still to be seen. Of these a ruinous amphitheatre, a brick arch, supposed to be one of the old gates of the city, and a small temple, are the principal. Bronze statues and vases have at different times been dug up, rewarding the searches of modern antiquaries. Not the least interesting spot in the vicinity of Cumæ, is the cave where the Sybil is said to have had her residence. A great cavern in the rock on which the citadel stood was shown by the Cumæans as the place whence that prophetess propounded her enigmas. This cavern existed unimpaired till the time of Narses, who availed himself of it to undermine the walls of the town. The walls fell, breaking down in their descent the roof of the cave, the remains of which, however, are still pointed out to the traveller. See AMALTHÆA, and ROMAN HISTORY.

CUMANA, a city of Venezuela and capital of a cognominal province, stands on the gulf of Cariaco, at the mouth of the Manzanares. It is the oldest European city in South America, having been founded by Diego Castellon in 1523. It was almost totally destroyed by the terrible earthquake of 1766. The houses are generally low and flat, and have a poor appearance; but the style of building has recently been much improved. Cumana possesses a capacious roadstead, and presents great facilities for obtaining provisions. The principal exports consist of cattle, smoked meat, and dried fish. Pop. 9000.

CUMBERLAND, a county of England, at its N.W. extremity; situated between 54. 6. and 55. 7½. N. Lat., and 2. 13. and 3. 30. W. Long.; bounded on the N. by Scotland and the Solway Firth; on the E. by Northumberland and Durham; on the S. by Westmoreland and Lancashire; and on the W., for about 67 miles, by the Irish Sea. It is, at a medium, about 50 miles long and 30 broad, within a bounding line of 215 miles, of which 75 are coast; and contains 1565 square miles, or 1,001,273 acres, of which the mountainous district comprises more than a third, the old inclosures about a half, and the lakes and waters 8000 acres; the remainder being either commons capable of improvement, or lands recently inclosed. The principal divisions are called wards, a term synonymous with hundreds in other counties. Of these there are five, namely, Cumberland, Eskdale, Leath, Allerdale above Derwent, and Allerdale below Derwent. The ward of Allerdale above Derwent is in the diocese of Chester, and all the others are in that of Carlisle. The county contains the city of Carlisle, 17 market-towns, and 112 parishes. The population in 1851 amounted to 355,558, being an increase of 66 per cent. in fifty years. The number of inhabitants to a square mile is 125; to a house 5·3. The total number of houses in 1851 was 38,547; 36,763 being inhabited, 1545 uninhabited, and 239 building. Cumberland presents every variety of surface. The south-western district is generally mountainous, rugged, and sterile, yet contains several rich though narrow valleys, with many fine lakes, islands, rivers, cascades, and woodlands, which, combined or contrasted in the view with the gigantic rocky masses around them, exhibit many remarkable scenes of grandeur, desolation, and beauty. Skiddaw, Saddleback, Helvellyn, rising to the height of more than 3000 feet, belong to this quarter. The highest part of that immense ridge which, commencing in Derbyshire, extends in a continued chain into the Lothians, forms the eastern boundary; in which Crossfell, about 3400 feet high, surrounded with other lofty and barren eminences, retains the snow upon its summit nearly three-fourths of the year.

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The northern part of the county, or what has been called the Vale of Carlisle, is in general flat; and a tract of low land, from two to four or five miles in breadth, extends along the western shore. The climate necessarily corresponds with this variety of surface: here, as in the other western counties, the rains are frequent and copious, particularly in summer, and often also in autumn. Black peat earth is the most prevalent soil in the mountainous districts, and is found too in the moors and commons of the low grounds. About half the cultivated land consists of dry loams, excellently adapted for the growth of turnips, herbage, and all sorts of grain. Fertile clays occupy but a small portion, but clay, wet and sterile, forms the subsoil in many parts. The principal rivers are the Eden, the Derwent, the Caldew, and the Esk. The Eden has its source in Westmoreland, near the borders of Yorkshire, and, pursuing a northwesterly course in its progress through Cumberland, passes Kirkoswald and Carlisle, and falls into the Solway Firth near Rockcliffe March, where it forms a fine estuary. The vale land on its banks is for the most part very narrow; and in some places the high grounds approach to the water's edge. On this river there are several salmon-fisheries belonging to different proprietors. The Derwent rises among the picturesque crags at the head of Borrowdale, in the south-west range of mountains, whence it dashes from rock to rock till it reaches Derwent Lake, from which it flows onward through Bassenthwaite water, and, after being joined by the Cocker near Cockermouth, falls into the sea a little from Workington. The scenery along the whole of its course is singularly varied and interesting. The Caldew issues from the south-east side of Skiddaw, and joins the Eden near Carlisle, after a course of 24 miles, in which it gives motion to a number of cotton and corn mills. The vale through which it flows is very beautiful, and its banks are well wooded. The Esk enters Cumberland from Scotland at a place called the *Moat*, and, flowing in a westerly direction by Longtown, falls into the Solway Firth. The Liddel, another Scottish river, which in part of its course separates Cumberland from Scotland, joins the Esk after it has passed into England.

Landed property is much divided in this county, and the small estates are commonly occupied by their owners. Most of them are held under the lords of manors, by what is called *customary tenure;* which subjects them to the payment of fines and heriots on alienation, and on the death of the lord or tenant, besides certain annual rents, and the performance of a variety of degrading and vexatious services. According to the authors of the *Agricultural Survey*, printed in 1794, about two-thirds of the county were held by this tenure, in parcels worth from L.15 to L.30 of yearly rent. On large estates, also, the farms were in general rather small, few then reaching L.200 a-year, possessed on verbal contracts or very short leases, and burdened, like the small estates, with payments or services, over and above a money rent; but leases for fourteen or

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twenty-one years are now not uncommon. The live stock consists of horses of rather a small size; cattle of the long-horned breed, with a few Galloways; to which of late the improved short-horns have been added by a few great proprietors; and sheep, chiefly of the black-faced heath variety. In the mountainous district, at the head of the Duddon and Esk rivers, there is a breed of sheep of a somewhat peculiar character; the ewes and wethers, and many of the rams, being polled, their faces and legs speckled, and the wool finer than that of the heath breed. They belong to the proprietor of the lands, and have been farmed out with them from time immemorial to *herds* at a yearly rent; and from this circumstance, it is said, have obtained the name of *Herdwicks*. There are a number of small dairies, at which butter and skimmed-milk cheese are made. All the common species of grain are cultivated, though in many instances with little attention to system, corn crops being often raised on the same soil for several years in succession. Turnips and clovers do not yet enter into the rotation in many parts of the county. Potatoes are extensively cultivated. That excellent variety of oats called the potato oat was first discovered in Cumberland in 1788, whence it has now spread over every part of the United Kingdom. Among the farm implements the single-horse cart deserves to be noticed, as being almost exclusively employed, and with great advantage, as it is not only by far the most convenient and economical carriage for the farmer, but is much less injurious to the public roads than the waggons and heavily-loaded carts used in many other English counties.

Manufactures.

The principal manufactures of Cumberland are calicoes, corduroys, and other cotton fabrics, established at Dalston, Carlisle, Warwick Bridge, and a few other places. Cotton-printing is carried on to some extent in Carlisle; the manufacture of sail-cloth and cordage at Workington and Whitehaven; and checks and coarse linens in several of the market towns. In this, as in other thinly peopled and mountainous districts, domestic manufactures, such as woollen cloth, stockings, &c. supply a great part of the wants of the peasantry. The Seaton iron-works, on the banks of the Derwent above Workington, a manufactory of coarse earthenware near Dearham, and paper mills in various parts of the county, with breweries, and a soap-work at Carlisle, comprise all the other manufacturing establishments of any note in this county.

Cumberland abounds in minerals, from which a great part of its wealth is drawn. The most valuable are coal, black lead, lead, copper, iron, slate, and limestone.

Coal is found at different places in the eastern mountains, and also near Brampton in the northern part of the county, but in greatest abundance on the west side of the river Caldew, and thence towards Maryport, Workington, and Whitehaven. A number of mines are constantly at work in this district, particularly near Whitehaven and Workington. The principal entrance to the coal-mines at Whitehaven is by an opening at the bottom of a hill, through a long passage hewn in the rock, which, by a steep descent, leads down to the lowest vein of coal. The greater part of this descent is through spacious galleries, intersecting each other; all the coal being dug away, except large pillars, which in deep parts of the mine are three yards high, and twelve yards square at the base. The mines generally are sunk to the depth of 130 fathoms; and one of them, the *King Pit*, with a depth of 160 fathoms, extends under the sea to places where the water overhead is of sufficient depth for ships of great burden. Four engines, when all working together, discharge 1228 gallons of water every minute; while another raises 9225 hogsheads every twenty-four hours. The seams all dip to the west about one yard in ten. Mr Spedding, the engineer of these works, observing that the fire-damp was not liable to be ignited by the sparks produced by the collision of flint and steel, many years ago invented a machine, in which, while a steel wheel was turned round with a very rapid motion, flints were applied to it, and, by the abundance of sparks emitted, the miners were enabled to carry on their work, where the flame of an ordinary lamp or candle would have occasioned explosions. But even this contrivance was found not to be an effectual preservative; and the ingenious inventor himself lost his life by one of those explosions which he had so sedulously attempted to prevent. There are railways from the pits to the quay, over which large flues or *hurries* are placed, through which the contents of the waggons are speedily discharged into the holds of the ships. The coals are exported to Ireland and the west of Scotland. The coal-pits at Workington are from forty to ninety fathoms deep. The uppermost seam is generally three feet thick, the second four, and the third or lowest that has been hitherto worked from ten to twelve feet.

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The famous black-lead mines are situated at the head of Borrowdale, in the south-west range of mountains. The mineral is found in irregular masses, generally imbedded in a slate rock, intersected by granite; and it is only wrought occasionally. At other times the mines are protected from pilferers by a temporary wall within; and the house of the steward is built over the entrance.

As these mines or "wad holes" cannot supply a sufficient quantity of the genuine plumbago, a considerable quantity is imported; and an imitation is manufactured which, for the commoner sorts of pencils, is used by itself, but is mixed with the mineral for drawing-pencils. The whole that is taken from the Borrowdale mines is sent direct to London, where it is sold to the manufacturers. Its price averages about thirty shillings a pound.

The principal lead mines are in Aldstone Moor, on the south-east borders of the county. The ore is found in veins often nearly perpendicular, and not unfrequently contains a considerable proportion of silver. The most considerable copper mines are near Caldbeck, at Hesket New Market, in Borrowdale, and at Newlands in the vicinity of Keswick; but they are not now wrought to a great extent. The ore is commonly a sulphuret, and usually contains both iron and arsenic. In the parish of Egremont, at a place called Crowgarth, is the most singular mine of iron ore, it is supposed, in Britain. It lies at the depth of twelve fathoms, and the thickness of the band of ore is from twenty-four to twenty-five feet. In 1791 and 1792, the annual exportation from it to the Carron foundry in Scotland, and others, was upwards of 20,000 tons. Very good slate is found in the south-western mountains, and limestone in various parts of the county. Of the latter, when calcined, the exportation to the west of Scotland used to be very considerable. Among the mineral or fossil productions may be mentioned marble, spar of various colours and forms, gypsum, steatites, and kaolin or porcelain clay.

Cumberland contains a number of towns, few of them large or populous. Carlisle, Penrith, Wigton, Maryport, Cockermouth, Workington, Whitehaven, Egremont, and Keswick, are the most considerable. The exports, chiefly from Whitehaven, Maryport, Workington, and Harrington, are coals, lime, butter, bacon, cured cod for the Liverpool market, and salmon and potted char for London. Since the East India trade was thrown open, Whitehaven has been among the first ports to embark in it; and it has long possessed a share of the trade with America.

Lakes.

The lakes and mountains of Cumberland have long attracted the admirers of the wild and beautiful in natural scenery. The lakes, including the tarns or smaller pieces of water, are fifteen in number. The finest are Ullswater and Derwentwater or Keswick Lake. Ullswater is partly situated in Cumberland and partly in Westmoreland: it is about nine miles in length, and from a quarter of a mile to

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one mile in breadth. Winding round the base of vast rocky mountains, it is seen only in successive portions; the scenery on its margin presenting new and striking objects at every stretch. The rocks in its vicinity are celebrated for reverberating sounds. The report of a cannon re-echoes six or seven times, with pauses between, in which the sound of the distant waterfall is for a moment heard. This lake contains various kinds of fish, particularly trout, perch, and eels; and also char and guiniad or skellies, the last in considerable numbers. Derwentwater or Keswick Lake is of an irregular figure, approaching to an oval, about three miles in length and one and a half in breadth. It is seen at one view, expanding within an amphitheatre of mountains, rocky but not vast; broken into many fantastic shapes; opening by narrow valleys the view of rocks which rise immediately beyond, and which are again overlooked by others. Masses of wood frequently appear among the cliffs, feathering them to their summits; and a white cottage sometimes peeps from out their skirts, seated on the smooth knoll of a piece of pasture projecting towards the lake. Its bosom is spotted by small islands, of which those called Lord's and St Herbert's are well wooded. The celebrated Fall of Lowdore, on the southern side of the lake, consists of a series of cascades, which rush over an enormous pile of protruding crags, from the height of nearly 200 feet. What is called the *floating island* of Keswick, appears occasionally on the side of the lake opposite to this fall, but only when the water in the lake is high, and then scarcely a foot above the surface. It is formed of matted weeds detached by the rising waters. The size of the island seems, according to different accounts, to vary; and its existence has not been unfrequently denied altogether. The waters of this lake are sometimes agitated in an extraordinary manner, without any apparent cause; and in a perfectly calm day they are seen to swell in high waves, which have a progressive motion from west to east. This is ascribed to what are called *bottom winds*. The swell sometimes continues for an hour or two only, at other times almost a whole day.

The following table shows the extent of the lakes, and their elevation above the sea level:—

	Length.	Breadth.	Elevation.
Ullswater	9 miles.	1 mile.	380 feet.
Bassenthwaite	4	1	210
Derwentwater	3	1½	222
Crummock Water	3	0¾	240
Wastwater	3	0½	160
Thirlemere	2¾	0½	473
Ennerdale Water	2½	0½	.
Buttermere	1¼	0½	247
Loweswater	1	0½	.

The heights of the waterfalls are as follows:—

Scale Force	156 feet.
Barrow Fall	124
Lowdore Fall	100
Airey Force	80
Birker Force	60
Stanley Gill	60
Sour-Milk Gill	60

Gilsland Spa, in the middle of a wild romantic valley, called the *Vale of Irthing*, about eight miles S.E. of Bewcastle, has long been a place of considerable resort; and, independently of the medicinal qualities of its springs, presents attractions to visitors, particularly the painter and geologist, in the variety of its landscape and the disposition of the strata exposed in the banks of the river in its vicinity.

From the tops of the mountains in Cumberland, the views are alike extensive and varied. The summit of Skiddaw brings under the eye the Irish Sea and the German Ocean; a chaos of dark mountains at a distance, with lakes seen dimly at the feet of the nearest, and a vast expanse of champaign country, bounded by the Irish Channel, and traversed by silvery thread-like streams in every direction. Upon the summits of the Cross-fell ridge there frequently hangs a vast volume of clouds, reaching half way down towards the base of the fells. At some distance from this *helm*, as it is called, and opposite to it, another cloud, called the *helm-bar*, is seen in continual agitation, whilst the helm itself remains motionless. When the *bar* is dispersed, the wind rushes from the helm, often with great fury, and sometimes on both sides of the mountains.

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The early history of this county is involved in obscurity. In the tenth century it appears to have been in the possession of the Scots; but whether by a grant from the crown of England or by conquest, has been matter of dispute. It was long made the scene of plunder and bloodshed, by the savage incursions of both kingdoms alternately. At a conference held at York, Henry III., in full satisfaction of the claims of the Scots, agreed to assign lands to them of the yearly value of L.200, within the counties of Northumberland and Cumberland, if lands of that value could be found therein, without the limits of the towns where castles were erected. But after this arrangement there still remained a tract between the two kingdoms, called the *debateable ground*, the resort of the worst characters of both, who continued to disturb the borders down to the union of the two crowns. Of the ancient British antiquities of Cumberland the most remarkable is a circle of stones, about three miles from Kirkoswald, called *Long Meg and her Daughters;* and there is a unique little circle of 48 stones, between Melkeld and Keswick, scarcely two miles from the latter. The stones are porphyritic greenstone. The Roman wall may still be traced from the neighbourhood of Carlisle, both to the east and west, for some miles. A great many coins, altars, and other vestiges of antiquity, have been discovered at the Roman stations on its line. In the mountainous parts the manners of the people are somewhat peculiar; and in some of the solitary dales they have perhaps undergone little alteration for a very long period.

Cumberland sends nine members to parliament; four for the county, two for Carlisle, two for Cockermouth, and one for Whitehaven. It is governed by a lord-lieutenant, high sheriff, 12 deputy-lieutenants, and about 85 magistrates. It lies in the north circuit, and chiefly in the diocese of Carlisle.

Cumberland, the capital of Alleghany county, North America, on the north bank of the river Potomac, 179 miles from Baltimore. It contains a court-house, county prison, market-house, two banks, and several handsome churches. In the immediate neighbourhood is a rich and extensive coal region, which in 1851 yielded to Baltimore alone a supply of 163,855 tons. Pop. (1850) 6076.

Cumberland *River*, a large river of North America, which flows through Kentucky westward about 200 miles, and after a meandering course of about 120 miles, again enters Kentucky, and falls into the Ohio. Its entire length is about 600 miles, and it is navigable for large steam-boats to Nashville, 203 miles and for boats of 15 tons 300 miles.

Cumberland, *Richard*, bishop of Peterborough, was the son of a respectable citizen of London, and was born in the parish of St Ann, near Aldersgate, in the year 1632. Having laid a proper foundation of classical learning in St Paul's school, he was removed to Magdalen College, Cambridge, where in due time he took his degrees in art, and obtained a fellowship. He took the degree of A.M. in 1653; and having proceeded A.M. in 1656, he was next year incorporated to the same degree in the university of Oxford.[1] For some time he applied himself

[1] *Biographia Britannica*, vol. iv., p. 558.

Cumberland. to the study of physic; and although he did not adhere to this profession, he retained his knowledge of anatomy and medicine. Mr Payne informs us that "he distinguished himself, whilst he was a fellow of the college, by the performance of his academical exercises. He went out batchelor of divinity at a publick commencement; and tho' it was hardly known that the same person performed those great exercises twice, yet such was the expectation he had raised, that he was afterwards sollicited to keep the act at another publick commencement for his doctor's degree." He took the degree of B. D. in 1663, and that of D. D. in 1680.[1] Two of his contemporaries and intimate friends were Dr Hezekiah Burton, a worthy clergyman, "who was early lost to his family, his acquaintance, and the world," and Dr Hollings, who settled as a physician at Shrewsbury, and was there held in universal esteem. There were other members of the same college with whom he likewise cultivated a particular acquaintance; and among these were Sir Samuel Moreland, who was distinguished by his knowledge of mathematics, Sir Orlando Bridgeman, who became keeper of the great seal, and Mr Pepys, who for many years was secretary to the admiralty, and who is well known by his posthumous Memoirs.

To this academical connexion he appears to have been in a great measure indebted for his subsequent advancement in the church. When Bridgeman was appointed lord keeper, he nominated Cumberland and Burton as his chaplains, nor did he afterwards neglect the interest of either. Cumberland's first preferment was the rectory of Brampton in Northamptonshire, which was bestowed upon him in 1658 by Sir John Norwich. He then quitted the university, and went to reside on his benefice, where he zealously devoted himself to the duties of his sacred office, and to the prosecution of those abstruse studies to which he had long been addicted. His chief relaxation consisted in occasional excursions to Cambridge, for the purpose of maintaining those lettered friendships which he had formed in early life, and probably for the purpose of consulting such books as his own library could not supply. In 1661 he was appointed one of the twelve preachers of the university. His character was very remote from that of a preferment-hunter; and in this unambitious retirement he might have spent the remainder of his life, if the lord keeper, who obtained his office in 1667, had not invited him to London, and soon afterwards bestowed upon him the rectory of Allhallows at Stamford. In this new situation, he acquired new credit by the fidelity with which he discharged his important functions. In addition to his ordinary duties, he undertook the weekly lecture, and thus was obliged to preach thrice every week in the same church. This labour he constantly and assiduously performed, and in the mean time found sufficient leisure, as well as inclination, to prosecute his scientific and philological studies.

At the mature age of forty, he published his earliest work, entitled "De Legibus Naturæ Disquisitio philosophica, in qua earum Forma, summa Capita, Ordo, Promulgatio, et Obligatio e Rerum Natura investigantur; quin etiam Elementa Philosophiæ Hobbianæ, cum moralis tum civilis, considerantur et refutantur." Lond. 1672, 4to. It is dedicated to Sir Orlando Bridgeman, and is prefaced by an "Alloquium ad Lectorem," contributed by the author's friend Dr Burton. Cumberland's treatise is evidently the production of an acute and philosophical mind, and entitles him to a very respectable place among writers on the principles of natural law; but his speculations are not entirely free from that indistinctness which is too prevalent among those who have undertaken similar enquiries. His arguments are chiefly directed against the Epicurean laxity of Hobbes, whose writings on the elements of morality and politics, though of a very debasing tendency, made a strong impression on his contemporaries. His system was now opposed by another, which comprehends a more pleasing view of man in his moral and social relations. "The most universal love, or most diffusive benevolence, of all rational beings towards each other, constitutes the happiest state they can be capable of; so that their endeavour of the common good, by this benevolence, is the sum of all the laws of nature, and in which they are all contained."[2]

Cumberland's treatise *De Legibus Naturæ* appeared during the same year with that of Pufendorf *De Jure Naturæ et Gentium*, which was printed at Lund, where the author was then a professor. This work of the English divine was highly commended in a subsequent publication of the German lawyer;[3] and his weighty suffrage must have had the effect of making it known on the continent. The book was reprinted at Lübeck in 1683, and again in 1694. It was likewise reprinted at Dublin. The style of the learned author has no particular recommendations; and as his work was printed in London while he was residing at Stamford, the first edition contains many typographical errors; nor are they removed in the subsequent editions. Dr Bentley afterwards undertook to revise the entire text, and, according to his grandson's account, he most effectually performed this task; but Barbeyrac, who had the use of the corrected copy, and who was a more competent judge of its value, entertained a less favourable opinion. This copy is now in the library of Trinity College, Cambridge. The author's family intended to publish a splendid edition of the work, but their laudable design was never executed.

Mr Tyrrell, who was the grandson of Archbishop Usher, and is himself well known as a writer on history and politics, digested Cumberland's doctrines into a new form, and published a considerable volume under the following title: "A brief Disquisition of the Law of Nature, according to the Principles and Method laid down in the Reve-

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[1] Cantabrigienses Graduati, p. 113. Cantab. 1800, 4to.

[2] Tyrrell's Disquisition of the Law of Nature, p. 7.

[3] "Quantum tamen mihi constat," says Pufendorf in allusion to Hobbes, "ipsius hypothesin inter Anglos solidissime destruxit Richardus Cumberlandus, libro erudito et ingenioso de Legibus Naturæ; simulque adversam hypothesin, quæ ad Stoicorum placita proxime accedit, firmissime adstruxit." (Specimen Controversiarum circa Jus Naturale ipsi nuper motarum, cap. i. § 6.) This tract is reprinted in the author's *Eris Scandica*. Francof. 1686, 4to. And it may likewise be found in Mascou's edition of his work *De Jure Naturæ et Gentium*. Francof. et Lips. 1759, 2 tom. 4to

Sir James Mackintosh, in his *Dissertation on the Progress of Ethical Philosophy*, p. 323, has inadvertently stated that Cumberland was the only professed answerer of Hobbes. Some of this philosopher's notions on the principles of natural law were discussed by George Lawson, rector of More in the county of Salop, who published "An Examination of the Political Part of Mr Hobbs his Leviathan" Lond. 1657, 8vo. His speculations were formally opposed by Roger Coke, in a volume which bears the following title: "Justice vindicated from the false fucus put upon it by Thomas White, Gent. Mr Thomas Hobbs, and Hugo Grotius: as also Elements of Power and Subjection, wherein is demonstrated the Cause of all humane, Christian, and legal Society." Lond. 1660, fol. A Dutch clergyman, Gisbertus Cocquius, doctor of philosophy, soon afterwards published "Hobbes ἐλεγχόμενος, sive Vindiciæ pro Lege, Imperio, et Religione, contra Tractatus Thomæ Hobbesii, quibus tit. de Cive et Leviathan." Ultrajecti, 1668, 12mo. The same divine is likewise the author of a book entitled "Vindiciæ pro Religione in Regno Dei Naturali, contra Hobbes de Cive, cap. 15. Leviathan, cap. 31." Ultraj. 1668, 12mo.

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rend Dr Cumberland's (now Lord Bishop of Peterborough's) Latin treatise on that subject; as also his Confutations of Mr Hobbs's Principles put into another method: with the Right Reverend Author's approbation." Lond. 1692, 8vo. Another edition appeared in 1701. A complete English version of the original work was published by John Maxwell, A. M. prebendary of Connor, under the title of "A Treatise of the Laws of Nature," &c. Lond. 1727, 4to. And at a more recent period, a French translation was executed by the learned Barbeyrac, who likewise enriched his native language by transfusing into it the great works of Grotius and Pufendorf. "Traité philosophique des Loix Naturelles, &c. traduit du Latin, par Monsieur Barbeyrac, Docteur en Droit, et Professeur en la même Faculté dans l'Université de Groningue: avec des notes du traducteur, qui a joint celles de la traduction Angloise." Amsterdam, 1744, 4to.

Having thus established a solid reputation, Dr Cumberland next prepared a work on a very different subject; "An Essay towards the Recovery of the Jewish Measures and Weights, comprehending their Monies; by help of ancient standards, compared with ours of England: useful also to state many of those of the Greeks and Romans, and the Eastern Nations." Lond. 1686, 8vo. This work, which is dedicated to his friend Mr Pepys, obtained a copious notice from Le Clerc,[1] and was translated into French. Some of the author's opinions were controverted without any mention of his name, in a work published two years afterwards by Dr Bernard, professor of astronomy at Oxford, a man of extensive and various erudition.[2] We are informed that he "writ some sheets to justify his calculations; but his averseness to any thing like wrangling made him lay them by, and leave his book to shift for it self."

About this period, he was greatly depressed, like many other good men, by apprehensions respecting the growth of popery; but his apprehensions were at length dispelled by the Revolution, which likewise brought along with it another material change in his circumstances. In the course of the year 1691, he went, according to his custom on a post-day, to read the newspaper at a coffee-house in Stamford, and there, to his great surprise, he read that the king had nominated Dr Cumberland to the bishopric of Peterborough. This mode of bestowing high preferment upon eminent and unobtrusive merit, must appear not a little singular to those who are chiefly acquainted with ecclesiastical proceedings in more recent times. The face of the bishop elect was scarcely known at court, and he had resorted to none of the usual methods of advancing his temporal interest. It is stated by his biographer that if the clergy had retained their ancient privilege of electing their bishop, they would have made no other choice. "Being then sixty years old," says his great-grandson, "he was with difficulty persuaded to accept the offer, when it came to him from authority. The persuasion of his friends, particularly Sir Orlando Bridgeman, at length overcame his repugnance; and to that see, though very moderately endowed, he for ever after devoted himself, and resisted every offer of translation, though repeatedly made and earnestly recommended. To such of his friends as pressed an exchange upon him he was accustomed to reply, that Peterborough was his first espoused, and should be his only one; and, in fact, according to his principles, no church revenue could enrich him; for I have heard my father say, that, at the end of every year, whatever overplus he found upon a minute inspection of his accounts was by him distributed to the poor, reserving only one small deposit of twenty-five pounds in cash, found at his death in his bureau, with directions to employ it for the discharge of his funeral expences; a sum, in his modest calculation, fully sufficient to commit his body to the earth."[3] To the duties of his new station he applied himself with great assiduity. He was a person of studious and retiring habits, nor did the natural calmness of his temper peculiarly fit him for the task of governing others; but if he erred in practising too much lenity towards those who were placed under his jurisdiction, he shewed no disposition to consult his own ease in the discharge of his various functions. His charges to the clergy are described as plain and unambitious, the earnest breathings of a pious mind. His old age was fresh and vigorous, nor did he discontinue his episcopal visitations till after he attained his eightieth year. When Dr Wilkins published the New Testament in Coptic, he presented a copy to the bishop, who began to study the language after he had completed the age of eighty-three. "At this age," says his chaplain, "he master'd the language, and went thro' great part of this version, and would often give me excellent hints and remarks, as he proceeded in reading of it." He died in 1718, in the eighty-seventh year of his age: he was found sitting in his library, in the attitude of one asleep, and with a book in his hand.

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Bishop Cumberland was eminently distinguished by his gentleness and humility. He was of a temper so cool and sedate, that it could not be roused to anger; and through the whole course of his life, his soul is represented as having been in a constant state of calmness and serenity, hardly ever ruffled by any passion. The theory which he maintains in his principal work, is founded on benevolence, and it naturally flowed from the habitual temperament of the author's mind. He was a man of a sound understanding, improved by extensive learning, and has left behind him several monuments of his talents and industry.

The care of his posthumous publications devolved upon his domestic chaplain Mr Payne, who soon after the bishop's death edited "Sanchoniatho's Phœnician History, translated from the first book of Eusebius *De Præparatione Evangelica:* with a Continuation of Sanchoniatho's History by Eratosthenes Cyrenæus's Canon, which Dicæarchus connects with the first Olympiad. These authors are illustrated with many historical and chronological remarks, proving them to contain a Series of Phœnician and Egyptian Chronology, from the first man to the first Olympiad, agreeable to the Scripture Accounts." Lond. 1720, 8vo. The preface contains an account of the life, character, and writings of the author, which was likewise published in a separate form, and exhibits a pleasing picture of his happy old age. The work itself is learned and elaborate, and the researches of such a man could not be entirely fruitless; but there is a material defect in the general design, inasmuch as it takes for granted the genuineness of a book which has very frequently been considered as spurious. It was treated as a fabrication by several of Cumberland's contemporaries, and, among others, by Dodwell and Van Dale;[4] nor is there much hazard in averring that it might now be more difficult to find many individuals of

[1] Bibliotheque Universelle, tom. v. p. 149.
[2] Edvardi Bernardi de Mensuris et Ponderibus Antiquis libri tres, editio altera. Oxoniæ, 1688, 8vo.
[3] Memoirs of Richard Cumberland, written by himself, p. 3. Lond. 1806, 4to.
[4] A. van Dale Dissertatio super Sanchoniathone, subjoined to his Dissertatio super Aristea de LXX. Interpretibus. Amst. 17 4to.—The learned Huet, who is sufficiently sceptical when it suits his particular views, feels no hesitation in admitting the genuineness of the work ascribed to Sanchoniatho: "Sanchoniathonem autem Trojanum bellum multis præcessisse annis, et ad Mosis ævum

Cumberland. critical learning inclined to adopt the bishop's opinion. The Phœnician History, of which some portion is preserved by Eusebius, was published in Greek by Philo Byblius as a version from the Phœnician tongue, and was produced by Porphyry as a composition of great antiquity. "I cannot but think," says Dodwell, that "this author counterfeited purposely with a design of confronting the antiquity of the Scripture. But who was the impostor, whether Philo Byblius or Porphyry, that I confess I cannot easily determine."[1] The book in which this passage occurs was published many years before the death of Cumberland, and was written by a person of much reputation for his learning. It is therefore obvious that a critical enquiry respecting the genuineness of the history ought to have preceded an attempt to draw any arguments from its details. A German translation appeared under the title of "Cumberlands Phönizische Historie des Sanchoniathons, übersetzt von Joh. Phil. Cassel." Magdeburg, 1755, 8vo.[2] The sequel to this work of the venerable bishop was likewise published by Mr Payne: "*Origines Gentium antiquissimæ;* or, Attempts for discovering the Times of the first Planting of Nations: in several Tracts." Lond. 1724, 8vo.

The author left an only son, who bore the same name, and belonged to the same profession: he was rector of Peakirk, in the diocese of Peterborough, and archdeacon of Northampton. One of the bishop's daughters married his faithful chaplain, S. Payne, A. M. rector of Barnack, and afterwards an archdeacon. The bishop's son, who inherited an estate which descended from his grandfather, had two sons and a daughter. The latter was married to Waring Ashby, Esq. of Quenby Hall in the county of Leicester. Richard, the elder son, died unmarried at the age of twenty-nine. The younger, named Denison from his mother, married Joanna the daughter of Dr Bentley, and became successively bishop of Clonfert and Kilmore. He was the father of the late Richard Cumberland. (D. I.)

CUMBERLAND, *Richard*, a dramatic and miscellaneous writer, was born at Cambridge on the 29th February 1722. He was the great-grandson of the Bishop of Peterborough, and he first saw the light under the roof of his maternal grandfather, Dr Bentley, in the master's lodge, Trinity College. When he had completed his sixth year, he was sent to the school at Bury St Edmunds, but for some time he made little progress in his learning, and it cost the master some trouble to awaken in him a proper spirit of emulation. This, however, was at length accomplished by publicly reproving him for his negligence; and, being thus roused to exertion, he soon found his tasks a pleasure rather than a burden. Whilst he remained at this school his grandfather Bentley died, and he was thereby deprived of the advantage which he might otherwise have reaped from the guidance and direction of the ablest scholar of the age. In his school exercises young Cumberland describes himself as aiming at something like fancy and invention; but this tendency seems to have betrayed him into grammatical inaccuracies which did him little credit with his master, and indeed exposed him to comments which he felt most acutely. He was not, however, very greatly discouraged by these strictures; for having made an excursion with his family, during the summer holidays, to visit a relation in Hampshire, he wrote a poem on the subject, in which he introduced a description of the docks at Portsmouth, and of the races at Winchester. This being his first regular attempt in English verse, he exhibited it to his father, who received it with unreserved commendation, and persisted, with pardonable partiality, in reciting it to his friends long after the author had gained experience enough to wish it consigned to oblivion. From the school of Bury St Edmunds young Cumberland was transferred to Westminster, where he remained about a year and a half, and profited much, particularly in point of composition. He was then sent to Cambridge, where he was admitted of Trinity College when he was only in his fourteenth year. At first he had two tutors, who paid little attention to his studies; but this inconvenience being soon felt, the head master, Dr Smith, in the last year of his under-graduate condition, recommended him to lose no time in preparing for his degree, and to apply closely to his studies during the remainder of the year. He did so, and worked with such indefatigable perseverance, that, though his health suffered severely in consequence, a high station was adjudged him among the wranglers of his year, and he obtained his bachelor's degree. This was in the year 1750. With the return of health he resumed his studies, and, without neglecting those in which he had recently been engaged, recurred to the authors who had lain untouched during his course of academical preparation. Cumberland.

Cumberland had early accustomed himself to read upon system, and now began to form collections on the various subjects of his pursuits. With this view he got together the different tracts relative to the celebrated controversy between Boyle and Bentley respecting the epistles of Phalaris, omitting none of the authorities and passages referred to, and compressed the reasonings on both sides into a sort of digest or report upon the question in dispute. But he was perhaps more agreeably employed in reading the Greek tragedians; and when Mason published his *Elfrida*, he planned and wrote, in imitation of that drama, a production of which Caractacus was the hero, with a chorus consisting of bards and druids. About this time, his health being still indifferent, he accompanied his family in an excursion to York, where he passed half a year in the society and amusements of the place; hunting in the mornings, dancing in the evenings, and devoting but little time to study. Having got hold of the Faery Queen, however, he began at intervals to write stanzas in the Spenserian measure; and he also composed short elegies in the same manner; but his mother having disapproved of these occupations, he relinquished them, and prepared to devote himself to more serious pursuits.

On his return to college young Cumberland was invited to the master's lodge by Dr Smith, who informed him of a new arrangement which had been determined on for annulling as much of the existing statutes as restricted all bachelors except those of the third year's standing, from becoming candidates for fellowships; and recommended him to present himself for examination, as, at the next election, he would be in the second year of his degree. Grateful for this friendly advice, he was preparing to resume his studies with increased alacrity, when he received an invitation from Lord Halifax to become private and confidential secretary to that nobleman. He accordingly proceeded to town, where he remained some time, and afterwards

accessisse, constat ex certissimis Phœnicum annalibus." (Demonstratio Evangelica, p. 158. Paris. 1679, fol.) In a very recent publication, it is stated with equal confidence that Sanchoniatho "is considered to be the most ancient writer of the heathen world." See the preface to Mr Cory's Ancient Fragments of the Phœnician, Chaldæan, Egyptian, Tyrian, Carthaginian, Indian, Persian, and other Writers. Lond. 1832, 8vo.

[1] Dodwell's Discourse concerning Sanchoniathon's Phœnician History, p. 62. Lond. 1681, 8vo.

[2] Fabricii Bibliotheca Græca, tom. i. p. 225. edit. Harles.

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returned to Cambridge, where, after a severe examination, he was elected fellow, along with Mr Orde, afterwards a master in Chancery, to the exclusion of two candidates of the year above them. On his return to town he lived as retired as if he had been still resident in his college. His first offering to the press, which appeared about this time, was a churchyard elegy in imitation of Gray's, but, as might be expected, greatly inferior in poetical merit. It seems to have made almost no impression. "The public," he observes, "were very little interested with it, and Dodsley as little profited." Whilst he was with Lord Halifax he met with Mr Charles Townshend, then one of the lords of trade, to whom he first recommended himself by the solution of some enigma or puzzle, and afterwards by revising and writing remarks on a report drawn up by Mr Townshend, which had been put into his hands for that purpose. About this time also he employed himself in collecting materials for a poem in heroic verse on the subject of India; but the design he afterwards abandoned as unsuitable; a circumstance which, judging from the specimen preserved in his *Memoirs*, respecting the discoveries of the Portuguese, can excite but little regret.

About this time he contracted an intimacy with Mr Bubb Dodington, and became a frequent guest at La Trappe, the residence of that eccentric personage, whom he also visited in London. This was perfectly agreeable to Lord Halifax, who not only lived upon intimate terms with Mr Dodington, but was then forming some opposition connections, having resigned his office as first lord of trade and plantations, and detached himself from the Duke of Newcastle's administration. Cumberland also accompanied Mr Dodington to his seat of Eastbury, in Dorsetshire, where he remained some time, and enjoyed ample opportunities of observing the character of his host, of which he has given a very interesting and graphic description in his *Memoirs*. On his return from Dorsetshire, he offered himself for a lay fellowship, then vacant, in Trinity College, Cambridge, and succeeded in attaining the object of his ambition; but he did not hold it long, owing to the condition of celibacy annexed to it. About this time he produced his first legitimate drama, *The Banishment of Cicero*, a performance of some merit, but wholly unfit for representation. It was accordingly rejected by Garrick, and published by the author as a dramatic poem in 1761, 4to. In the beginning of 1759, he married Elizabeth, the only daughter of George Ridge, Esq. of Kilmiston, to whom he had paid his addresses on receiving through Lord Halifax an appointment as crown agent for Nova Scotia. On the accession of George III. Cumberland addressed a poem in blank verse to the young sovereign; and when Lord Halifax was appointed lord-lieutenant of Ireland, he accompanied that nobleman as Ulster secretary, while his father was made one of the vice-regal chaplains. This brought him in contact with the celebrated William Gerard Hamilton, better known by the name of Single-speech Hamilton, who, having neither received his appointment from Lord Halifax, nor been in the first instance altogether acceptable to that nobleman, rendered Cumberland's situation exceedingly unpleasant. But the latter, notwithstanding, acquitted himself so well that, towards the close of the session, the lord-lieutenant expressed his satisfaction with Cumberland's services, and offered him a baronetcy, which, however, he judiciously declined; a circumstance which, he thinks, contributed to weaken his interest with Lord Halifax. Why such an honour should have been offered to a young man just commencing the career of public life, and wholly unprovided for, it is not easy to conjecture. It appears, however, that when his patron afterwards became secretary of state, he applied in vain for the situation of under secretary, and only obtained the clerkship of reports in the office of trade and plantations under Lord Hillsborough.

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The success with which Bickerstaff had brought forward his operas of *Love in a Village* and *The Maid of the Mill*, induced Cumberland to attempt a drama of the same description, under the title of *The Summer's Tale*; but although the music had been composed by Bach, Arne, Arnold, and Simpson, it was performed, with little applause, only for nine or ten nights. Subsequently, however, the author cut it down to an afterpiece in two acts, under the title of *Amelia*, in which form it met with tolerable success. The drama was published in 1765 and the afterpiece in 1768. His next production was the comedy of *The Brothers*, which was brought out at Covent-Garden, well received by the audience, and published in 1769. He now began to plan and compose *The West Indian*, which he completed before leaving Ireland; and on his return to London he entered into an engagement with Garrick to bring it out at his theatre, but he at the same time availed himself of the manager's suggestions, by adding a new scene, and introducing other improvements. This piece, which appeared in 1771, proved eminently successful, although the moral of the plot is far from being unexceptionable. Cumberland next entered the lists of controversy, by publishing a pamphlet containing animadversions upon a character of Dr Bentley, which had been drawn by Bishop Lowth, in a letter addressed to the author of the Divine Legation of Moses demonstrated. This pamphlet passed through two editions, but elicited no reply.

About the same time he was admitted into a literary society, the members of which used to dine together upon stated days at the British coffee-house, and at one of these meetings it was suggested to him to delineate the character of a North Briton, as he had already done those of an Irishman and of a West Indian. He availed himself of the hint, and in consequence drew the character of Colin Macleod in his comedy of *The Fashionable Lover*; but the attempt, as might have been expected, proved a total failure, owing, no doubt, to the author's entire ignorance of the distinctive peculiarities of the people of whom Colin Macleod was intended to be the representative. This comedy, though in point of composition superior to the *West Indian*, did not meet with equal success; and the author resented the criticisms made upon it with that sensitive jealousy which latterly induced Garrick to call him "the man without a skin." Throughout his whole life, indeed, he evinced a soreness to criticism, which necessarily exposed him to the very infliction which he dreaded so much and felt so acutely. His comedy of *The Choleric Man* proved more successful, but exposed him to the charge of venting illiberal and contemptuous sarcasms against his contemporaries; a charge which he endeavoured to rebut by prefixing to the play, when he published it, a "dedication to Detraction, directed chiefly against an Essay on the Theatre," in which a comparison was drawn between laughing and sentimental comedy, and under the latter description some severe observations were pointed against *The Fashionable Lover*. Cumberland's next dramatic production was *Timon of Athens*, altered from Shakspeare, in which the parts of Evanthe and Alcibiades were, the former nearly, and the latter altogether, new, and which, although it has now fallen into neglect, was favourably received at the time. The entertainment called *The Note of Hand, or Trip to Newmarket*, was the last of his pieces produced by Garrick, before disposing of his property in Drury-Lane. It is only remarkable as containing another sketch of Hibernian character, though on a smaller scale than the former one. The tragedy entitled *The Battle of Hastings* was brought out under the direction of Mr Sheridan, and published in 1778.

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Cumberland's prospects now began to brighten. On Lord George Germaine's accession to office, he was appointed secretary to the board of trade, with an income which could not but be acceptable to the father of six children; and he was particularly noticed by his lordship, who continued his friend and patron till death. He afterwards resided at Tetworth, in Bedfordshire, in the vicinity of Lady Frances Burgoyne, sister of Lord Halifax, and during one of the summer recesses he passed there he wrote his opera of *Calypso*, which was brought out at Covent-Garden with indifferent success. *The Widow of Delphi*, which he wrote the following season, has never been printed, although the author considered it as one of his very best productions. *The Bondsman*, a tragi-comedy, and *The Duke of Milan*, altered, also remain in manuscript, probably without any great detriment to literature.

In 1780, Cumberland was sent on a confidential mission to the courts of Madrid and Lisbon; but this appointment, however honourable in itself, seems to have been the source of all his future troubles, and to have embittered the remainder of his long life. The direct object of his mission was to induce the court of Spain to enter into a separate treaty with this country; but, although his conduct gave satisfaction to the Spanish court, and procured him the confidence and favour of the Spanish king, yet, owing to the disturbances which at this time broke out in London, and other untoward circumstances, he failed in accomplishing the object of his mission, and was recalled, in 1781, after having contracted, in the public service, a debt of nearly L.5000, which Lord North's ministry meanly refused, or at least neglected to pay, and which ultimately absorbed the whole of his hereditary property. It has been asserted indeed that he exceeded his powers, and compromised the ministry which had employed him; but of this no evidence whatever has been produced, and the losses to which he was subjected certainly amounted to a punishment much too severe for a mere error in judgment. It appears, in fact, that on his journey homewards his bills were stopped, and his credit rendered so utterly bankrupt, that he would have been thrown into prison at Bayonne, had not a fellow traveller advanced him a sum sufficient to enable him to pursue his journey through France. Nor did his misfortunes end even here. Mr Burke's economical bill having annihilated the board of trade, Mr Cumberland lost his situation, and was forced to retire with a compensation allowance, which, as is usual in such cases, was far from being adequate to the emoluments of the office of which he had been deprived. Resolved, however, to accommodate himself to circumstances which he could not control, he now fixed his residence at Tunbridge Wells, and made reductions in his establishment proportioned to his diminished income.

His first publication, after his return from Spain, was *Anecdotes of eminent Painters in Spain*, a curious and interesting work, which he afterwards rendered more complete by the publication of a *Catalogue of the King of Spain's Paintings*. The Anecdotes were published in 1782, in two vols. 12mo; the Catalogue appeared in 1787. His comedy of *The Walloons*, which he had written before settling at Tunbridge Wells, was brought out at Covent Garden Theatre, and followed by *The Mysterious Husband* in 1783, as well as by a tragedy entitled *The Arab*, which was acted once only, for the benefit of an actor. In 1783 appeared his *Letter to the Bishop of Llandaff*, on his lordship's proposal for equalizing the revenues of the established church; and in 1785 were brought out his tragedy of *The Carmelite* and his comedy of *The Natural Son*. The collection of essays under the title of *The Observer*, were also first printed experimentally in 1785, in two vols. 12mo; but a new edition, considerably augmented, appeared in five volumes the following year; and when this was exhausted he made another arrangement of the essays, and, having incorporated therewith his translation of *The Clouds* of Aristophanes, published the whole in six volumes. These papers have since been included in the collection of the British Essayists. His other productions of this period are a *Character* of his patron Lord Sackville, and a trashy pamphlet, published anonymously, entitled *Curtius rescued from the Gulf*, being an attempt at defending some one against an attack made on him by Dr Parr. His comedy of *The Impostor*, and *Arundel*, a novel in two vols. 12mo, appeared in 1789; in 1792 he published *Calvary, or the Death of Christ*, a poem in eight books, 4to; and, in 1795, he produced another novel, in four volumes 12mo, under the title of *Henry*, a production on which he bestowed more care and attention than on *Arundel*, the hasty effusion of a few weeks of leisure at Brighton. Cumberland is also the author of some works of a serious cast, particularly a version of fifty of the Psalms of David, *A few plain Reasons why we should believe in Christ*, a considerable number of sermons, numerous prayers, and metrical versions of passages selected from the Old Testament.

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But the drama was the field which had the greatest attraction for "the Terence of England." In 1793 he brought out a comic opera in three acts, founded on the story of Wat Tyler; but the lord chamberlain having objected to it, he was obliged to recast and produce it under the title of *The Armourer*. His comedy of *The Country Attorney* was produced in the same year, at the summer theatre, when under the direction of the elder Colman; and here also, in 1794, were brought out his *Box Lobby Challenge*, and *Don Pedro*. At the opening of the new theatre in Drury Lane was represented his comedy of *The Jew*, which he wrote with great rapidity, but which had for its object to disabuse the public mind of unjust prejudices against the character of a people who have so long been without a country, and who have either been persecuted or reviled in almost every country where they have sojourned. His celebrated comedy of *The Wheel of Fortune* came out in the preceding season, and was closely followed by another called *First Love*. In 1796, *Days of Yore*, a drama, was produced at Covent Garden; and, in 1795, *The Last of the Family*, a comedy, was brought out at Drury Lane. Five other comedies were also produced successively by this prolific writer, namely, *False Impressions, The Word of Nature, The Dependant, The Eccentric Lover*, and *The Sailor's Daughter*; of which the first was represented at Covent Garden, and the last at Drury-Lane. In the year 1806 he brought out *Hints for Husbands*, a comedy, which was performed at Covent Garden, but had a run of five nights only; and in the same year he published *Memoirs of his own Life*, to which he afterwards added a supplement. He was also concerned in *The Exodiad*, an epic poem, now forgotten; *John de Lancaster*, a novel, in 3 volumes; and *Joanna of Montfaucon*, a dramatic romance, neither of them productions of any merit. He was likewise the conductor of *The London Review*, a critical journal established on the French plan of affixing to each article the name of the writer; but the attempt did not succeed.

From the time when Mr Cumberland retired from public life and fixed his residence at Tunbridge Wells, he devoted himself entirely to literary pursuits, and produced the various works we have enumerated. Here also he lost his wife, who had so long been the partner of his joys and sorrows; but he bore the bereavement with the resignation of a man of sense, convinced that patience is no mark of insensibility, nor the parade of lamentation any evidence of the sincerity or permanence of grief. During the alarm

Cumberland.

of invasion he caught the patriotic infection of the time, and having headed two companies of volunteer infantry, received the commission of major-commandant. His latter days were spent chiefly in London, where, on the 7th of May 1811, he expired after a short illness, at the house of a friend in Bedford Place, being then in the eighty-ninth year of his age. The last act of his life was the publication of a poem entitled *Retrospection*, embracing opinions of men and things which are much more fully and satisfactorily treated in his *Memoirs*.

Of the personal character of Cumberland a pretty accurate judgment may be formed from his *Memoirs*. His self-esteem was great, and his vanity overweening, but, although extremely sensitive to criticism, and intolerant of censure, he had no real malignity in his composition, and, like most excitable persons, seems to have been as placable as he was irritable. His temperament was of a kind which, if easily disturbed, as quickly recovered its balance; and there is every reason to believe that the predominant tone of his feelings was alike generous and liberal. On the only occasion of his life where his moral principles were put to the test they appeared to the very greatest advantage. His conduct respecting the bequest of Mr Reynolds, who had devised to Mr Cumberland his estate, to the exclusion of the natural heir, evinced the greatest disinterestedness, and the highest sense of honour and probity. It was his misfortune to have been bred a courtier, and never to have taken his degrees in that school. He evidently wanted the suppleness and versatility necessary to ensure success in such a career. In a subordinate station, which merely required attention to formal and technical duties, he acquitted himself indifferently well; but, in venturing to act as minister, he found himself wofully deficient in those qualities without the possession of which genius and talents are of little avail. At the same time, having associated with most of the eminent men of his time, the sketches and anecdotes which he has introduced into his *Memoirs* are in the highest degree interesting; whilst his habits of observing and discriminating character give to his delineations an authority, and consequently a value, which it is difficult to over-estimate. In society his chief aim was to please; and, by the admission of his contemporaries, few men appeared to more advantage in conversation, or evinced a more perfect mastery, when he chose to exercise it, of the art of pleasing. The great faults of his character were a tendency to lavish hollow compliments on those who were present, and a propensity, without provocation or necessity, to indulge in bitter sarcasms against individuals after they had taken their departure. That this was the result of mere recklessness, or of a desire to provoke or minister to mirth, may be readily believed; but, by giving way to so unfortunate a bias, he lost more than he gained; and, although his address was studied, polite, and courtly, his character for sincerity became depreciated beyond all recovery. As a writer, he is more remarkable for the number than for the excellence of his works; but many of them, it should be remembered, were hastily produced in order to better his income, and some of them are marked by no ordinary degree of intellectual power. In every variety of fortune the drama was his favourite pursuit; and if he has produced much that is perishable or forgotten, he has also evolved creations which have been enregistered as among the finest efforts of genius. The character of Penruddock in *The Wheel of Fortune*, for example, is a masterpiece, which received a double consecration from the histrionic talents of John Kemble, by whom it was so often and so nobly personated. As a poet he cannot by any means rank high; for, while he had a play of imagination, which unfitted him for the concerns of actual life and business, his warmest admirers can only claim for him the praise of correct versification and elegant sentiment, which, however, has secured for some of his poetical works a considerable share of popularity. With regard to his *Observer*, now that he has acknowledged how much he borrowed from the manuscripts of his grandfather Bentley, we need scarcely say that it no longer supports his pretensions as a Greek critic. His learning was shallow, and, like his wit, it was often taken at second hand.

(J. B—E.)

Cumbrae ‖ Cunningham.

CUMBRAE, GREAT and LITTLE, two small islands in the Firth of Clyde, belonging to Buteshire. See BUTESHIRE.

CUMNOCK, or OLD CUMNOCK, a village of Ayrshire in Scotland, on the Lugar Water, 12 miles east of Ayr. It is noted for the manufacture of snuff-boxes, similar to those of Laurencekirk, the peculiarity of which is the "invisible wooden hinge." See article *Snuff-Boxes* in M'Culloch's *Commercial Dictionary*.

CUMMIN SEEDS, the fruit or seeds of *Cuminum cyminum*, an umbelliferous plant found wild in Egypt and Greece, and still extensively cultivated in the East, as in the remotest times, for the sake of its aromatic seeds. These have a strong and rather peculiar odour, with a corresponding aromatic taste; and like anise, dill, &c., possess well-marked stimulant and carminative properties.

CUNEGO, DOMENICO (1727–1794), an Italian engraver, born at Verona. He practised his art chiefly at Rome; and is best known to us by his 22 plates in Gavin Hamilton's *Schola Italiana*, in a neat but rather heavy style; and by his outline of *The Last Judgment* of the Sistine Chapel.

CUNEIFORM (Lat. *cuneus*, a wedge), wedge-shaped.

CUNEIFORM INSCRIPTIONS, a term applied to certain characters found inscribed on the bricks of Nineveh and Babylon, as well as on the buildings of Persepolis, Hamadan, and other remains of the ancient Persian monarchy. The researches of modern authors, especially of Colonel Rawlinson, have shown that there are three alphabets of the *arrow-head* character; the earliest and simplest, the Assyrian; the Persian consisting of 36 letters; the Median comprising about 100. Considerable progress has been made in deciphering the first, which promises to throw much light on the obscurity that has hitherto veiled Assyrian history, and seems to be the key to at least two distinct languages.

CUNINA, in *Roman Mythology*, the goddess who protects children in the *cunæ* or cradle.

CUNITZ, MARIA, the eldest daughter of Heinrich Cunitz, a doctor of medicine in Silesia, was born about the beginning of the seventeenth century. She learned languages with amazing facility, and understood Polish, German, French, Italian, Latin, Greek, and Hebrew. She attained a knowledge of the sciences with equal ease, and was skilled in history, physic, poetry, painting, and music: yet these were only her amusements; for she applied herself to the mathematics, and to astronomy, which she made her principal study, and in which she made such rapid and extensive progress that she was ranked amongst the ablest astronomers of her time.

Her astronomical tables, which gained for her a great reputation, were printed in Latin and German, and dedicated to the Emperor Ferdinand III. These tables, under the name of *Urania Propitia* sive *Tabulæ Astronomicæ*, were first printed at Oels in 1650, and afterwards at Frankfort in the following year. She married a Dutch physician named Elias de Loewen, and died at Pitschen in 1664.

CUNNINGHAM, ALEXANDER, a celebrated critic and civilian, was the son of John Cunningham, minister of Cumnock, in Ayrshire, and the owner of a small estate named Block, in the same county. He was

Cunningham. served heir to his father in the year 1677.[1] The time of his birth and the place of his education have not hitherto been ascertained. The earliest employment in which we find him engaged was that of tutor to Lord George Douglas, who was a younger son of the first duke of Queensberry, and died in the year 1693.[2] It was probably through the influence of this noble family that he was appointed professor of the civil law in the university of Edinburgh. In 1698 the Scotish parliament voted a salary of one hundred and fifty pounds sterling to Alexander Cunningham, as professor of the civil law, "nominat and designed to that profession." The act was to continue in force during the period of five years; and the same provision in his favour was, for the same period, renewed in 1704.[3] On the 18th of October 1710, the magistrates of Edinburgh, without recognizing any former appointment, nominated James Craig professor of the civil law.[4] He was a descendant of the famous Sir Thomas Craig, and is said to have filled his situation in a manner not unworthy of his ancestor.[5] The city magistrates, regarding themselves as the proper patrons of the university, have always entertained the greatest jealousy of any interference on the part of the crown; and as Cunningham must have held a royal professorship, they would studiously decline to recognize his appointment. The payment of his salary must have ceased at the expiration of the second term of five years, that is, in 1709; and it was in the course of the ensuing year that the magistrates established another chair; nor is it superfluous to mention that this new foundation took place after the death of the duke of Queensberry, who had acted as her majesty's commissioner at the important crisis of the union.

So early as the year 1590, the judges, the magistrates, and the advocates and clerks to the signet, had raised a fund of L.3000 for the endowment of a professorship of law in the university of Edinburgh; each of these three parties contributing an equal portion. Adam Newton, an advocate, was first appointed to the office; but having neglected to obtain the approbation of the magistrates, he was dismissed in the year 1594. He afterwards procured better employment, and successively became tutor and secretary to Prince Henry.[6] In the professorship he was succeeded by Hadrian Damman of Bisterveld, who was born in the neighbourhood of Ghent, and there was for some time employed in teaching the classics:[7] he retained the chair for a few years, and was afterwards resident of the States-General at the court of Scotland. In the year 1597, after his resignation, the interest of one third of the sum formerly contributed was allotted for a professor of humanity, and the interest of the remainder for the maintenance of six exhibitioners. Newton and Damman had both taught humanity, without reading any public lectures on law.[8] After the more recent foundation of a law-professorship, the resort of Scotish students to the foreign universities became somewhat less frequent, but the practice was never entirely discontinued; and of the present race of lawyers, several have studied at Leyden, Utrecht, and Göttingen. Cunningham.

It is highly probable that Cunningham had completed his academical course at Leyden or Utrecht.[9] He had equally devoted his attention to the studies of philology and the civil law, which at that period were not very vigorously cultivated in his native country; and he at length fixed his residence in Holland, where those studies were prosecuted with uncommon ardour and success. A late writer has erroneously described him as an advocate: in the records of the faculty for that period, we find no advocate of the same name. He now settled at the Hague, where he appears to have resided during the remainder of his life; but we can discover no evidence of his having there taught "both the civil and canon laws." He apparently lived in Holland as a private gentleman, sup-

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[1] Inquisitionum Abbreviatio, vol i. Ayr, 612.

[2] Wood's Peerage of Scotland, vol. ii. p 380.

[3] Acts of the Parliaments of Scotland, vol. x. p. 176 vol. xi. p. 203. On the 19th of August 1698, a petition from Alexander Cunningham, "for encouraging a design of illustrating the civill law," had been remitted to the committee for the security of the kingdom. Vol. x. p. 145.—About this period, several advocates began to read private lectures on the civil law. One of these was Alexander Drummond, who in the year 1699 inserted the following advertisement in an Edinburgh newspaper: "These are to give advertisement to all persons who are desirous to be instructed in the knowledge of the Institutions and Pandects of the Civil Law, and the laws of this kingdom, or either of the two, or both, that Mr Alexander Drummond of East-field, Advocate, does profess to teach the same; and by reason of a singular method he uses in teaching of the civil law, he undertakes to perfite and accomplish any of a middle capacity, more in a years time, then others have been by being abroad and out of the country 3 years How profitable and advantagious this may tend to the kingdom in general, he leaves it to every one to judge. He is to be spoke with at his lodging in the foot of Blackfrier Wind." Another private lecturer on the civil and municipal laws was John Spottiswoode; and their example was followed by John Cunningham, who published his inaugural lecture under the title of "Joannis Cuningamii, J.Cti. Oratio inauguralis, recitata Edinburgi cum primum Jus Civile docere cœpit" Edinb. 4to. This publication is without a date, but it probably appeared about the same period with "A Discourse by Mr John Cunninghame, Advocate, at the Beginning of his Lessons on the Scots Law." Edinb. 1705, 4to. He was the second son of Sir John Cunningham of Caprington, Bart an eminent lawyer. (Douglas's Baronage of Scotland, p. 267.)

[4] Register of the Town Council, vol. xxxix. p. 948.

[5] Tytler's Account of the Life and Writings of Sir Thomas Craig, p. 321. Edinb. 1823, 12mo.

[6] Adam Newton was the son of a baker in Edinburgh. Though a layman, he held the deanery of Durham from 1606 to 1620, when he resigned it; and during the latter year he was created a baronet. He translated into Latin King James's treatise against Vorstius, and the first six books of Paolo Sarpi's history of the council of Trent. The last two books were translated by Dr Bedell. (Birch's Life of Prince Henry, p. 14. 218. Lond. 1760, 8vo) "Sic se gessit," says Dempster, "ut moderatione summa cum maximum locum occuparit, majorem mereri censeretur." (Hist. Ecclesiast. Gentis Scotorum, p. 505.)

[7] Sanderus de Gandavensibus Eruditionis Fama claris, p. 3. Antverp. 1624, 4to. Andreæ Bibliotheca Belgica, p. 9. edit. Lovan. 1643, 4to.—According to these writers, Damman was invited to Scotland by Buchanan. In this country he appears to have acquired an estate; for in his metaphrase of Du Bartas, he describes himself as *Dominus de Faire-hill.* He married Margaret, a granddaughter of John Stewart, earl of Buchan, but she left no issue. (Wood's Peerage, vol. i. p. 268) The literary historians of Flanders mention some of his poems as having been printed on the continent; and after his settlement in Scotland, he published the following works. Schediasmata. Edinb. 1590, 4to Bartasias, qui de Mundi Creatione libri septem; e Guilielmi Salustii Dn. de Bartas Septimana, poemate Francico, liberius tralati, et multis in locis aucti. Edinb. 1600, 8vo. Both these volumes were printed by Waldegrave. The first of them contains one Greek and six Latin poems, all relating to the royal nuptials, and the reception and coronation of the queen.

[8] Crawford's Hist. of the University of Edinburgh, p. 34. 40.

[9] A letter of Jacobus Gronovius, dated at Leyden on the 9th of May 1687, contains the following passage: "Cuningamius ubi hæreat, postquam ex hac urbe discessit, nullo labore potui inquirere, nisi quod populares quidam ejus dicant Germanicum iter ab eo susceptum, non alicubi fixisse mansionem: unde tuas ad eum literas etiamnum detineo." (Clarorum Belgarum ad Ant. Magliabechium Epistolæ, tom. ii. p. 168. Florent. 1745, 2 tom. 8vo.) As we have other evidence of the civilian's acquaintance with Gronovius, we suppose him to be the individual here mentioned.

Cunningham. ported by the rent of his estate, and probably by an annuity from the noble family with which he had been connected. From a notice which occurs in a work of Best, published in the year 1707, it may perhaps be inferred that he was then residing in that country;[1] and a letter of Cuper, dated on the 12th of November 1709, mentions him as having been residing at the Hague.[2]

His edition of Horace made its appearance in the year 1721, but long before that period he enjoyed a very high reputation as a classical scholar. His notes are brief, and relate to the various readings; but he announced his intention of preparing another edition, illustrated with more copious annotations; and at the same time he published a separate volume, consisting of animadversions on the notes and emendations of Bentley, whose edition of Horace had been printed ten years before. To this volume, which displays much learning and sagacity, and evinces the author to have studied the art of criticism with uncommon assiduity and success, he has prefixed an address to Dr Bentley, whom he everywhere treats with much freedom, and even severity. Bentley was a man of great vigour of intellect, and of erudition not less accurate than extensive: of the Greek language he possessed a masterly knowledge; and he had studied the ancient metres with a degree of nicety unknown to former critics. His principal defect seems to have been a want of taste; for when he quits the mechanism and analogy of language, and the mere structure of verse, he cannot be regarded as a very safe guide in subjects of polite literature. His conjectural emendations, particularly of the Greek poets, often display singular felicity; but on some occasions they are chiefly remarkable for their audacity. Many of his rash conjectures on Horace are very successfully exposed by Cunningham. One of the emendations on which he seems to congratulate himself with most complacency, is the substitution of *ter natos* in the subsequent verse of the Art of Poetry:

Et male *tornatos* incudi reddere versus.

A reading more repugnant to every principle of taste could not easily have been devised; and yet his learned correspondent Grævius speaks of it in the following terms: "Eam qui videt et non probat, is in his litteris cæcior est quavis talpa. Quid enim torno cum incude?"[3] Bentley professes to be offended with the incongruity of Horace's metaphor, and he asks the same question with Grævius; but he perceives no incongruity in an animal being produced at three births, and being moreover hammered upon an anvil. Cunningham, who was fully aware of this absurdity, has unnecessarily adopted the reading *formatos*, which appears somewhat flat. There is in reality no occasion for any change: when an artist has turned a piece of iron without being able to give it the shape or polish which he intended, he very naturally brings it back to the anvil, and a second time prepares it for the lathe. The metaphor therefore which occurs in this passage, is at once consistent and expressive. The vanity and arrogance with which Bentley exercised his critical functions,[4] are likewise exposed by this formidable antagonist. Cunningham appears to have been the friend of Le Clerc, and on that account he may have pointed his animadversions with more keenness. Cunningham.

Cunningham's animadversions excited no ordinary degree of attention, and he was acknowledged to be the most able of Bentley's critical antagonists. Jani, a recent editor of the odes of Horace, speaks of him in the following terms: "Omnium doctissime in hoc castigando versatus est Alexander Cuningamius, vir summus et doctissimus, unus omnium qui in Horatium scripserunt criticorum princeps, ipsique Bentleio, si quid intelligo, anteferendus.... Emendationes autem ejus fatendum est omnium doctissimas esse ac ingeniosissimas, sæpe, si ad leges artis criticæ excutiantur, pro unice veris lectionibus habendas. Sæpius tamen non minor in iis, quam in Bentleianis, audacia est, sed illa melior profecto aliorum indocta modestia."[5] This estimate differs very widely from that of Wakefield, who styles Cunningham "ille criticus illaudabilis,"[6] and repeatedly honours him with some of the peculiar graces of his elocution. Of his own character as a critic, the greatest of living scholars has pronounced no very favourable opinion.[7] Klotz remarks that Sanadon has pilfered much from both Bentley and Cunningham.[8]

The Scotish critic appears to have been intimately connected with most of the eminent scholars and civilians who then flourished in Holland.[9] In France he had several learned correspondents; and from a passage in his animadversions, it may be inferred that he was acquainted with Addison.[10] Duker and various other critics mention him in friendly terms.[11] When Otto published his great collection of tracts on the civil law, he professed to have been chiefly indebted to Bynkershock, Cunningham, and Brenkman. "Post virum illum primarium, alios quoque recolere juvat, qui re et judicio suo hoc opus instruxerunt. Hos inter haud postremum locum obtinent Alexander Cuninghamus, et Henricus Brenkmannus, viri clarissimi, et optima fide de republica literaria pariter ac jurisprudentia merentes, qui repetitis deliberationibus ad delectum librorum institutis, adfuerunt, dignoscere cauti quid solidum crepet."[12] The chief labour of Cunningham's life was a critical edition of the Pandects, which however he did not live to publish. Of this long-meditated edition great expectations were formed. In a letter addressed to Cuper in the year 1709, Leibnitz, having mentioned his own project of remodelling the Pandects, expresses a wish to have his labours associated with those of Cunningham. "Nempe cuique auctoris libro sua reddita sunt verba in Pandectas Justiniani relata. Tantum jam reliquum est, ut edantur hæc Rediegesta, sed sine ali-

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[1] "Sed et insuper," says Best, "ne quid dubites, idem mihi adseveravit vir doctissimus Cunninghamius, natione Scotus, qui præclara ingenii monumenta, quibus jurisprudentiam arctissime sibi devinxit, non diutius, ut speramus, erudito orbi invidebit, quum id ipsum sæpius percontatus didicisset ab accuratissimo Jacobo Gronovio." (Ratio Emendandi Leges, p. 17. Ultraj. 1707, 8vo.) See likewise the preface to Wieling's *Lectionum Juris Civilis libri duo*, edit. Traj. ad Rhen. 1740, 8vo.

[2] Lettres de Gisbert Cuper, p 233. Amst. 1742, 4to.

[3] Bentleii Epistolæ, p. 137. Lond. 1807, 4to.

[4] See the Bibliotheca Critica, vol. iii. part. ii. p. 123.

[5] Jani de Horatii Editionibus, p. xxxviii. See likewise his preface to the second volume. Gebauer has remarked of Cunningham, "sobriæ critices fuisse studiosissimum." (Narratio de Henrico Brenkmanno, p. 10. Gottingæ, 1764, 4to.)

[6] Wakefield ad Lucretium, lib. v. v. 205.

[7] "In quo viro," says Hermann, "quum quantum ingenii, tantum effrenatæ temeritatis, Græcæ autem linguæ haud accuratior quam Latinæ cognitio sit, debet ille aliquam sane, sed non eam auctoritatem habere, quam apud nostrates, nimis æquos exterorum judices, consequutus est." (Præf. in Euripidis Hecubam, p. iv. Lipsiæ, 1800, 8vo.)

[8] Klotzii Vindiciæ Q. Horatii Flacci, p. 206. Bremæ, 1764, 8vo.

[9] Some of his letters to J. P. d'Orville may be found in the appendix to the second edition of Dr Irving's Memoirs of the Life and Writings of George Buchanan, p. 417. Edinb. 1817, 8vo.

[10] Cunningamii Animadversiones, p. 214.

[11] Dukeri præf. in Florum. Lugd. Bat. 1722, 8vo.

[12] Thesaurus Juris Romani, tom. i. præf.

Cunningham.

quo cultu, itaque optandum foret emendationes ex Pandectis Florentinis accedere; et cum intellexerim Cunninghamum Scotum, doctrina et ingenio valentem, multum in constituendo textu laborasse, non video ubi melius emendationes vel collationes suas collocare posset."[1]

Cunningham died in the year 1730. The auction of his library commenced on the 20th of November, and he may be supposed to have died some months before that period. His collection of books was very curious and valuable, particularly in the departments of philology and jurisprudence.[2] The printed catalogue describes it as a most splendid library, and mentions that the greater part of the books were in gilt vellum or calf. His real and personal property descended to his nephew, the Rev. George Logan, A. M., afterwards one of the ministers of Edinburgh. The estate of Block was at that time worth between fifty and sixty pounds a year, and may at present be worth five times as much. With respect to his papers, we find some information in a letter from Sir John Pringle to Forbes of Culloden.

"I wrott to Mr Logan of Dunbar, as I told you I would do, both in your name and mine, about his uncle Mr Cunningham's papers, and I have since had an evening's conversation with him; the sum of which was, that his uncle has not left one single scrape of any thing ready for the press, or even in any tolerable order. His notes on Horace are written on the margin of six volumes, whereof three are the text of Horace as he published it, and the other three are his animadversions on Bentley. The use of these I am promised again next week: the Lord have mercy on the patients till I have done with them! His notes on Phædrus are likewise only on the margins of two editions of Phædrus; but he thinks them fuller than the others, and is talking of giving them to Mr Ruddiman, if he will be at pains to putt them in order and publish them. He has marginal notes upon several other authors, as Virgil, Statius, Quintillian, Cicero; any of which he offers to send me after I have done with Horace. His notes on the Corpus are larger than any of the rest, and not writt on the margin, as the rest. His copy of the Corpus is interleaved with clean paper; so that there is a leaf of written notes for every printed leaf. He told me the Advocats Library has applied to him to have it, but he has given the curators no answer as yet, nor did he seem determined when he spoke to me.—What will surprise you most is, that he has left nothing of his scheme of the Christian religion. Mr Logan told me he had inquired at him about it when he was in his perfect senses, but that he declared to him that he had never putt it in writing, and that he would dictate it to him any day, for he had it all in his head, and that it could be contain'd in four or five sheets of paper; however, every day that Logan pressed him to do it, he found always some reason for shifting it, till he was incapable of doing any thing." This letter is dated at Edinburgh on the 13th of January 1731; and on the 2d of February, he writes thus: "I have gott two volumes of Horace, with Cunningham's marginal notes; but the hand is so bad, and the lines so closs on one another, that I have difficulty to make sense of them, tho' I perceive no *siglæ*, or secret marks, among them. However, I design to give true pains, and you will see probably the fruit of my labours when you return."[3] Cunningham.

His speculations on the evidences of the Christian religion are mentioned in a letter from T. Burnet to Locke, dated at London on the 17th of March 1699. "I thought once of sending this packet with Mr Cunningham, who told me at my chambers some days ago he was to go out to you; but now, after waiting longer than his set time, I was resolved to delay no longer. I wish you would indulge him, before he leaves you, to piece together his proofs of the Christian religion, that the world may enjoy that light he hath so long promised."[4]

What became of the papers mentioned by Pringle, we have not been able to ascertain. In the Advocates Library there are copies of Vinnius's first edition of the Institutes, and Best's *Ratio Emendandi Leges*, with manuscript notes ascribed to Cunningham: they were presented in the year 1763 by David Clerk, M. D. the son of another physician to be afterwards mentioned. The greater part of the notes was apparently written by some other person. We subjoin a list of the publications which bear Cunningham's name.

1. Alexandri Cuningamii Animadversiones in Richardi Bentleii Notas et Emendationes ad Q. Horatium Flaccum. Hagæ Comitum, apud Thomam Jonsonium, 1721, 8vo.

2. Q. Horatii Flacci Poemata: ex antiquis codd. et certis observationibus emendavit, variasque scriptorum et impressorum lectiones adjecit Alexander Cuningamius. Hagæ Comitum, apud Thomam Jonsonium, 1721, 8vo.

3. P. Virgilii Maronis Bucolica, Georgica, et Æneis ex recensione Alexandri Cuningamii Scoti, cujus emendationes subjiciuntur. Edinburgi, apud G. Hamilton et J. Balfour, 1743, 8vo.

4. Phædri Augusti Liberti Fabularum Æsopiarum libri quinque, ex emendatione Alexandri Cuningamii Scoti. Accedunt Publii Syri, et aliorum veterum Sententiæ. Edinburgi, apud G. Hamilton et J. Balfour, Academiæ Typographos, 1757, 8vo.

Of this posthumous edition of Virgil, the preface was written by John Clerk, M. D.[5] who is described as a physician of great learning and eminence, and of whom Dr Cullen has left an interesting account.[6] He likewise published the edition of Phædrus,[7] which contains a preface by the editor, but is without annotations. Some of the conjectural emendations are considered by Schwabe as too bold, and others as unnecessary.[8] It appears from one of Drakenborch's letters to La Croze, that Cunningham had formed the design of attacking Bentley's edition of that poet, but finally abandoned it, lest he should interfere with a similar design of his friend Burman.[9] (D. I.)

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[1] Lettres de Gisbert Cuper, p. 233.

[2] Bibliotheca Cuningamia, continens selectissimos rarissimosque omni in lingua Libros: hos omnes multo judicio, vigilantia, ac labore collegit celeberrimus ac eruditissimus vir D. Alexander Cuningamius, Jurisconsultus et Polyhistor eximius. Lugd. Bat. 1730, 8vo. Pp. 130.

[3] Culloden Papers, p. 120–1. Lond. 1815, 4to.

[4] See Lord King's Life of John Locke, p. 403. Lond. 1829, 4to.—The writer of the letter, who speaks of his chambers like a lawyer, was perhaps Sir Thomas Burnet, a son of the bishop of Salisbury.

[5] Ruddimanni Bibliotheca Romana, p. 10. Edinb. 1757, 8vo.

[6] See Dr Thomson's Account of the Life, Lectures, and Writings of William Cullen, M. D. vol. i. p. 525.

[7] Catalogue of the Library of the learned Dr John Clerk, Physician in Edinburgh, and of Dr David Clerk, his son, p. 72. Edinb. 1768, 8vo

[8] Notitia Litteraria de Phædro, p 104, prefixed to Schwabe's second edition. Brunsvigæ, 1806, 2 tom. 8vo.

[9] Thesauri Epistolici Lacroziani tom. i p. 124. Lipsiæ, 1742–6, 3 tom. 4to.—One of the Cunninghams is mentioned in a letter from Colonel Codrington to Dr Charlett, written in June 1702. (Letters written by eminent Persons, vol. i p. 133. Lond 1813, 3 vols. 8vo.) The editor of Horace is said to have assisted in revising a French translation (Haye, 1725, 2 tom. 4to) of the first

Cunningham. CUNNINGHAM, *Alexander*, the historian, has frequently been identified with the professor of the civil law, but it has at length been ascertained that they were different individuals. The father of the historian was Alexander Cunningham, minister of Ettrick, in Selkirkshire, and the owner of a small estate, named Hyndhope, and situated in the same county. The elder son, James, inherited this property, and left descendants. Alexander was educated at Selkirk school, and was originally destined for the church. According to one account, he prosecuted his academical studies in Holland: this account, which is sufficiently probable in itself, is contained in a communication from the late earl of Buchan to Dr Thomson. From a manuscript notice written by a descendant of his elder brother, we learn that, in the capacity of a travelling tutor, "he was employed both in the Argyle and Newcastle families;" that he afterwards studied the law of England, and was in great repute as a chamber-counsel, but never pleaded at the bar. He visited his brother at Hyndhope when Murray of Philiphaugh was sheriff of the county, but did not long remain in Scotland.[1] His connexion with the Argyle family, as travelling tutor to Lord Lorne, was previously known from other sources of information. It was stated by the late earl of Hyndford that Cunningham travelled with his uncle and his father, James, afterwards earl of Hyndford, and the Hon. William Carmichael, afterwards solicitor-general for Scotland; that they passed two winters at Utrecht and Franeker, between the years 1692 and 1695, and subsequently travelled together for some time. "I have heard," says his lordship, "that the same Alexander Cunningham was afterwards tutor to an English nobleman, whose name is unknown to me." If we may rely on the notice already quoted, this young nobleman must have been connected with the Newcastle family. A letter from Cunningham to Carstares, dated at Bruges on the 20th of October 1697, contains the subsequent gleanings of information. "My Lord Argyle has not yet written any thing concerning his son: he was gone from this place to his regiment before I came here, which I was glad of, for I know his l. colonel will take care of him....As for the project, I know you will not only use all your credit with Secretary Ogilvy, but will also recommend the thing to all the Scots nobility and gentry you shall meet with at London. I have bought in this country a considerable number of books, in order to the carrying of it on; and, so soon as I am free of my L. Lorne, I resolve to set seriously about it."[2] Lord Lorne, though only about seventeen years of age, was now colonel of a regiment in Flanders. In the course of the following year, Dr Lister found Cunningham at Paris, and he makes an allusion to his having recently visited Rome. "I had a visit," he remarks, "from Mr Cunningham, tutor to my Lord Lorne, a very learned and curious man in books. I askt him (knowing him to have been lately at Rome) very particularly about the papers of Monsieur d'Azout. He told me that he saw him not half a year before he died, and was very intimately acquainted with him, and saw him for a twelvemonth very often. That he told him that he had about 80 difficult passages in Vitruvius, which he had commented and explained; and the correction of a great number of errata in the text. Also that upon Julius Frontinus (though that was a much less task) he had much more to say than he had upon Vitruvius."[3] From a passage in Cunningham's history, Dr Thomson had inferred that the author must have accompanied Lord Lorne to Rome; but from the context he was led to suppose that this occurrence must have taken place about the close of 1699 or the beginning of 1700. Cunningham.

In the year 1701, Cunningham was employed in a new capacity. He was sent to France by the king's authority: the ostensible object of his mission was to conduct a negociation respecting the trade between Scotland and France, but he is supposed to have supplied the king with important information of another kind.[4] During the reign of George I. he was appointed minister to the state of Venice, and he retained his functions from 1715 to 1720. How long he survived, we have not hitherto been able to ascertain, but the earl of Hyndford is known to have visited him in London in the year 1735. He was married, and had four sons and a daughter. His eldest son, Robert, a barrister, died unmarried. Thomas married, and had a son and a daughter. Robert died in 1748, and Thomas in 1749: their uncle, James Cunningham of Hyndhope, attended the funerals of both; and at that of the latter he acted as chief mourner, the only son of the deceased being then a child. Alexander, the third son, was educated at Westminster school, and afterwards went to Leyden, where he died. Jane, the historian's only daughter, was married to Mr Clayton, brother to the mayor of Newcastle. It is sufficiently evident that the historian was a different person from Alexander Cunningham, who died on the 15th of May 1737, and was buried in the chancel of St Martin's church. By his testament, registered at Doctors Commons, the latter makes a provision for nephews and nieces, without any mention of his own descendants.

Long after the death of Cunningham, his Latin history came into the possession of Dr Hollingbery, archdeacon of Chichester, who describes the author as nearly connected with his family. The original has not been published; but a spirited translation, executed by William Thomson, LL.D. made its appearance, under the title of "The History of Great Britain, from the Revolution in 1688 to the Accession of George the First." Lond. 1787, 2 vols. 4to. It is certainly a curious circumstance that, at so barren a period of its literary annals, Scotland should have produced two learned writers of the same name and surname.[5] The identity of their pursuits and accomplish-

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volume of Bishop Burnet's History of his own Time. See *Journal des Sçavans, pour l'année* 1726, p. 669. His reputation as a chess-player was not inferior to his reputation as a scholar. About the year 1700, Professor Wodrow played at chess "with Mr Alexander Cunningham of Bloak, his old acquaintance. Mr Cunningham, after playing a game with him, said he thought he was able to give him a rook and a bishop of advantage, and his very outmost was queen, but he doubted that would be too much, which was a high commendation from him who is reckoned the best chess-player in Europe." (Wodrow's Life of James Wodrow, A. M. Professor of Divinity in the University of Glasgow, p. 174. Edinb. 1828, 12mo)

[1] All these particulars we state on the authority of a notice written by a well-known individual, the late Mr Alexander Cunningham, jeweller in Edinburgh, who was himself descended from the historian's elder brother; and, in 1787, committed to writing, "from his father's information, the circumstances related by him as they now stand; these he learnt when in London, from the widow of his grand-uncle." From the same source we derive our information respecting Cunningham's children.

[2] Carstares's State-Papers and Letters, p. 360. Edinb. 1774, 4to.

[3] Lister's Journey to Paris in the year 1698, p. 99. 2d edit. Lond. 1699, 8vo.

[4] Cunningham's Hist. of Great Britain, vol. i. p. 238. Carstares's State-Papers, p. 709–10. See likewise Dr Thomson's Introduction, p. xiii.

[5] About the same period, there was a third scholar of the name of Alexander Cunningham, who was professor of humanity in the university of Edinburgh. His testament was confirmed by the commissary court on the 26th of March 1697. He is the writer of a Latin poem subjoined to a work entitled *Grammatica Latina, authore Patricio Dykes Perthensi.* Edinb. 1679, 8vo.

Cunningham.

ments is likewise remarkable: both of them were travelling tutors, and both lawyers; both of them were great proficients in Roman literature, and both were famous for their skill at chess. When we consider all these coincidences, as well as the chronological agreement, it does not appear surprising that they should frequently have been supposed to be one and the same individual. It is remarked by Dr Thomson, that if we duly examine Cunningham's history, "we shall find reason to pronounce it a just and legitimate composition, and perhaps to rank its author in the first class of our historians." Most readers will at least be disposed to admit that he was a man of learning and talents, and that he has made some important additions to the common stock of materials for the history of the eventful period to which his work relates. His decided attachment to the principles of the Whigs, will further recommend him to those who prefer the interest of the great body of the people to the interest of a particular family and particular classes. (D. I.)

CUNNINGHAM, *Allan*, a poet and miscellaneous writer, was born of comparatively humble parentage, at Blackwood, Dumfriesshire, in 1784. Entering life as apprentice to a stone mason, he early displayed a promise of poetical talent, and happening to be introduced to the engraver Cromek, the editor of the "Remains of Nithsdale and Galloway Song," he undertook the collection of ballads for the work. He sent to Cromek, as genuine remains, his own imitations of the ancient ballad literature. These form the bulk of Cromek's work. The cheat was long unsuspected, but the sagacity of Bishop Percy, James Hogg, Walter Scott, and especially Professor Wilson (see Blackwood's Magazine, December 1819), ultimately demonstrated the imposition, much to the reputation of the real author.

Invited by Cromek to seek a higher sphere of fortune, he went to London in 1810. After a short period of employment with the sculptor Bubb, he devoted himself to newspaper reporting. This confining labour affected his health, and he was ultimately fortunate enough to obtain an engagement in Chantrey's studio. He became secretary or clerk of the works; and in this situation he continued till his death. Chantrey's gratitude to Cunningham's long and valuable services was displayed in his will. In this congenial position of comfort and independence, he enjoyed opportunities for the employment of his active pen, and for intercourse with men of kindred genius. His warm heart, his honest, energetic, upright, and earnest character, attracted the affectionate esteem and respect of all who enjoyed his acquaintance. He died at London in 1842.

Cunningham's poetry consists of songs, ballads, and kindred short pieces; a species of Epic, in Spenserian stanzas, "The Maid of Elvar," illustrative of Dumfriesshire scenery and society a few centuries ago; and "Sir Marmaduke Maxwell," a wild tumultuous collection of border superstition. His prose works include three novels, "Paul Jones," "Sir Michael Scott," and "Lord Roldan;" "Life of Burns," "Traditional Tales," "Lives of eminent British painters, sculptors, and architects," in Murray's Family Library; and he died in the act of finishing a "Life of Sir D. Wilkie." A very genial work of Cunningham is his "Songs of Scotland." He left, says his son, "some thirty volumes of works, and ample materials for perhaps ten more."

Cunningham's smaller poems are airy, natural, and intensely Scotch; vigorous, and even splendid in their higher moods, affectingly pathetic in their softer strains. His poetic wing was not formed, as the "Maid of Elvar" proves, for a long continued flight; the poem is weighed heavily down by its stanza and prolixity of description. Many of his "Tales" are pleasing, with a strong border relish about them, but their features are often strained and violent. The same criticism is applicable to his novels, which are piles of glittering description, and exaggerated and unnatural characters, sufficient to furnish forth ornament for fifty fictions, and wonder for whole generations of boyhood. His judgment did not control the fervour of his genius, or corroborate the slenderness of his knowledge in the delineation of character, and the architecture of scenic combination. His critical power in the fine arts is directed in a great measure by his poetic faculty, and his reader feels that though he peruses a pleasing writer, he is undirected by an authoritative judge; nay, that his decision in the severer technicalities of art and literature is the reflex of opinion derived from external sources. The cast of Cunningham's education and business in life necessarily prevented his learning on the subjects on which he writes from being minute and comprehensive. Hence he is too much inclined to generalize from isolated facts in history, and his conclusions are often felt to be wrought from too slender a thread of premises. But Cunningham is an eloquent and honest writer; and in the diffuse and brilliant stream of his style the reader forgets defects which are inexcusable only in the highest genius with the most unfettered opportunities.

Cunocephali ‖ Cupar-Fife.

CUNOCEPHALI, or CYNOCEPHALI (κύων, dog, and κεφαλή, head), in *Egyptian Mythology*, a kind of baboons, or animals with heads like those of dogs, which were supposed to be wonderfully endowed, and were preserved with great veneration by the Egyptians in many of their temples. It is related that by their assistance the Egyptians found out the particular periods of the sun and moon; that one-half of the animal was often buried, whilst the other half survived; and that they could both read and write. This strange fable is supposed by Bryant to relate to the priests of Egypt, to the novices in their temples, and to the examinations which they were obliged to undergo before they could be admitted to the priesthood. The death of one part whilst the other survived, is understood to have denoted the regular succession of the Egyptian priesthood. *Cynocephali* are also found in India and some other parts of the world. See ANUBIS.

CUPAR-ANGUS, a burgh of barony of Scotland, partly in the county of Perth and partly in that of Forfar. It stands on the Isla, a small tributary of the Tay, about 13 miles N.E. from Perth, and 61 miles by railway from Edinburgh. The town is well-built, and, in addition to the parish church, contains chapels for the Free Church, United Presbyterians, Episcopalians, Original Seceders, and Independents. Its trade consists in the weaving and bleaching of linen, and the tanning of leather. In ancient times it was famous for a Cistercian abbey, founded on the site of a Roman camp by Malcolm IV. in 1164. This building, however, was destroyed at the Reformation, and only a few ruins now remain. Pop. (1851) 2004.

CUPAR-FIFE, a royal and parliamentary burgh, and the county-town of Fifeshire. It stands in the centre of the *Howe* of Fifeshire, about 6 miles from the sea, and by railway and ferry is about 32 miles distant from Edinburgh. It consists principally of one long street, extending from east to west, and intersected by a cross street leading north and south. The town and county halls are the principal public structures; and besides two Established churches there are chapels belonging to the Free Church, the United Presbyterians, and the Episcopalians. There is also a large academy formed by the incorporation of an old joint-stock academy with a modern one on Dr Bell's foundation. The principal trade of the burgh is connected with its weekly corn-markets, and with the manufacture of coarse linen goods, snuff, leather, candles, bricks, and earthenware. For such branches of industry its clay-fields and water-power present considerable facilities. It is governed by a

provost and 17 councillors; and unites with St Andrews, Crail, Anstruther, Kilrenny, and Pittenweem, in sending one member to the imperial parliament. On a mount called the Castlehill, at the east of the town, stood the fortress of the Macduffs, the feudal earls or thanes of Fife. The estate of Sir David Lindsay of the Mount was within a short distance of Cupar; and on a green esplanade in front of Macduff Castle, still called the "Play-field," the satirical drama of the "Three Estates" is said to have been performed. From the press of Mr Tullis in Cupar appeared the editions of Virgil, Horace, &c., edited by Dr Hunter of St Andrews. Pop. (1851) of royal burgh 4005; of parliamentary burgh 5686.

CUPEL (Lat. *cupella*, a little tub or vessel), a small earthen cup-shaped vessel used in the refining of metals. It is usually made of phosphate of lime, or the residue of burnt bones, rammed into a mould. In the process of assaying the precious metals, the silver or gold is fused upon a cupel with lead, when the lead becomes oxidated and vitrified, and is absorbed by the substance of the cupel, while the silver or gold remains in a state of purity. This process is called *cupellation*. See ASSAYING, vol. iii., p. 770.

CUPID, the god of love, or love personified, called EROS by the Greeks, and by the Romans AMOR or CUPIDO. There were three divinities, or rather three forms of the same deity, with this appellation. The first Eros is described by Hesiod as the fairest among the gods. The second, who may be regarded as almost identical with the first, is the Eros of the philosophers and mysteries, by whom, as the uniting power of love, the discordant elements of chaos were brought into harmonious order. The third is the Eros of the epigrammatists and erotic poets. This deity is represented as the youngest of all the gods, and gave rise to that notion of the deity most familiar to the moderns. He is called the son of Venus; and his father is either Mars, Jupiter, or Mercury. Originally this god was represented as a youth of beautiful aspect; and it was only posterior to the time of Alexander the Great that he came to be depicted by the poets as a wanton and mischievous boy, from whose pranks neither gods nor men were secure. In this form he presided over love, as the symbol of reproduction; and in token of his power over every variety of animated nature he is represented in the designs of classic art as riding on the backs of lions and other wild beasts which he has tamed, sporting with the monsters of the deep, stealing the arms of Hercules, and even breaking the thunderbolts of the father of gods and men. One of the earliest and most pleasing descriptions of Eros in the form under which he is most familiar to the moderns is to be found in the *Ode to Cupid*, attributed to Anacreon. Until about the time when this ode was written, the intercourse of the sexes had been characterized much more by passion than by sentiment, and the writer of the Anacreontic Odes, whoever he may have been, was one of the first to introduce those little tendernesses which constitute the spiritual part of the affection, and to give a new and higher conception of the idea of Cupid. From the ode in question is borrowed the popular notion of the appearance of the god, as a winged child, sometimes blindfold, and bearing a bow and a quiver filled with arrows. Praxiteles, however, one of the most illustrious of all the Greek sculptors, designed as his *beau idéal* of Cupid a full-grown youth of the most perfect symmetry of form and faultless beauty of feature. For an account of the beautiful legend of Cupid and Psyche, see PSYCHE. Intimately associated with Eros was Anteros, originally an antagonistic being to the god of love, but afterwards the avenging deity of unrequited affection.

Cupid was worshipped with especial solemnity at Thespiæ in Bœotia, at Samos, Sparta, Athens, and Megara; in some of which cities his festivals, known as Erotia or Erotidia, were celebrated every five years.

CUPOLA (Italian), a spherical or spheroidal vault, in form of an inverted bowl, on the top of an edifice. See glossary to ARCHITECTURE.

CUPPING, in *Surgery*, the operation of applying the cucurbita or cupping-glass. The flame of a spirit lamp having been introduced momentarily into the glass in order to expel the greater portion of the air by dilatation, the glass is to be immediately applied to the skin; when, in consequence of the partial vacuum produced by the cooling and contraction of the included air, the part of the body operated upon will be drawn up forcibly into the glass, and on its removal will exhibit a red and swollen appearance in consequence of the propulsion of blood into the small vessels. This operation is termed *dry cupping*. When it is desired to extract blood, an instrument called a *scarificator* is employed to make incisions in the part so operated upon; after which, when the glass is applied to the part as before, a considerable quantity of blood may be drawn off at once. The scarificator consists of ten or twelve lancets so adjusted within a case, that, by means of a spring and trigger, the whole are discharged and withdrawn with instantaneous quickness through slits in the plane surface of the case, and thus make a series of regular incisions in the part to which the instrument is applied. Cupping, when skilfully performed, is not a very painful operation.

CUPREOUS (Lat. *cuprum*, copper), consisting of or resembling copper, or partaking of its qualities.

CUPRESSUS, a genus of *Coniferæ*, containing the different species of cypress. See BOTANY.

CURAÇOA, or CURAÇAO, an island in the Caribbean Sea, lying off the N. coast of Venezuela, in Lat. 12. N., Long. 69. W. It is 40 miles in length from N.W. to S.E., and 10 in average breadth. The island is hilly and deficient in water, being wholly dependent upon the rains; yet considerable quantities of sugar, indigo, tobacco, and maize are raised. The shores, which are bold, are in some places deeply indented and present several harbours, the chief of which is Santa Anna, on the S.W. side of the island. The entrance, which is narrow, is protected by Fort Amsterdam and other batteries; but the harbour itself is large and secure, and is the port of the chief town Curaçoa or Wilhelmstadt. Pop. (1847) 15,164, of whom 9728 were slaves. The island was settled by the Spaniards about 1527, and was captured by the Dutch in 1634. It was taken by the English in 1798 and again in 1806; but was restored in 1814 to the Dutch, in whose possession it has since remained.

CURATE (from Lat. *curare*, to take care of), properly, an incumbent who has a cure of souls; in which general sense it is frequently used in the rubrics of the English Prayer-book, and applied to any clergyman lawfully appointed to a parish, whether he be rector, vicar, or perpetual curate. But the term is now almost exclusively used to signify the spiritual assistant of a rector or a vicar in his cure. Curates form the lowest order of the clergy, and are divided into two classes—perpetual and stipendiary. Perpetual curates are such as are appointed to the church of a parish in which the tithes are impropriated, and no vicarage is endowed. These are not removable, and the impropriators are obliged to find them. In some cases a certain portion of the tithes is settled on them. A stipendiary curate, having no fixed estate in his curacy, may be removed at pleasure by the bishop or the incumbent.

CURATOR (Latin), in a general sense, one who superintends or takes charge of a thing; an overseer, a keeper.

Among the Romans it was used more particularly to denote a guardian or a trustee, as of a minor, an imbecile, an absent person, &c. In a cognate sense also it was applied under the emperors to various public functionaries, of whom the most important were the following:—

Curatores Alvei Tiberis, those who had charge of the navigation of the Tiber.

Curatores Annonæ, those who regulated the price of corn and oil, and distributed them among the poor.

Curatores Aquarum, those who had the superintendence of the aqueducts.

Curatores Kalendarii, those who had the charge of the books in which the sums of money belonging to their respective municipia, lent out at interest, were entered.

Curatores Ludorum, the superintendents of the public games; usually called in inscriptions *curatores muneris gladiatorii*, &c.

Curatores Operum Publicorum, the inspectors of the public buildings.

Curatores Regionum, those to whose care were committed the fourteen districts of the city, for the prevention of disorder and extortion.

Curatores Reipublicæ, or *Logistæ*, the administrators of the landed property in their respective municipia.

Curatores Viarum, the superintendents of the public ways; a title frequently assumed by the emperors themselves.

Curator *of a University*, in the United Provinces, or Holland, an officer elected to superintend the affairs of the institution, the administration of its revenues, the conduct of the professors, &c. In learned institutions generally, the officer who has charge of libraries, museums, &c., is frequently styled *curator*.

CURB (Fr. *courbe*, from Lat. *curvo*), in a general sense, restraint. Hence it is applied to a small iron chain attached to a horse's bridle, for the purpose of giving greater efficiency to the bit.

It also denotes a tumour on the back part of the hock of a horse, attended with stiffness, and sometimes pain and lameness.

CURCAS, a name given in Egypt to an esculent root, approaching in taste and virtues to the colocasia. This is also a name given in Malabar to a small fruit of the shape and size of a hazel nut. It is very probable that the curcas of the East Indies may be the fruit called *bell* by Avicenna, and said to possess the same virtues. Gracias has been led into an error by this similarity of names and virtues, and supposes the curcas of Egypt to be the same with that of the East Indies.

CURCUMA, a genus of the natural order of *scitamineous* plants, to which zedoary, turmeric, and other useful vegetables belong.

CURD, the coagulated or thickened part of milk, which by pressure is converted into cheese. See Dairy.

CURES, in *Ancient Geography*, an old town of Sabinum, not far from the left bank of the Tiber, about 25 miles from Rome. It was renowned in early Roman history as the birth-place of Tatius the colleague of Romulus, and of Numa the second king of Rome. It was from the name of this town also that the term *Quirites*, the distinguishing epithet of the Roman people in later days, was believed by the ancients themselves to be derived. If it be true, as Strabo asserts, that Cures was at one time a large and flourishing city, it very early fell into decay. About 100 years B.C. it was colonized by Sulla, and continued to prosper till about the fourth century of the Christian era. It was finally destroyed by the Lombards before the end of the sixth century. Remains of the city and traces of its site have been discovered at a place occupied by the modern village of Correse, which word is evidently a corruption of the ancient Cures.

CURETES, Κουρῆτες, in *Antiquity*, priests or people of the island of Crete, identified by some with the *Corybantes*. The history of the Curetes is involved in very great obscurity. They are said to have been originally inhabitants of Mount Ida in Phrygia, and hence were also called *Idæi Dactyli*. Lucian and Diodorus represent the Curetes as very expert in throwing the javelin, while other authors assign them no weapons except the pike and buckler; but all are agreed respecting their use of drums and cymbals, to the noise and clashing of which instruments they exercised themselves in dancing of the wildest and most extravagant description. It is related that with this noise they prevented Saturn from hearing the cries of the infant Jupiter, and thus preserved the child's life. Some authors, however, give a different account of the Curetes. According to Pezron and others, the Curetes were, in the times of Saturn, and in the countries of Crete and Phrygia, what the Druids were afterwards among the Gauls and Britons; namely, priests who had the care of all that related to religion and the worship of the gods. Hence, as in those days it was supposed that there was no communication with the gods but by means of divinations, auguries, and the operations of magic, the Curetes passed for magicians and enchanters; and to these accomplishments they added the study of the stars, of nature, and of poetry. In short, they were philosophers, astronomers, and poets. Vossius (*De Idolat.*) distinguishes three kinds of Curetes; those of Ætolia, those of Phrygia, and those of Crete, who were originally derived from the Phrygians. The first, he says, took their name from κουρά, *tonsure*, because from the time of a combat in which the enemy had seized them by their long hair they always kept it short. But those of Phrygia and Crete, he supposes, were so called from κοῦρος, *young man*, because they were young, or because they had taken charge of the infant Jupiter. See Cabiri, Corybantes, Crete, Dactyli, &c.

CURFEU, Curfew, or *Couvre-feu*, a signal, as by tolling a bell, to warn the inhabitants of a town to extinguish their fires and lights and retire to rest. This was a common practice during the middle ages, especially in cities taken in war. In the law Latin of those times it was termed *ignitegium*, or *pyritegium*.

The curfew is commonly said to have been introduced into England by William the Conqueror, who ordained, under severe penalties, that at the ringing of the curfew-bell at eight o'clock in the evening all lights and fires should be extinguished. It seems probable, however, that he merely enforced an existing and very common police regulation to that effect. The curfew-bell was abolished by Henry I. in 1100. The practice of tolling a bell at a fixed hour in the evening, still extant in many places, is a remnant of the ancient curfew.

As a precaution against conflagrations, the curfew was a most useful regulation, at a period when it was the custom to place the fire in a hole in the middle of the floor, under an opening in the roof to allow the escape of the smoke. When a family retired to rest for the night, the fire was extinguished by covering it up; and hence the term *couvre-feu*, or *curfew*. But this salutary regulation served another important end, since by obliging people to keep within doors, nocturnal brawls in the streets were in a great measure prevented. The severity exhibited by William the Conqueror in enforcing obedience to the curfew, appears to have been more particularly designed to prevent the English from assembling in secret to plan schemes of rebellion against himself.

The ringing of the *prayer-bell*, as it is called, which is still practised in some Protestant countries, originated in that of the curfew-bell. Pope John XXXIII. dreading that misfortunes were about to befall him, ordered every person on hearing the *ignitegium* to repeat the *Ave Maria* three times, with a view to avert them. When the appearance of a comet, and a dread of the Turks, alarmed all Christendom, Pope Calixtus VIII. increased these periodical times of prayer, by ordering the prayer-bell to be also rung at the hour of noon.

CURIA, one of the thirty sections into which the Roman people were distributed by Romulus. That legislator di-

Curiatii ‖ Curling.

vided the people into three tribes, and each tribe into ten curiæ. Originally, a tribe consisted of 1000 men, each curia including 100. The number of tribes was afterwards increased by degrees to thirty-five, and they were divided into country and city tribes; but the number of the curiæ always remained the same. This division of the people into tribes and curiæ was of great political importance in early times, as none but real citizens were included; but through time the curiæ fell into disrepute in proportion as the importance of the plebeians, and afterwards of the nobilitas, arose, till at length even the religious observances connected with them were suffered to fall into disuse. See ROMAN HISTORY.

CURIA was also used to denote the place in which a curia assembled. Each curia possessed its own proper chapel or temple for the performance of the offices of religion; and each was under the superintendence of a chief, who acted as a priest, assisted by another called flamen curialis. Each curia elected its own chief; but over all there was a superior called curio maximus, who was elected by the several curiæ assembled in the comitia curiata.

The Romans also used the word curia to designate the place in which the senate held its meetings, such as the Curia Hostilia, Curia Julia, Curia Pompeiana, Curia Octaviæ; and hence the term came to be applied to the senate itself in the Italian towns.

In modern usage, curia denotes a place of justice with the judges therein assembled.

CURIATII. See HORATII, and ROMAN HISTORY.

CURIO, the chief and priest of a curia. See CURIA.

CURIOSI, officers of the Roman empire during the lower age, employed in the capacity of secret spies or police, to prevent frauds or irregularities, and to give intelligence to the court of what passed in the provinces.

CURISCHES-HAFF. See PRUSSIA.

CURLEW. See index to ORNITHOLOGY.

CURLING (Teutonic *krullen*), a favourite Scottish diversion practised on the ice, in which the contending parties slide large stones (flattened for the purpose, and furnished with handles) towards a tee or mark. It thus bears some resemblance to bowling on a green.

Curling appears to have been first known in Scotland about the commencement of the sixteenth century, and was probably introduced by the immigrant Flemings. Of this game Sir David Brewster has given the following account:—

"The stones employed in it are of a spherical form, flattened above and below, so that their breadth may be nearly equal to twice their thickness. The upper and under surfaces are made parallel to one another, and the angles of both are rounded off. The under surface, or sole as it is called, is polished as nicely as possible, that the stone may move easily along. The blocks from which they are made are of whinstone or granite of a close texture, free from cracks, and capable of taking a fine polish. Those whinstone nodules, called "Yolks," on account of their toughness, and never breaking into large fragments, are reckoned the best. They have bent iron or wooden handles, and are from 30 to 60 lb. of avoirdupois weight, according to the strength of the person who uses them.

"The place where the stones move is called the *Rink*, the chief property of which is, that the ice be level, smooth, and free from cracks, particularly such as are in a longitudinal or oblique direction. A mark or hole is then made at each end, called a *Tee*, *Toesee*, or *Witter*. Round this two circles of different diameters are drawn, that the relative distances of the stones from it may be calculated at sight; as actual measurement is not permitted till the playing at each end be finished. These circles, in the technical language of the game, are called the *Broughs*. A score drawn across the rink at each end, distant from the *tee* about a sixth part of the length of the rink, is called the *Hogscore*. The length of the rink, from tee to tee, varies from 30 to 50 yards. The breadth is about 10 or 12 feet. When the ice is covered with snow, it must be cleared to that extent, and also 10 or 12 feet beyond the tee at each end, that the stones, when impelled with too much force, may have room to get far enough not to be of any use.

"The number of players upon a rink is eight or sixteen; eight when the players use two stones each, and sixteen when they use one stone each. There may be one or more rinks, according to the number of curlers. The game may also be conducted by one person against another, by two against two, or three against three, each using one or more stones, as it may be agreed upon.

"He who is reckoned the best curler has generally the power of arranging the order of the players; and whoever is last in order gives directions to all the rest of his party. He is called the *Driver*, and the first the *Lead*.

"The game at first is remarkably simple. The lead endeavours to lay his stone as near the tee as possible. If it be a little short of it, upon the middle of the rink, it is reckoned to be fully better laid than if it touched it. The object of the next in order is nearly the same as that of the lead. The next attempts to guard the stone of his partner, if it be near the tee, or to strike off that of his antagonist if it be nearer. The one who follows, if a stone belonging to his own party lie nearest the tee, tries to guard it; if one of the opposite party, to strike it off; or if no stone be near the tee, to draw a shot, that is, to make his stone rest as near the tee as he can.

"As the game advances, it becomes always the more intricate. Sometimes the stone nearest the tee, which is called the winner, is so guarded, that there is no possibility of getting at it directly. It then becomes necessary, in order to get it removed, to strike another lying at the side in an oblique direction. This is called *Wicking*, and is one of the nicest parts of the game. But when the winner cannot be reached even in this way, the last in order but one or two must endeavour to remove the opposing stones by striking them with great force. Sometimes the stones are so situated, that the driver, to avoid the risk of losing any shots which his party may have gained, throws away his stone without attempting anything. When the stones on both sides have been all played, the one nearest the tee counts one; and if the second, third, fourth, &c. belong to the same side, all these count so many shots, thirty-one of which for each side is the number usually played for."

Curmi ‖ Curran.

CURMI (κοῦρμι), in *Antiquity*, a sort of malt liquor or ale made of barley, and which, according to Dioscorides, was used by many nations instead of wine. That writer also relates that in the western part of Iberia, and in Britain, a similar beverage was in his time prepared from wheat.

CURRAH, a district of Hindustan, province of Allahabad. It has a fertile soil, which, when well watered, yields all kinds of grain, also sugar-cane, cotton, tobacco, and a species of earth impregnated with alkali, which is used as soap. The capital, of the same name, is situated on the S.W. bank of the Ganges, and extends above a mile along the bank of the river, and about half-a-mile inland. On the banks of the Ganges, and in the middle of the town, stands an old fort, in the vicinity of which there are several Hindu temples. The governor of the province formerly resided at Currah; but on his removal by the Emperor Acbar, the town fell into decay. Its decline was greatly accelerated towards the close of the last century by the vizier of Oude, who ordered several of the most elegant buildings to be destroyed for the sake of the freestone of which they were built, to furnish materials for his new buildings at Lucknow. It is 45 miles N.W. from Allahabad. E. Long. 81. 28.; N. Lat. 25. 41. (E. T.)

CURRAN, JOHN PHILPOT, a celebrated Irish barrister

Currant. and orator, was born at Newmarket, near Cork, in 1750 He received his education at Trinity College, Dublin, after which he went to London, and studied at one of the inns of court. In due time he was called to the bar; and shortly afterwards married Miss O'Dell, an Irish lady of a very respectable family. His talents soon rendered him conspicuous; and during the Duke of Portland's administration he received the silk gown. In 1784 he was chosen a member of the Irish House of Commons, where his abilities were advantageously employed; and he gradually rose to be the most popular advocate of his time in Ireland. The distracted state of Ireland towards the close of the last century gave frequent opportunities for the display of Curran's forensic powers; and he was often called upon to defend persons accused of political offences. Mr Fitzgibbon, afterwards Lord Clare, at that period attorney-general, was his opponent; and from being brought frequently into collision with each other, their professional rivalry at last degenerated into personal animosity, which was finally consummated in a bloodless duel. On a change of ministry, during the vice-royalty of the Duke of Bedford, the patriotism of Curran was rewarded with the situation of master of the rolls. This situation he held till 1814, when he resigned it, and obtained a compensation of L.3000 a-year. With this he retired to England, and resided chiefly in the neighbourhood of London till his death, which took place at Brompton, Nov. 13, 1817.

Curran's talents were of a very high order. His wit, drollery, and pathos were alike remarkable. If the expression may be used, the character of his eloquence was peculiarly Irish. It was replete with bold and striking metaphor, and went more to interest the feelings by its irresistible appeals, than to convince the judgment by its closely reasoned deductions. It was the language of fearless and impassioned genius. And this was just the kind of eloquence that was wanted in the cases upon which he was employed, and among the people before whom he pleaded. If it be the test of supreme genius to produce strong emotions, some of Curran's speeches may be placed amongst the noblest efforts of forensic skill which modern times can boast of. Even after the lapse of half a century, when the circumstances which called them forth have begun to fade into dimness and distance, they cannot be perused without rousing the feelings to the highest pitch. Curran's convivial powers were of the highest order, and his conversation was often highly fascinating. In his domestic relations he was very unfortunate; and it seems that he laid himself open to censure. He does not appear to have committed anything to press; but some poetical effusions published in his memoirs possess considerable merit. In 1805 there appeared an unauthorized collection of his forensic speeches; and since that time several selections from these have been published. Memoirs of his life have been published by his son, Mr Charles Phillips, and Mr O'Regan.

CURRANT (from *Corinth*), a small species of grape. It is found in greatest perfection along the shores of the Corinthian Gulf, in Cephalonia, Ithaca, and in Zante, in which island its cultivation engrosses nearly two-thirds of the cultivated land. The plant is delicate, and takes six or seven years to arrive at perfection. When the flower is out, it gives a singular richness and beauty to the landscape. The currant succeeds best on plains near the sea, or on the lower slopes of mountains, in a dry and light soil; but the crop is particularly liable to injury from rain in harvest. After being dried in the sun, the currants are packed in large butts for exportation, the greater proportion being sent to the western parts of Europe, especially to Britain.

The quantity imported in 1853 amounted only to 267,282 cwts., owing to a failure in the crop; whereas in 1850 it amounted to 429,607 cwts., and in 1851 to 721,119 cwts.

Previous to 1834 the duty on currants was as high as 44s. 4d. a cwt. In that year it was reduced one-half, and in 1844 it was further reduced to 15s. per cwt. Currency || Currie.

The name is also given to a small fruit, well known in our gardens as the produce of two species of *Ribes—R. rubrum*, and *R. nigrum*.

CURRENCY. See MONEY.

CURRENT (Lat. *currens*, from *curro*, to run, to flow), literally signifies running, flowing, passing. Hence, passing from person to person, or from hand to hand; circulating; as current opinions, current coin. In commerce it is applied in an analogous sense to the price of any commodity; as current value—that is, the ordinary or present value. As applied to time it is equivalent to now present or passing; as the current month or year.

CURRENTS, OCEAN. See PHYSICAL GEOGRAPHY, section vi.

CURRICLE (Lat. *curriculum*, a chariot), a carriage with two wheels, drawn by two horses abreast, and supported by a pole connected with a bar across the horses' backs.

CURRICULUM, a Latin word signifying a race-ground, a course, a chariot, in its modern acceptation denotes the whole course of study in a school or university.

CURRIE, JAMES, M.D., was born May 31, 1756, at Kirkpatrick-Fleming, near Moffat, Dumfriesshire, where his father was minister of the parish. He was the only son in a family of seven children, and by his mother's side was descended from the ancient family of Kilmarnock.

He began his education at the parish school of Middlebie, to the living of which his father had been preferred; and was afterwards sent to a seminary at Dumfries, then conducted by Dr Chapman, the author of a work on education.

During a visit to some friends in Glasgow, the spectacle of its commercial activity captivated the adventurous spirit of young Currie; and abandoning his original intention of qualifying himself for the medical profession, he was induced, with the concurrence of his father, to engage in the service of a company of merchants who were going out on a speculation to Virginia. The hopes of the speculators were disappointed by the breaking out of hostilities between America and England; and Currie, in addition to their harsh and ungenerous treatment, had to struggle with a long and dangerous illness which seized him soon after his arrival. The death of his father, at the same time, added to the complicated difficulties of his situation; but his misfortunes did not prevent him from generously dividing among his sisters the scanty inheritance which had fallen to his share. Renouncing the pursuits of commerce, with which he had been completely sickened, he turned his attention to the political topics which were then the universal subject of interest in America; and published a series of letters in defence of the English government in an American newspaper, under the signature of "An old Man." These juvenile essays procured him considerable reputation among his friends; but the hostility which they provoked from the adverse party led him to abandon the unpromising pursuit of literature and politics for the more hopeful study of medicine.

To carry his resolution into effect he quitted America; and as the war had by this time precluded all direct communication with England, he proceeded thither by way of the West Indies. After a voyage of great hardship and danger, he at length arrived at London in 1776. From thence he immediately repaired to Edinburgh, and began his academic studies, which he prosecuted with remarkable assiduity and success till the spring of 1780. He soon became conspicuous among the students by the extent of his acquirements, and by the singular acuteness of his mind; and, in particular, he distinguished himself as a member of the Medical Society. The papers which, according to custom,

Currie. he contributed, bear the stamp of superior talent, and are curious, as furnishing proofs that, even at this early period, his attention had been actively directed to subjects which he afterwards illustrated by important practical discoveries.

During the prosecution of his studies, however, he was incessantly weighed down by a sense of his dependence on his aunt and sisters, which prompted him to grasp at the first opportunity of securing a comfortable maintenance. With this view he was on the eve of accepting the humble appointment of surgeon's mate in the regiment of General Sir William Erskine, when a more lucrative office presented itself abroad in the service of the British army in Jamaica. To qualify himself as a candidate for this latter appointment he hastily graduated at Glasgow, but on arriving at London he had the mortification to find it already bestowed on a young Irish physician of considerable merit. Disappointed in this quarter, Dr Currie still cherished the hope of pushing his fortunes abroad, and had taken passage in a merchant vessel bound for Jamaica, when, during the detention of the ship at London, he was induced to abandon the project and settle at Liverpool. Here, in a congenial sphere, he quickly formed a large circle of acquaintance, was elected one of the physicians to the infirmary, and rose to the highest eminence in his profession. His domestic happiness was at the same time secured by his marriage in 1783 with Miss Lucy Wallace, a lineal descendant of the Scottish patriot of that name, and daughter of a respectable merchant in Liverpool. Nor amidst the harassing duties of his profession did he allow his literary tastes to remain uncultivated. Along with Roscoe and several other gentlemen he founded a literary club, which long retained its reputation, and was the precursor of those splendid establishments of a similar kind in that town.

His career thus auspiciously begun was, however, greatly retarded by ill health. His assiduous and anxious attendance on Dr Bell, an intimate friend of his who had settled in Manchester, and who had been seized with a fatal disorder, together with the frequent journeys which he was in consequence under the necessity of taking, in the midst of winter, frequently at night, in addition to his other professional labours, and a violent peripneumony brought on by the fatigues encountered in his assiduous attendance on Dr Bell, placed his life for some time in imminent danger. This was followed by a train of pulmonary symptoms, which at length necessitated his removal to Bristol, where, shortly after his arrival, he experienced the shock of witnessing the death of one of his sisters from the same fatal disorder. From Bristol he soon after removed to Matlock, Derbyshire; and thence, in hopes of bidding adieu to his only surviving sister, who was hastening rapidly to the grave, he set out for Scotland. On the journey his health began to improve; and when he reached Dumfriesshire his strength was so far recruited as to allow of his sitting on horseback for an hour together. But the hope which had prompted his revisiting his native land was cruelly disappointed; for, on the day on which he reached the end of his journey, the remains of his sister had been committed to the grave. Under careful treatment the progress of his own disease was arrested, and he was at length able to return on horseback to Lancashire, by the lakes of Cumberland, arriving at Liverpool Sept. 1 (1792), having rode the last day of his journey 40 miles. An interesting narrative of his case, and the means employed for his recovery, was drawn up by himself, and is given by Dr Darwin in the second volume of his *Zoonomia*.

On his return, his esteem for Dr Bell led him to undertake a translation of an inaugural dissertation "*De Physiologia Plantarum*," delivered by his friend before the *Literary and Philosophical Society of Manchester*; to which he added valuable notes, and prefixed a memoir of the author's life. These were published by the society in the second volume of their Transactions. The biographical sketch which he has there given, and which was the first acknowledged production of his pen, is executed with a bold and masterly hand, and evinces a profound knowledge of the human heart—the failings as well as the merits of his friend being traced with a delicate yet faithful pencil. Currie.

On being elected a member of the London Medical Society in 1790, he communicated to it an essay on *Tetanus and Convulsive Disorders*, which was published in the third volume of its Transactions. In 1791 he presented to the Royal Society a paper containing *An account of the remarkable effects of a shipwreck on the mariners; with experiments and observations on the influence of immersion in fresh and salt water, hot and cold, on the powers of the living body*, which appeared in the *Philosophical Transactions* of the same year; and soon afterwards he was elected a fellow of the Royal Society. The inquiries which form the subject of this memoir were but a part of a long series of investigations in which he had been engaged even when a student at the university, and which he continued to prosecute in the genuine spirit of the inductive philosophy. The more mature results of his experience and reflections were given to the world in 1797, under the title of *Medical Reports on the effects of water, cold and warm, as a remedy in Fever and other Diseases, whether applied to the surface of the body or used internally*; a work by which his reputation as a physician was widely extended, and which has effected a considerable revolution in the mode of treating febrile disorders. The limits of the present article will not admit of our entering into any exposition of the contents of this valuable work, the fruit of so much experience and profound reflection. It may be sufficient to observe that the healing art is eminently indebted to Dr Currie, for establishing on solid grounds the salutary agency of cold applied to the surface of the body, under certain circumstances, and in certain modes, both in fevers and in many convulsive diseases. Although this mode of treatment had already been suggested, and even tried, by Dr Wright, it was reserved for Dr Currie to determine the circumstances which render its employment safe and salutary, and to point out the nature of its operation, on clear and rational principles.

We have already seen the interest he took in the party discussions which agitated the public in America at the commencement of its alienation from England. He did not again obtrude his sentiments on the public till the occurrence of the "No Popery" riots in St George's Fields, excited by Lord George Gordon. On this occasion he wrote three letters on the subject in the Public Advertiser, under the signature of Caius; and these were afterwards republished in a collection of political tracts. These, as well as his writings in America, show that his earlier views of politics were in favour of those Conservative principles to which his education had given him an early bias. But in proportion as his judgment acquired strength and maturity, his solicitude for preserving the authority of those intrusted with power gave place to a deeper feeling of anxiety for the interests of the community at large, on whom that power is exercised; and which appeared to him, from the prejudices and passions excited during the American war, to be exposed to much greater danger. These sentiments were strongly expressed in his *Letter, Commercial and Political, addressed to the Right Honourable William Pitt*, which he published under the assumed name of *Jasper Wilson*. The mass of important information contained in this pamphlet, the enlarged and profound views of political economy which it presented, and the nervous and manly strain of eloquence in which they were enforced, attracted much attention; it was read with avidity, and quickly went through several editions. Although unacknowledged by himself, the name

Currier ‖ Currying.

of its real author could not long remain concealed; and the reputation which accrued to Dr Currie from this publication, in a limited circle of enlightened men, was gained at the expense of much odium, which it entailed upon him from the opposite and more numerous party. But Dr Currie bore all the violence and malignity of their attacks with perfect evenness of temper, and abstained from gratifying his enemies by engaging in a controversy which he knew could add but little to the force of what he had already published.

During his excursion into Scotland in 1792 he had become personally acquainted with Robert Burns, and deeply fascinated by the social powers of that brilliant and extraordinary genius. The family of the poet having been left nearly destitute at his death, a subscription was set on foot in Scotland for their relief, and Dr Currie was requested to edit a complete edition of his works for their exclusive benefit. Accordingly, in 1800, appeared, in four vols. 8vo, his edition of *The Works of Robert Burns, with an Account of his Life, and Criticisms on his Writings; to which are prefixed some Observations on the Character and Condition of the Scottish Peasantry.* It is sufficient to say that the preliminary observations from the pen of Dr Currie are marked with his usual felicity of manner, and exhibit the same sagacity of remark and liberality of sentiment which pervade all his writings; and that he had the satisfaction of securing by his labours a comfortable provision for the widow and children of the poet.

His constitution had never completely recovered from the shock of the severe illness which he had suffered in 1784. He was seldom long free from threatenings of a relapse; but it was not till the year 1804 that his health began evidently to decline. In the autumn of that year he retired from Liverpool, and spent the winter months alternately at Clifton and Bath. After practising for a short time in Bath, his returning illness compelled him to retire, as a last resource, to Sidmouth, where, after much suffering, he expired, Aug. 31, in the fiftieth year of his age. His disease was ascertained to be an enlargement and flaccidity of the heart, accompanied with a remarkable wasting of the left lung, without either tubercle or ulceration. Few men have possessed a more amiable or estimable character, or a more enlarged and cultivated mind, than Dr Currie. Most of the public institutions, literary and benevolent, of which Liverpool can boast, were suggested, improved, or perfected by his advice and assistance. His political views were guided always by a pure, and latterly by an enlightened patriotism. His professional labours and discoveries are such as entitle him to an elevated rank among medical philosophers; whilst the important improvement that has resulted from them in the healing art justifies us in enrolling his name amongst the distinguished benefactors of mankind.

CURRIER (Lat. *coriarius*), one who dresses and colours leather after it has been tanned. See CURRYING, and LEATHER.

CURRY-COMB, an iron instrument used for currying or rubbing down and cleaning horses.

CURRYING, the method of dressing skins after they have been tanned, to render them fit for the purposes of the shoemaker, coach and harness maker, &c. The skins, after coming from the tanner's yard, and having many fleshy fibres on them, are soaked by the currier for some time in water. He then stretches them on a smooth wooden horse, and with a paring knife scrapes off all superfluous matter. He then soaks them again. He next puts them wet on a hurdle, and treads or beats them with a mallet, in order to render them soft and pliant. He then applies grease, such as train or other oil; and afterwards spreads them on large tables, and fastens them at the ends. Then, with the help of an instrument called a *pommel* (which is a thick piece of wood, the under side of which is full of furrows crossing each other), he folds, squares, and moves them forwards and backwards several times, under the teeth of this instrument, which breaks their too great stiffness. This is what is properly called currying. The order and number of these operations is varied by different curriers, but the material part of them is always the same. After the skins are curried there may be occasion to colour them. The colours are black, white, red, yellow, and green: the other colours are given by the skinners, who differ from curriers in this, that they apply their colours on the flesh side, whereas the curriers do so on the hair side. In order to whiten skins, they are rubbed with lumps of chalk or white lead, and afterwards with pumice-stone. When a skin is to be made black, the currier, after having oiled and dried it, passes over it a brush dipped in a solution of sulphate of iron; and after his first wetting, he gives it another in water prepared with lamp-black, vinegar, and gum-arabic. These different dyes gradually turn the skin black, and the operations are repeated till it be of a shining black. The grain and wrinkles, which contribute to the suppleness of calves' and cows' leather, are made by the reiterated folds given to the skin in every direction, and by the care taken to scrape off all hard particles. See LEATHER.

Cursitor ‖ Curtius.

CURSITOR, a clerk of the court of chancery, whose business it is to make out original writs. The cursitors are twenty-four in number, and form a body corporate. They are also styled *clerici de cursu*, or clerks of the course.

CURSITOR BARON, an officer of the court of exchequer who administers the oaths to all high-sheriffs, under-sheriffs, bailiffs, and to several officers of the revenue.

CURTAIN (Fr. *courtine*), in *Fortification*, that part of the rampart which joins the flank of one bastion to that of another.

CURTESY, or COURTESY, otherwise CURTIALITY, is, by the law of Scotland, that right whereby the surviving husband of an heiress, if a living child which has been heard to cry have been born of the marriage, is entitled to the liferent of the whole heritable estate in which his wife dies infeft as heiress of her predecessor—conquest being excluded. The right depends exclusively upon the existence of issue—not upon the duration of the marriage. The wife's sasine measures the extent of the courtesy, and no service or renewing is required to complete the right of the husband, as he has only to continue possession of the estate. By marriage settlements, courtesy, like terce, is often excluded, and a simple liferent annuity substituted; and in that case a special resignation is necessary. As the right is conferred on the husband as father of the heir rather than as widower of the heiress, where there is a child of a former marriage, who is to succeed to the property of the mother, courtesy does not vest in the second husband during the child's lifetime. The husband, as his wife's temporary representative, is liable for not only all yearly real burdens, but even for current interest of personal bonds so far as *lucratus*.

The law of courtesy in England is substantially the same with that of Scotland.

CURTIUS, METTUS or METIUS, a Roman youth, who, in B.C. 362, devoted himself to death for the safety of his country. A wide chasm having suddenly opened in the Forum, the oracle declared that it never would close until Rome threw into it whatever she accounted her greatest treasure. Curtius immediately perceived that an armed citizen was the sacrifice required; and having armed himself and mounted his charger, he plunged into the abyss, on which the earth instantly closed over his head.

CURTIUS, *Rufus Quintus*, the celebrated biographer of Alexander the Great. Of his personal history nothing whatever is known with certainty, some fixing his epoch in the Augustan, others as far down as the mediæval age. It is, however, more probable that he flourished somewhere during the first three centuries of the Christian era. His

Curvature || Cusa.

work originally consisted of ten books, but the first two of these are entirely lost, and the remaining eight present considerable gaps. The supplements of Freinsheim are the most valuable; and the best modern editions of the text are those of Zumpt, Baumstark and Mützell.

CURVATURE OF A LINE, is the peculiar manner of its bending or flexure, by which it becomes a curve of such and such form and properties. Thus the nature of the curvature of a circle is such as that every point in the periphery is equally distant from a point within called the centre, and hence the curvature of the circle is everywhere the same: but the curvature in all other curves is continually varying.

CURVE, in *Geometry*, any line which is neither straight nor composed of straight lines; or, in other words, a line of which no three consecutive points are in the same straight line.

CURVE of *Equable Approach*. Leibnitz first proposed to find a curve down which a body descending by the force of gravity shall make equal approaches to the horizon in equal portions of time. This curve, as it has been found by Bernouilli and others, is the second cubical parabola placed with its vertex uppermost, and which the descending body must enter with a certain determinate velocity. The question was rendered general by Varignon for any law of gravity, by which a body may approach towards a given point by equal spaces in equal times. Maupertuis also resolved the problem in the case of a body descending in a medium the resistance of which is as the square of the velocity.

CURVES, *Algebraical* or *Geometrical*, are those in which the relation of the abscisses to the ordinates can be expressed by a common algebraic equation.

CURVES, *Transcendental* or *Mechanical*, are those which cannot be defined or expressed by an algebraic equation.

CURULE CHAIR, *Sella Curulis*, in Roman antiquity, the chair of state used by the chief magistrates. Those who were entitled to this honour were the dictator, the consuls, prætors, chief ædiles, and censors; as were also the flamen dialis, and those whom the dictator deputed to the under himself, as for instance the *magister equitum*. Under the empire, this mark of honour was extended also to some others. The appellation of *magistratus curules* distinguished those magistrates who were entitled to use the sella curulis from all the rest, who were called *non-curules*. When the curule magistrates proceeded to council, this chair was placed in a chariot (*currus*); from which circumstance it received its name. It appears to have been of various forms; but that generally used was a stool or seat without a back, covered with leather, and supported on four curved legs, each pair of which crossed each other somewhat in this manner X. It was likewise so constructed that it might be folded like a camp-stool, for the convenience of carriage. It appears that from the earliest times it was adorned with ivory; and hence Horace calls it *curule ebur*. Sometimes we find the epithet *alta* applied to it, because it was frequently placed on a tribunal, or as being the emblem of dignity; and also that of *regia*, because it was first used by the kings, who appear to have borrowed it, along with the other insignia of royalty, from the Etruscans. In later times it was overlaid with gold, and elaborately adorned.

CURZOLA (the ancient *Corcyra Nigra*), an island in the Adriatic, separated by a narrow strait from the peninsula of Sabioncello, and forming part of the circle of Ragusa in Dalmatia. It is about 25 miles in length from E. to W., with an average breadth of 4 miles. About three-fourths of its surface are covered with wood. Pop. about 6000.

CUSA, NICOLO DE, a learned cardinal, born in 1401, at Cusa, where his father was a fisherman. He was created cardinal in 1448; and having been appointed governor of Rome by Pope Pius II. during the absence of that pontiff at Mantua, Cusa became the chief author and manager of the war against Mohammed II. He founded a church, and a noble library of Greek and Latin authors, at Cusa; and left many excellent works, which were collected and published in three vols. at Basle in 1565. In these he boldly exposed the fabulous traditions and the sophistries of the Roman Church.

Cush || Cuspinian.

CUSH, the eldest son of Ham, from whom seems to have been derived the name of the *land* of Cush, which is commonly rendered by the Septuagint and by the Vulgate *Ethiopia*.

The locality of the land of Cush is a question upon which eminent authorities have been divided; for while Bochart maintained that it was exclusively in Arabia, Gesenius held with no less pertinacity that it is to be sought for nowhere but in Africa. Others again, such as Michaelis and Rosenmüller have supposed that the name Cush was applied to tracts of country both in Arabia and Africa—a circumstance which would easily be accounted for on the very probable supposition, that the descendants of the primitive Cushite tribes, who had settled in the former country, emigrated across the Red Sea to the latter region of the earth, carrying with them the name of Cush, their remote progenitor.

The existence of an *African* Cush cannot reasonably be questioned, though the term is employed in Scripture with great latitude, sometimes denoting an extensive but undefined country (Ethiopia), and at other times one particular kingdom (Meroe). It is expressly described by Ezekiel as lying to the south of Egypt beyond Syene. Hence we find Mizraim and Cush (*i. e.* Egypt and Ethiopia) often classed together by the prophets. The inhabitants are elsewhere spoken of in connection with the Lubim and Sukkiim, supposed to be the Libyans and Ethiopic Troglodytes, and certainly nations of Africa, for they belonged to the vast army with which Shishak king of Egypt "came out" of that country against Rehoboam king of Judah. In these, and, indeed, in most other passages where "Cush" occurs, Arabia is not to be thought of; the Ethiopia of Africa is beyond all doubt exclusively intended. Though there is a great lack of evidence to show that the name of Cush was ever applied to any part of Arabia, there seems no reason to doubt that a portion of the Cushite race did early settle there. In the fifth century of our era the Himaryites, in the south of Arabia, were styled by Syrian writers Cushæans and Ethiopians; and Niebuhr found in Yemen a tribe called Beni Chusi. The Book of Job speaks of the topaz of Cush, and there was a Topaz Island in the Red Sea.

Some again have sought for another Cush in more northerly regions of Asia, as in the Persian province of Chusistan or Susiana, in Cuthah, a district of Babylonia, &c.; and as Nimrod, the youngest son of Cush, spread his conquests in that direction, it is no doubt possible that his father's name might be preserved in the designation of some part of the territory or people. The data, however, are very unsatisfactory.

CUSHION, among engravers, a bag of leather filled with sand, for supporting the plate to be engraved.

CUSP (Lat. *cuspis*, a spear-point). In astronomy, the points or horns of the moon, or of any other luminary, are termed cusps. In architecture, cusp is used to denote the points of the small arcs or foliations terminating the internal curves of trefoiled, cinquefoiled, &c. heads of Gothic windows and panels. Cusp, in astrology, denotes the first point of each of the twelve houses, in a figure or scheme of the heavens.

CUSPINIAN, JOHN, a German historical writer, whose family name was *Speishammer*. He was born at Sweinfurt in 1473, and died at Vienna in 1529. He was first physician to the Emperor Maximilian I., and was employed by that prince in several delicate negotiations. His works include *A History of the Roman emperors from Julius Cæsar to the death of Maximilian I.*, 1519, fol.; *A History of Aus-*

Custom ‖ Cutch.

tria, Basle, 1553, fol.; and a *History of the origin of the Turks, and of their cruelties towards Christians*, Antwerp, 1541, 8vo. Gerard Vossius calls Cuspinian *magnum suo ævo historiæ lumen*.

CUSTOM (Fr. *coûtume*, for *coustume*), in a legal sense, is applied to such acts or practices as through time have passed into established use, and thus obtained a legal force. Custom is hence defined, both by lawyers and civilians, as *lex non scripta*, a law not written, established by long usage and the common consent; in which sense it stands opposed to the *lex scripta*, or written law.

CUSTOMS, the duties imposed by law upon merchandise imported and exported. See ENGLAND, and TAXATION.

CUSTOM-HOUSE, an office established by law in maritime cities or seaports, for the receipt and management of the customs and duties imposed on goods imported or exported.

CUSTOS BREVIUM, the title of an officer both in the Court of Queen's Bench and in the Court of Common Pleas, who had the custody of all the writs made returnable in their respective courts, and filed warrants of attorney and other documents connected with the business of the courts. These offices were abolished by Act 1st Will. IV., cap. 58, and compensation was granted to the holders.

CUSTOS ROTULORUM, the keeper of the rolls or records of the sessions of the peace, is the first civil officer of a county. He is always a justice of the peace, and quorum in the county for which he is appointed. It has been an invariable practice to appoint the lord-lieutenant of the county to this office, though the two offices are otherwise quite distinct.

CUTCH, or TERRA-JAPONICA. See CATECHU.

CUTCH, a native state in the south-western extremity of Hindustan, situated between the 68th and 72d degrees of east longitude, and the 22d and 25th of north latitude. It is a peninsulated tract of land, inclosed towards the west by the eastern branch of the Indus or the Koree; on the south by the Indian Ocean and the Gulf of Cutch; and on the north and east, towards the interior, by the great Northern Runn, an extensive salt morass or lake, which from May to October is flooded with salt water, and communicates in its greatest extent with the Gulf of Cutch on the west, and the Gulf of Cambay on the east, these two gulfs being united during the monsoon.

The interior of Cutch is studded with hills of considerable elevation, and a range of mountains runs through it from east to west, many of them of the most fantastic shapes, with large insulated masses of rock scattered in all directions. In the intervening valleys the country is not deficient in fertility and verdure, and is sufficiently productive in all cases where the nature of the government permits the cultivator to enjoy the fruits of his labour. But this very seldom happens. Many of the hills are covered with jungle, and with the strongholds and dens of petty chiefs, who sometimes protect, but more frequently issue forth to plunder the lower country. The general appearance of Cutch is barren and uninteresting. The greater part is a rock destitute of soil, and presenting the wildest aspect; the ground is cold, poor, and sterile; the rains are generally scanty, and often fail altogether; and the whole face of the country bears marks of volcanic action. From the violence of tyranny, and the rapine of a disorderly banditti, by which this district has from time immemorial been infested, as well as from shocks of earthquakes, the villages have a ruinous and dilapidated appearance; and, with the exception of a few fields in their neighbourhood, the country presents a rocky and sandy waste, with in many places scarcely a show of vegetation. Water is scarce and brackish, and is chiefly found at the bottom of low ranges of hills, which abound in some parts; and the inhabitants of the extensive sandy tracts suffer greatly from the want of it. Mrs Elwood, who visited this country in her overland journey to India, observes, that "she could imagine that Cutch had been originally a rocky island of volcanic production, thrown up at some great convulsion of nature, and that in the course of ages soil had been washed down by the Indus, the Bunnass, the Phuraun, and other streams, which now lose themselves in the sand." Owing to the uncertainty of the periodical rains in Cutch, the country is liable to severe famines, which, along with the internal broils by which it has been harassed, have greatly obstructed cultivation, and thinned the inhabitants, many of whom have been induced to emigrate to Bombay and Gujerat; and, in addition to all these evils, an uncommonly violent earthquake, which occurred on the 16th of June 1819, nearly destroyed Bhooj, the capital, and greatly injured the towns of Anjar, Mandavie, and Moondria or Mundra. The soil of Cutch produces grain, cotton, tobacco, ghee, &c.; and iron and coal have been discovered, the latter near the surface of the ground, on the banks of one of the rivers, seven miles north-east of Bhooj, but it is not in general used as fuel. Cutch.

The Runn, which communicates with the Gulf of Cutch, and sweeps round the northern side of that province, is a very extensive salt morass, varying in breadth from five to eighty miles across, and during the rains nearly impassable for horsemen. The total area of this immense morass may be estimated at about 8000 square miles, without including any portion of the Gulf of Cutch, which is in many parts so shallow as to resemble a marshy fen rather than an arm of the sea. The Runn is said to be formed by the overflow of the rivers Phurraun, Loone, Bunnass, and others, during the monsoon; but in December it is quite dry, and in most places hard. The wild ass is very common on the borders of this lake, being seen in herds of from sixty to seventy at a time.

The temperature of Cutch during the hot season is high, the thermometer frequently rising to 100° or 105°; and in the months of April and May, clouds of dust and sand, blown about by hurricanes, which are common in these months, envelop the houses, and the glass windows scarcely afford any protection. The hot wind in May is so scorching that it has been compared to the feeling which would be experienced on standing near a burning prairie. For nine months of the year the climate is comparatively temperate and agreeable; but the approach of October is equally dreaded both by the native and European population as extremely unhealthy, and at the close of the monsoon the oppression of the atmosphere is described as being intolerable. The influence of the monsoon is greatly moderated before it reaches this country, and the rains sometimes fail altogether; but although in this case the necessary consequences are want and misery to the great body of the people, yet these dry seasons are far more favourable to the health of Europeans. In 1825, when the monsoon rains were copious, the country was extremely unhealthy; and, on the other hand, the years 1823 and 1824 were equally remarkable for salubrity and for drought. The monsoon generally sets in with great violence from the north-east before it settles in the south-west. The prevailing wind is westerly, and it blows west by south and west by north ten months in the year. The easterly winds, which do not blow more than a month in the year, are always unhealthy and unpleasant, and bring with them, if they continue long, epidemics and locusts. Cutch is considered unhealthy by the natives from other parts of the country; and Dr Burnes, who was stationed there, and gives an account of its medical topography, mentions that he has known many persons from Bombay, especially servants, who were perfectly useless from continued sickness in Cutch, but who recovered their health the moment they left it. He also adds, that he never was at any station where recoveries from fever were so tedious and incomplete. The hospital returns do not, however, he adds, show

Cutch. any extraordinary sickness. The cholera, that dreadful scourge of Europe as well as of India, has made no progress in Cutch. The most common diseases among the natives are fever and rheumatism; and fever is also the prevailing disease among Europeans, the first attacks of which are always the most dangerous.[1] "These," Dr Burnes mentions, "are generally in the form of bilious remittents, leaving a tendency behind them to intermittent fever, liable to produce a paroxysm on any exciting cause;" and in elucidation of this, he mentions, that of five officers resident in Cutch (of whom he was himself one) not one was exempt from periodical attacks of this malady, and scarcely at any time enjoyed six months' uninterrupted health. These, however, are not severe, and easily yield to the remedy of sulphate of quinine without any serious injury to the constitution. There are some stations at Cutch particularly noxious, such as Narrona, a village in a marsh twenty-four miles north-east of Bhooj, near the Runn; and Luckput Bunder, remarkable for the badness of its water.

The principal towns are Bhooj, Anjar, Jharrah, Kuntcote, and Kuttaria. The principal seaports are Mandavie and Mundra. The town best known to Europeans is Bhooj, which is situated inland, and is surrounded by an amphitheatre of hills, some of which approach within three or four miles of the city. The hill of Bhoojeah, on which the fort is situated, and under the S.W. angle of which is the cantonment of the Cutch brigade, rises to the height of 500 feet in the middle of the plain, and is detached from other high ground. The residency is four miles distant in a westerly direction. There are many mountain streams, but no navigable rivers. They scarcely contain any water except in the rainy season, when they are very full and rapid, and discharge themselves into the Runn, all along the coast of which the wells and springs are more or less impregnated with common salt, and other saline ingredients.

Various causes have contributed to thin the population of this country. In 1812 it was ravaged by a famine and pestilence, which destroyed a great proportion of its inhabitants; according to some accounts, nearly one-half. This, joined to the tyranny and violence of the government until the year 1819, and more lately to a succession of unfavourable seasons, has forced many of the cultivators to remove to Scinde and other countries. At present the inhabitants may be estimated at 500,536, of whom one-third are Mohammedans, and the remainder Hindus of various castes, resembling in their habits and manners those of other parts of India. The Jharejah Rajpoots form a particular class, being the aristocracy of the country; and all are more or less connected with the family of the Rao or prince. There are in Cutch about 200 of these Jharejah chiefs, who all claim their descent from Sacko Goraro, a prince who reigned in Scinde about a thousand years ago. From him also the reigning sovereign is lineally descended, and he is the liege lord of whom all the chiefs or nobles hold their lands in feu, for services which they or their ancestors had performed, or in virtue of their relationship to the family. They are all termed the brotherhood of the Rao, and supposed to be his hereditary advisers, and their possessions are divided among their male children; and to prevent the breaking down of their properties, the necessary consequence of this law of inheritance, there is no doubt that infanticide is common among them, and that it extends to the male as well as the female progeny. The British have exerted their influence to check this inhuman practice; and though it has been found to be closely interwoven with the state of manners and the succession of property, its complete suppression at no distant period is anticipated. The Jharejahs consider it as unlawful to marry any female of their own tribe, being all descended from a common parent. They accordingly marry into the families of other Rajpoots; and to this unfortunate regulation may be chiefly ascribed the destruction of all the female children. The Jharejahs have a tradition that when they entered Cutch they were Mohammedans, but that they afterwards adopted the customs and religion of the Hindus. It is certain, indeed, that they still retain many Mohammedan customs. They take oaths equally on the Koran or on the Shastras; they employ Mussulman books; they eat from their hands; the Rao, when he appears in public, alternately worships God in a Hindu pagoda and a Mohammedan mosque; and he fits out annually at Mandavie a ship for the conveyance of pilgrims to Mecca, who are maintained during the voyage chiefly by the liberality of the prince. The Mohammedans in Cutch are of the same degenerate caste with those usually found in the western parts of India. The Meeanahs form a particular class, who claim the same descent as the Jharejahs, and boast of their constancy to the Mohammedan creed, while the latter apostatized; but they have now entirely degenerated, and are little better than banditti, always ready to commit outrages, and to sally out in disorderly bands to plunder the defenceless country. Such has been the weakness and tyranny of the rulers of Cutch, that they have frequently had recourse to these wretched auxiliaries in order to aid them in their inordinate exactions, while at other times they recruited the army from the same race. They were nearly extirpated under the rigorous rule of Futteh Mohammed, but of late years they have returned in considerable numbers to their villages among the hills. In the seasons of scarcity of 1823 and 1824, many of them emigrated to Scinde, where, joining with other adventurers, they formed disorderly bands, who made forays into Cutch, several villages of which they plundered and burned. The natives are in general of a stronger and stouter make, and even handsomer, than those of western India; and the women of the higher classes are also handsome. The Ryots are described as intelligent, and the workmen are justly celebrated for their ingenuity and mechanical skill. The palace at Mandavie, and a tomb of one of their princes at Bhooj, are fair specimens of their architectural skill. In the manufacture of gold and silver ornaments they display a taste and nicety far beyond any Asiatic artists, except those of China; and there is scarcely any piece of mechanism which, with some instruction, may not be imitated by the goldsmiths and carpenters at Bhooj. The natives of this country are in general peaceable and obedient subjects, for robberies and murders are seldom committed except by the Meeanahs. They are universally addicted to the use of opium and the hookah. The quantity of opium which they take is enormous; and its effects, according to Dr Burnes, are less deleterious to their constitution than might be supposed; though he mentions, that from being continually under its influence, they appear to be of a dull and phlegmatic character.

Cutch.

The country of Cutch was invaded about the ninth century by a body of Mohammedans of the Summa tribe, who under the guidance of five brothers emigrated from Scinde, and who gradually subdued or expelled the original inhabitants, consisting of three distinct races. The descendants of these five leaders assumed the name of Jharejah, from a chief named Jharrah, who set an example of female infanticide by putting to death his seven daughters in one day. Cutch continued tranquil under their sway for many years, until some family quarrel arose, in which the chief of an elder branch of the tribe was murdered by a rival brother. His son fled to Ahmedabad to seek the assistance of the viceroy, who was married to his sister, and who reinstated him in the sovereignty of Cutch, and Moorvee in

[1] See Narrative of a Visit to the court of Scinde; also a Sketch of the History of Cutch, &c. By J. Burnes, Surgeon to the Presidency at Bhooj. 1831.

Cutch. Kattiwar, with the title of Rao or Rawul, in the year 1519.

The succession continued in the same line from the time of this prince until the year 1666, when a younger brother, Pragjee, murdered his elder brother, and usurped the sovereignty. This line of princes continued till the year 1760 without any remarkable event, when, in the reign of Rao Gore, the country was invaded four times by the Scindians, who wasted it with fire and sword. The reign of this prince, as well as that of his son Rao Rahiden, by whom he was succeeded in 1778, was marked by cruelty and blood. The latter prince was dethroned, and, being in a state of mental derangement, was during his lifetime confined by Futteh Mohammed, a native of Scinde, who continued, with a short interval (in which the party of the legal heirs, Bhyjee Bawa, gained the ascendency), to rule the country until his death in 1813. It was in the reign of Futteh Mohammed that a communication first took place with the British government. During the contests for the sovereignty between this usurper and the legal heir, the leader of the royal party, Hunsraj, the governor of Mandavie, sought the aid of the British. But no closer connection followed at that time than an agreement for the suppression of piracy, or of any inroads of troops to the eastward of the Runn, or Gulf of Cutch; and in return the company's government agreed to warn the rulers of Scinde against any attempt to invade the neighbouring country of Cutch. But the Gulf of Cutch, notwithstanding this agreement, continued to swarm with pirates, who were openly encouraged or connived at by the son of Hunsraj, who had succeeded his father; as well as by Futteh Mohammed, who also permitted bodies of banditti to cross into Kattiwar, which they laid waste, and even proceeded to lead a force across the Runn into Purkur, with a view of extending his authority in that quarter. Futteh Mohammed left several sons by different wives, who were competitors for the vacant throne. Hussein Meyan succeeded to a considerable portion of his father's property and power. Jugjevan, a Brahmin, the late minister of Futteh Mohammed, also received a considerable share of influence; and the hatred of these two factions was embittered by religious animosities, the one being Hindu and the other Mohammedan. The late Rao had declared himself a Mohammedan, and his adherents were preparing to inter his body in a magnificent tomb, when the Jharejahs and other Hindus seized the corpse and consigned it to the flames, according to the forms of their superstition. The two factions declared, the one for Ladoba, the nephew of the late prince Rao Rahiden; the other for Maun Sing, his son by a slave girl, who was elevated to the throne under the name of Rao Bharra, or Bharmuljee.

The administration of affairs was nominally in the hands of Hussein Meyan and his brother Ibrahim Meyan. Many sanguinary broils now ensued, in the course of which Jugjevan, with several of his family, were murdered, and the executive authority was much weakened by the usurpations of the Arabs and other chiefs. In the meantime Ibrahim Meyan was stabbed by an assassin; and after various other scenes of anarchy and blood, the Rao Bharmuljee, by general consent, resumed his lawful power. But his reign was one continued series of the grossest enormities; his hostility to the British was no longer concealed; and his inroads into their territories were continued with increased activity. There was no longer, therefore, any room for hesitation; and accordingly a force of 10,500 men crossed the Runn in November 1815, and were within five miles of Bhooj, the capital of the country, when a treaty was concluded, by which the Rao Bharmuljee was confirmed in his title to the throne, and agreed to pay for the losses sustained by the chieftains of Kattiwar from predatory incursions; to re-imburse the expenses of the expedition, which, however, was not insisted on by the British; to make himself responsible for the good conduct of his subjects; to disband the Arab mercenaries; and to fix the Runn and the Gulf of Cutch as the eastern boundaries of his principality, and to cede in perpetuity to the British Anjar and its dependencies. The Rao, however, was far from fulfilling the terms of this treaty. He gave himself up to intemperance and the grossest indulgences; and being a tool in the hands of an unprincipled faction, he gave orders for the murder of his cousin Ladoba, the nephew of the late Rao; and on every occasion he displayed his hostility to the British. On these grounds, it was determined to depose him; and an army was assembled at Anjar under the command of Sir William Keir, where it was joined by the five principal Jharejah chiefs. The British force soon approached the capital, and having taken the fort of Bhorjeah by assault, the Rao Bharmuljee surrendered his person to the British, who made a provision for his maintenance, and elevated his infant son to the throne.

Cutch Gundava || Cuthah.

In 1822 the relations subsisting between the ruler of Cutch and the British were modified by a new treaty, under which the territorial cessions made by the Rao in 1816 were restored in consideration of an annual payment. The sum fixed was subsequently thought too large, and in 1832 the arrears, amounting to a considerable sum, were remitted, and all future payments on this account relinquished. From that time the Rao has paid a subsidy of L.20,000 per annum to the British for the maintenance of the military force stationed within his dominions. Suttee has been prohibited in Cutch; and, under the influence of British counsel, various other measures of a salutary and beneficent character have been adopted. (E. T.)

Cutch Gundava, a district in the province of Beloochistan, situated at the bottom of the mountains lying south-east of Khelat, between Lat. 27. 40., and 29. 50., and Long. 67. 20. and 69. 17. It is about 150 miles in length, and measures nearly an equal distance in its greatest breadth. The Hala range of mountains extends along its western frontier, and forms the eastern wall or face of the elevated table-land of central Beloochistan. Through this range are two great passes; the cebrated Bolan Pass in the north leading in a north-westerly direction, and the Moola or Gundava Pass, which, more to the south, takes an extensive circuit, the two extremes pointing towards the north, and the convex towards the south. The soil is rich, black, and loamy, and produces every species of grain, as also cotton, indigo, madder, and other commodities. The rains are heavy in June, July, and August; it rains also, but not so heavily, in the spring months. The climate during the summer is unhealthy, owing to the simoom or pestilential wind which blows at that time, by which many people lose their lives. Great quantities of grain are exported from this district to the seaports of Kurachee and Sonmeany. Cutch Gundava is the most populous part of Beloochistan, and constitutes the most valuable portion of the dominions of the khan of Khelat, who during winter resides at the chief town. (E. T.)

CUTHAH, in *Ancient Geography*, a district in Asia, whence Shalmaneser transplanted certain colonists into the land of Israel, which he had desolated (2 Kings xvii. 24-30). From the intermixture of these colonists with the remaining natives sprung the Samaritans, who are called Cuthites in the Chaldee and the Talmud; and for the same reason a number of non-Semitic words which occur in the Samaritan dialect are called Cuthian. The situation of the Cuthah from which these colonists came is altogether unknown. Josephus places it in central Persia, and finds there a river of the same name (*Antiq.* ix. 14. 3; x. 9, 7). Rosenmüller and others incline to seek it in the Arabian Irak, where Abulfeda and other Arabic and Persian writers place a town of this name, in the tract near the Nahr-Malca, or royal

Cuticle || Cutlery.

canal, which connected the Euphrates and Tigris, southward of the present Baghdad. Winer seems to prefer the conjecture of Stephen Morin and Le Clerc, which identifies the Cuthites with the Cossæi in Susiana. All these conjectures refer essentially to the same quarter, and any of them is preferable to the one suggested by Michaelis,—that the Cuthites were Phœnicians from the neighbourhood of Sidon,—which he founds upon reasons which no one regards as satisfactory, and which it is therefore unnecessary to reproduce.

CUTICLE (Lat. *cuticula*), the epidermis or scarf-skin; the exterior membranous covering of the body. See ANATOMY, vol. ii., p. 834.

CUTLERY (Fr. *coutellerie;* Lat. *culter*, a knife), generally speaking, includes all cutting tools made of steel. Various countries and cities have at different periods excelled in the manufacture of some particular article, as Damascus for a beautiful sword blade, which has hitherto baffled all attempts at imitation. If this blade is made, as is commonly supposed, by welding together extremely fine wires of iron, steel, and gold, laid alternately on each other, the dexterity required is such as must astonish the most active and experienced workmen of other countries. The peculiar wave, usually called the water, so universally admired, is effected by the application of a weak acid to the polished surface of iron and steel. At Damascus sulphate of alumine is used; but any dilute acid seems to answer the purpose. The cutlery of England is deservedly held in high estimation in every part of the civilized world. The finer articles, as razors, penknives, scissors, and surgical instruments, are made of cast-steel, that is, steel purified and equalized by fusion. Dexterity and nice attention on the part of the workman to a variety of circumstances, as the quality of the steel, nature of the fuel, accuracy in the processes of hardening and tempering, and many other minor considerations, are essential to the production of a good cutting instrument. For table-knives, and all cutlery of that description, shear-steel is generally used: the tang and shoulder of the table knife and fork are iron, united to the blade by welding. The celebrated Indian steel called wootz is not used in the manufacture of British cutlery.

The principal seat of the cutlery trade is at Sheffield, where all kinds of table cutlery, razors, penknives, scissors, surgeons' instruments, and every variety of cutting instruments, are manufactured. There are also some small manufactures of similar articles in London; but much the greater proportion of the cutlery sold as London-made is actually manufactured in Sheffield, although bearing the name of London manufacturers. Describing the process of making any one blade, a razor for instance, will suffice for most other articles of cutlery. The workman being furnished with a bar of cast-steel, forges the blade, using a forge similar to that of a smith. The brow of his anvil and his hammer being convex, he is enabled to give to the blade a degree of concavity which greatly facilitates and accelerates the subsequent work of grinding. The blade is then fashioned more exactly with a file. It is again heated to a cherry-red colour, and instantly quenched in a cold fluid, commonly water. In this stage the blade is extremely hard, and requires to be tempered; a process usually performed by heating it over a fire free from flame and smoke, until the surface, which has been previously rubbed with pumice-stone, assumes a straw colour. It is again quenched, and is then ready for grinding. As this method of tempering is liable to many objections, a tempering-bath, with thermometer, will be described—the superior advantages of which appear too obvious for comment. It now remains to grind and polish the blade; and this is so generally understood as hardly to need explanation. The diameter of the stone is chosen according to the degree of concavity required; and in polishing, care is necessary to avoid heating the blade by friction, which would render it useless. In London, the blade is generally the production of one workman, who is accountable for the whole manipulation, and who, if the work is faulty, can transfer no blame to another. At Sheffield, by division of labour, and the local advantages of coal and water to carry on extensive machinery, more despatch is attained, and the manufacture is conducted at an expense considerably below that of London. Numerous attempts have been made to preserve from rust that beautiful polish given to the cutlery of England. The most effectual method is to coat the surface with ethereal solution of gold, or, what is still better, with muriate of platina. The late Mr Stodart has given his method of preparing and using these solutions in the eleventh volume of Nicholson's *Journal*. The process is interesting, independently of its utility, as a chemical experiment, proving the almost infinite divisibility of gold.

Cutlery.

It is worth mentioning, that the iron procured from meteoric stones is less susceptible of oxidation than any other. This is most probably owing to its being combined with nickel. By artificially combining the two metals, we might obtain an alloy valuable for making instruments which are necessarily exposed to moisture. Having objected to the common method of hardening and tempering steel, on which process the excellence of the instruments so much depends, we proceed to state some improvements in that art. The method of tempering with a thermometer was practised by Mr Stodart with perfect success. The following experiment is simple, and clearly exhibits and illustrates this manner of tempering. Let a plate of steel finely polished be so laid as to float on the surface of a bath of mercury, or of the fusible alloy of tin, lead, and bismuth: into the bath plunge the bulb of a thermometer, graduated up to 600° Fahrenheit. A good argand will heat the bath. No change of colour will be visible on the steel until the mercury has risen to 430°, and it will then be so faint as only to be perceptible by comparison with a plate that has not been heated. At 450° the colour will be a fine pale straw, which, as the heat increases, will become deeper; and successive changes will take place until it be heated up to the boiling point of mercury.

The advantages of this mode of tempering will now appear obvious and conclusive. If, for example, a straw colour indicates the best temper for a penknife, the blade, or any number of blades, is suffered to remain in the bath until the thermometer rises to the number corresponding to that colour, when they are instantly removed from further increase of heat, and, consequently, are all of one temper. After the first experiment, it is unnecessary for the bath to be metallic—oil will answer the purpose equally well.

The late Mr Nicolson, who devoted much attention to the subject of steel, used, in hardening delicate articles, a bath of lead; and a metallic bath may, perhaps, frequently be advantageous in hardening as well as in tempering. A very ingenious method of hardening steel work was communicated to Mr Stodart by Dr Wollaston. The steel is inclosed in a tube, surrounded by the well-known fusible alloy of eight parts lead, two tin, and five bismuth. The tube, with its contents, is heated in a furnace to redness, and then plunged into a cooling fluid. It is afterwards thrown into boiling water, by which the alloy is fused, and the steel is left perfectly hardened, and unaltered by twisting, cracking, or in any way changing its shape. Several experiments have been made to ascertain the best cooling fluid, without any very satisfactory result. A large quantity of water cooled down to about 40° Fahrenheit seems to answer as well as anything hitherto tried. Mr Stodart quenched a scalpel in snow and muriate of lime, without perceiving any advantage from the extreme cold.

Having mentioned the wootz of India, a brief account of

Cutlery. this famous steel may be acceptable. For the introduction of wootz into this country we are indebted to Sir Joseph Banks, who submitted some of it to the experiments of intelligent workmen in the year 1795. It was soon found to contain valuable properties. From the cake (as the lump is called in the state in which it is imported) a small penknife was made. The forging was attended with considerable difficulty, partly owing to the unmanageable form of the cake, but more especially to the inequality of the mass; the steely principle being deficient in some parts, whilst others were quite overcharged with it. The penknife, however, proved excellent, and fully justified and encouraged further trials. The inequality in the mass was evidently owing to imperfect fusion; a defect that will most likely remain until the Indian steel-maker is acquainted with the formation and management of a proper furnace. If he were likewise instructed to pour the fluid metal into a mould instead of allowing it to crystallize in the crucible, and afterwards to form it into bars with a tilt-hammer, it might be imported in the shape of English cast steel, and probably at a price not greatly exceeding that article. The Indian account of wootz-making is the following:—Pieces of forged iron are inclosed in a crucible with wood, and heated together in a furnace; the fire is urged by three or more bellows peculiar to the country; and thus the wood is charred, the iron fused, and at the same time converted into steel. The metal is suffered to crystallize in the crucible; and in this state it is imported. This method of steel-making is neat and ingenious. Its chief peculiarity consists in the wood not being previously charred; its apparent defect, in the fusion not being complete. When wootz is submitted to a second and more perfect fusion, it improves so much as scarcely to be recognised. This advantageous change is evidently owing to the whole mass being purified and equalized when in a state as thin as water. It is now fit for all purposes of fine cutlery, and is in fact infinitely superior to the best cast steel of England. Is this owing to the use of uncharred wood, or is it not rather, as suspected by Mr Stodart, owing to some particular property of the iron ore of India highly favourable to steel-making? The present state of chemical knowledge does not militate against the supposition, that this steel may be alloyed with one or more of the metals of the earth. We know that a very minute quantity of one metal is capable of producing extraordinary effects by combining with another. Sir Humphry Davy's discovery is a fine example of this, namely, that mercury is rendered solid, and has its specific gravity diminished from 13 to 3, by combination with $\frac{1}{12000}$ of ammonium. Wootz requires from the workman every attention and care in forging. If overheated it is useless. In hardening, it should be quenched at a cherry-red colour, and in tempering be heated from thirty to forty degrees higher than our best cast steel. Thus if a razor of cast steel should be removed from the bath at 460°, one of wootz may remain to 500°, and even then it will be the harder of the two. Notwithstanding its excellence, this steel has hitherto been little used by cutlers.

We have already mentioned a branch of cutlery which, from its importance, claims more particular notice. Knives and other edge instruments for surgical operations, made and finished in the very best manner, are indeed invaluable. When fortunately the form and physical properties of the instrument are exactly to the wish of the operator, he is freed from many embarrassments inseparably connected with a bad or indifferent instrument. This truly desirable state of excellence is confessedly of difficult attainment. The choicest pieces of steel should be carefully selected, and the skill and undivided attention of the best workman devoted to the whole manipulation of forging, hardening, tempering, grinding, and polishing. By want of ability or diligence during these various processes, the knife may be rendered totally unfit for the purposes for which it was intended. Finishing the edge, technically termed setting, is a work of much delicacy and skill. Very few acquire this art in the highest degree of perfection. The artist must be in a situation undisturbed by noise or conversation, and his attention must be exclusively devoted to the object on which he is engaged. This very nice and delicate process is performed on a hone moistened with fine oil. Hones are imported in large quantities; yet not many of superior quality can be selected. The very finest of these are still inadequate to give the last finish to the edge. This is performed on a beautiful green stone, found in some parts of the old pavement of London; the only known material capable of giving perfect smoothness to the points of lancets and other delicate instruments. These points, when made and finished in the very best manner, will perforate a thin piece of leather, by which they are usually proved, with such ease and facility, that no more resistance is sensibly felt, or noise made, than would be if the point were dropped into a fluid, as water or oil. Nothing short of this proof of excellence is satisfactory; mediocrity cannot, at least ought not, to be admitted. These observations apply generally to every description of knife used in surgery; but the nature of each particular operation should be considered, in judging of the requisite degree of strength or delicacy of edge. Next in importance to the knives are the saws used in surgery. All of these must be of the best spring temper, which, for the cast-steel blade, is about 570° of Fahrenheit, and for one of Indian steel 600°, or quite the boiling point of mercury. Of another class of instruments, namely, those denominated blunt, it will be sufficient to observe, that what is known by the name of shear steel is best adapted for the purpose. Case-hardened iron has been most improperly used, this hardening being very superficial. It is, in fact, converting the surface only into steel, by heating it to redness, in a close vessel, in contact with animal charcoal, such as charred bone, leather, or horn, and quenching it when red-hot in a cold fluid. Iron thus treated will take a beautiful polish; but, except for ornamental purposes, it ought never to be employed. Some instruments are necessarily made of gold or silver; as catheters, and other tubes and probes. (See BOUGIE.) When for these ductility is required, the metals should be unalloyed; the extra expense of which will be more than compensated by the convenience of giving to the instruments, in all cases, the desired curve and form.

The handles of instruments, together with all ornamental parts, must in a great measure depend on the taste and choice of the purchaser. It would be well, however, to avoid such materials as are known to produce chemical action when in contact with polished steel. Ivory, mother-of-pearl, and ebony are much used; but the fine walnut-tree, such as the London gunmakers employ, is perhaps of all the woods the best for the purpose. Sandal-wood answers very well, although it by no means deserves all the credit which has been given to it as a preservative of steel from rust. The instrument-maker who wishes to excel will do well to avail himself of every opportunity of witnessing the operative part of surgery; that he may observe how far the instrument is mechanically and physically adapted to its purpose, and, if necessary, be the better able to make the requisite alteration.

Sheffield cutlery has deservedly obtained a high degree of reputation in almost every part of the civilized world; and it is of great importance to the commercial interests of the country that this high character should be maintained. But here it must not be omitted to be mentioned, that there is also an extensive manufacture of an inferior description of cutlery, principally consisting of table knives and forks, scissors, and pocket-knives, which are professedly made for export to the less civilized portions of the globe, but

Cuttack ‖ Cutter.

also retailed in large quantities in this country. It is manufactured by casting from a species of pig-iron. This iron is, from the superabundance of its carbon, highly susceptible of liquidity, and readily casts into the required form. In this state the cast-iron cutlery is extremely hard, and as brittle as glass; but it is reduced from this hardness by decomposition,—being subjected to a strong and long-continued fire in close vessels, in contact with iron ore, oxide of iron, or any substance containing oxygen, with which the superabundant carbon combines, when kept at a high temperature, and flies off in the state of carbonic acid gas. This cast-iron cutlery is, when finished, not always distinguishable in appearance from that made at the forge, and can, of course, be afforded at a much lower price. This very fusible iron may be applied to many purposes. It is hardly necessary to add, that it is quite unfit for any description of edge instrument. (J. S—T.)

CUTTACK, an extensive district of Hindustan, province of Orissa, lying between the 20th and 22d degrees of north latitude, and between the 86th and 88th degrees of east longitude. It is bounded on the north by the British districts of Midnapore and Hidgellee; on the north-west by the petty native state termed the Cuttack Mehals; on the west by the district of Ganjam, and on the east and south-east by the Bay of Bengal. Cuttack has an area of 7635 square miles. Its length is computed at about 200 miles, and its average breadth at about 60. The country varies in the quality of its soil: in the delta of the Mahanuddy, which resembles the Sunderbunds at the estuaries of the Ganges in its numerous sluggish winding streams, it consists of a deep mud, the surface of which is covered with coarse reedy grass and brushwood; westward of the delta extends the Mogulbandi, a dry tract with a sandy soil, yet highly cultivated, and producing most of the grains common in Bengal. Inland of this is the hill country, in which the land fit for tillage bears a trifling proportion to the extent of rocks and forests which occupy this region. The district is well watered by the Mahanuddy, the Brahmunnee, the Byturnee, and by some minor streams which fall into the Chilka Lake. This shallow but extensive piece of water is situate in the southern quarter of the district, and measures upwards of forty miles in length and sixteen in breadth. It communicates with the sea by a narrow channel, and its waters are saline. The chief towns are Cuttack, Juggernaut, Balasore, and Jagepore. The population is officially returned at 2,127,555; an amount which, compared with the area, affords a relative density of about 280 to the square mile. This district is mentioned as early as the year 1212, under the title of Jagepore, by the Mohammedan historians; and it was not finally subdued till 1592, when it was conquered and annexed to Bengal. It was ceded in 1751 to the Mahrattas, and came into the possession of the British in 1803, during the administration of Marquis Wellesley, who subdivided it into the southern, northern, and central districts of Balasore, Cuttack Proper, and Pooree or Juggernaut. By its subjection the British acquired a political supremacy over the group of native states known as the Cuttack Mehals. (E. T.)

CUTTACK, the capital of the above district, was formerly fortified, and contained a number of good houses and bazaars; but during the period of its possession by the Mahrattas it fell into decay. Its position is naturally strong, being on a neck of land washed by the Mahanuddy and Gunjoory rivers, and it is a place of some consequence. The low country round the town is under water during the rainy season for a circuit of ten miles, and the station is considered unhealthy. In 1592 it withstood the Mogul arms for nearly a month. Pop. of town estimated at 40,000. Lat. 20. 28.; Long. 85. 55. (E. T.)

CUTTER, in naval affairs, a small vessel with one mast, and rigged nearly as a sloop. Many of these vessels are employed by government, either under the direction of the admiralty or that of the custom-house, for the prevention of illicit traffic along the British coasts.

Cutter ‖ Cuvier.

CUTTER is also the name of a small boat used by ships of war.

CUTTERAH, a village of British India, presidency of Bengal, district and 30 miles S.E. of Bareilly. Here was fought the decisive battle, in 1774, in which Sujah ud Dowlah, with the aid of the British, defeated the Rohillahs, who were nearly exterminated by the cruelty of the conquerors. See HINDUSTAN.

CUTTLE-FISH, a name applied in English indifferently to the *Loligo vulgaris* and the *Sepia*, animals belonging to the cephalopodous class of the *Mollusca*. The most remarkable characteristic of the tribe of animals to which the cuttle-fish belongs is the inky fluid which they emit when hard pressed by any of the numerous foes by which they are liable to be assailed. The organ in which this fluid is secreted is spongy and glandular. In some species it is contained in a recess of the liver, which has given rise to the opinion that the fluid in question was bile. In other species, however, this gland is detached from the liver and situated either before or behind that organ. The excretory canal of this gland opens in the rectum, so that the fluid escapes through the funnel. It mixes readily with water, and imparts to it its own peculiar colour. When dried it is used as a pigment, and is considered as the basis of china ink. It is obtained by digesting the ink with very dilute nitric acid, until it become yellowish, washing it well and separating it by the filter; it is then boiled frequently in water, one of the washings being slightly alkalized, and finally with distilled water. See MOLLUSCA, class Cephalopoda.

CUTTS, JOHN, *Lord*, a distinguished English officer, son of Richard Cutts, Esq. of Matching, in Essex, where the family were settled about the time of Henry VI., and had a great estate. He entered early into the service of the Duke of Monmouth, was aide-de-camp to the Duke of Lorrain in Hungary, and first signalized himself at the taking of Buda from the Turks in 1686. Addison, in a Latin poem, alludes to Cutts's distinguished bravery at that siege. After the Revolution, he was created Baron of Gowran in Ireland, and held various appointments at court. In 1701, we find Steele, who was indebted to his interest for a military commission, inscribing to him his first work, *The Christian Hero*. On the accession of Queen Anne, he was made a lieutenant-general of the forces in Holland, commander-in-chief of the forces in Ireland under the Duke of Ormond, and afterwards one of the lords justices of that kingdom. Lord Cutts died at Dublin Jan. 26, 1707, and was buried in the cathedral of Christ-Church. He was the author of a poem on the death of Queen Mary, and published, in 1687, *Poetical Exercises*, with a dedication to her Royal Highness Mary princess of Orange.

CUVETTE, or CUNETTE, in *Fortification*, a ditch within a ditch; that is, a trench about four fathoms broad filled with water, and running along the middle of the great dry ditch. It serves both as a defence against assault and against mining.

CUVIER, GEORGE-LEOPOLD-CHRISTIAN-FREDERIC-DAGOBERT, the most celebrated naturalist of modern times, was a native of Montbéliard, now a French town, but formerly the chief place of a principality in Switzerland, dependent on the Duke of Wurtemberg. He was born on the 23d of August 1769. His family came originally from a village on the Jura, which still bears the name of Cuvier. His father was a retired officer, who had served forty years in a Swiss regiment in the pay of France, whence he derived a moderate allowance or pension; and latterly he held the command of the artillery at Montbé-

Cuvier. liard, where, under the superintendence of his mother, young Cuvier was initiated in the elements of learning. He was brought up in the Protestant faith, which was that of his family, and early gave indications of those mental qualities for which he afterwards became so greatly distinguished. He was gifted with a memory of extraordinary power, and likewise evinced an aptitude for drawing, his taste for which was formed at the age of twelve, from the works of Buffon. The study of the Latin and Greek languages occasioned him but little difficulty; the German he acquired with equal facility; and he also made himself master of the different other modern languages in succession. He had a passion for every kind of reading, particularly history; and such was the tenacity of his memory, that the driest details of nomenclature, and the most lengthened lists of sovereigns, princes, statesmen, and warriors, were remembered by him without effort, and so forcibly impressed on his mind as never afterwards to be effaced. At the age of fourteen, having acquired nearly all the instruction which the school of Montbeliard could supply, he was sent to Stuttgard, under the patronage of Duke Charles of Wurtemberg, and had a place assigned him, free from all expense, in the Caroline Academy, where he was entered in the month of March 1784. He remained four years at this seminary, and his progress corresponded with the advantages which he enjoyed; and in every department of knowledge which formed the subject of instruction, he evinced that reach of comprehension and soundness of judgment for which he was always remarkable. Lessons were given in five different faculties, one of which was exclusively devoted to the study of government; and, singular as it may appear, it was to this that he attached himself the most. The principal subjects taught were the elementary and practical departments of law, and the more useful details connected with finance, police, agriculture, and technology; and so sensible was he of the advantages of such a branch of instruction, that he always lamented that a corresponding system had not been established in France.[1] Among the teachers composing the faculty which formed the object of Cuvier's predilection was M. Abel, professor of natural history, who took a lively interest in the progress of the young Frenchman, whose genius he had not failed to discover; contributed to supply him with the means of indulging his inclination for the study of the natural sciences, to which, amidst all his varied occupations, he continually recurred; and engaged him, sometimes in reading and meditating on the standard works in this department of knowledge, and at other times in drawing insects or forming an herbarium. But this favourite occupation did not prevent him from obtaining the most decided success in the other studies prescribed by the rules of the academy; and, at the termination of the course, he received, in addition to the highest prizes, an order of merit conferred only on five or six out of the four hundred pupils belonging to the establishment.

The term of his education being thus completed, circumstances rendered it necessary for him to turn his thoughts to the active business of life; and his first resource was to engage himself as tutor to superintend the education of one of the children of a Protestant family in Normandy. Cuvier. This situation, how humble soever it may appear, had at least the recommendation of affording him sufficient leisure for the prosecution of his scientific duties; from being employed in the useful labour of instructing others he derived the means of promoting his own improvement; and he never afterwards shrunk from the recollection of his entrance on a path which in process of time conducted him to so much celebrity. It was in July 1788, when he had scarcely completed his nineteenth year, that Cuvier went to reside in Normandy, at a country-house situated near the sea, in the middle of an almost insulated district. In this remote retreat he found a secure asylum from the fury of the revolutionary tempest which desolated so many other parts of France; and during the days of dismal memory with which the history of that period is darkened, he escaped the danger which threatened all who were conspicuous for virtue and excellence. About this time a fortunate accident procured him the acquaintance of Tessier, whom terror had driven to the neighbourhood where Cuvier then resided; and having quickly discerned the talents of the young naturalist, this accomplished person hastened to put him in communication with many scientific men in Paris, particularly with Lamétherie, Olivier, Lacépède, Geoffroy, and Mellin de Grandmaison. When the reign of terror had terminated, these distinguished persons invited him to Paris, where the re-establishment of literary and scientific institutions was now becoming an object of attention. Cuvier accordingly repaired to the capital in the spring of 1795, and, by the interest of Mellin and Tessier, he was almost immediately appointed a member of the Commission of Arts, and shortly afterwards made professor to the Central School of the Pantheon. It was for the use of this school that he prepared his *Tableau Elémentaire de l'Histoire Naturelle des Animaux*, the first work which the public knew to be his, and which, notwithstanding its elementary appearance, has served as the basis of all subsequent works on zoological classification. But his principal object had not yet been attained. He desired to enter the Museum of Natural History, which alone could furnish him with the means of prosecuting the scientific investigations which were already matured in his mind; and this satisfaction was not long denied him; for the professor, Mertrud, who had been appointed to the newly-established chair of comparative anatomy, having attained an advanced age, which unfitted him for teaching a science that was new to him, yielded to the entreaties of his colleagues Jussieu, Geoffroy, and Lacépède, and upon their recommendation accepted Cuvier to supply his place.

Cuvier, having thus attained the object of his ambition, laboured indefatigably to prove himself worthy of the confidence which had been placed in him, and formed, for the use of comparative anatomy, that collection which is now known throughout all Europe; whilst the lectures by which he rendered it so useful soon attracted a numerous concourse of students, who spread his fame to a distance as an eminent and successful teacher. These lectures have since been published in five volumes 8vo, and their merit is universally acknowledged. This was the grand epoch

[1] Baron Pasquier states, in his *Eloge de Cuvier*, that the latter had often been heard to express regret at the little assistance afforded in France to those who were employed in acquiring a knowledge of the principles of government. The Baron's words are, "Quand la science des lois, dont les tribunaux font l'application, est partout, disait-il, l'objet d'études pour lesquelles tous les genres de secours et d'encouragemens sont prodigués, d'où vient qu'on dédaigne, ou au moins qu'on néglige de fournir à la jeunesse les moyens d'acquérir méthodiquement la connoissance de cette foule de dispositions, de règlemens qui influent si puissamment sur un nombre infini d'intérêts publics et privés? d'où vient qu'on ne s'occupe pas de lui apprendre de la même manière les principes sur lesquels repose, ou devrait reposer cette législation administrative? Je me plais à rapporter cette vue de M. Cuvier, parce qu'elle indique déjà l'attrait que devaient avoir pour lui les travaux auxquels il s'est en effet livré avec tant de zèle, tous les fois que l'occasion lui a été offerte de prêter à l'administration publique le secours de ses talens et de ses lumières."

Cuvier. of Cuvier's life. He had now attained a station which enabled him to give full scope to all his energies, and to reach that height of scientific distinction where he maintained an undisputed pre-eminence for the long period of forty-seven years. Cuvier, in fact, may be regarded as moving in three different spheres; namely, in that of literature, that of public instruction, and that of the administration: yet, in the midst of a multiplicity of occupations, the minutest details, whether these related to public instruction, the deliberations of the council of state, or the committee of the interior, were never neglected by him; and to his unrivalled fame as a naturalist he was enabled to add the reputation of a most useful as well as a most illustrious citizen.

The National Institute was established in the year 1796. At this time Cuvier was professor of comparative anatomy in the Museum of Natural History; and, in consequence of the reputation which he had acquired by his course of lectures, as well as by the publication of some memoirs, he was soon invited to become a member. At first the secretaries were only temporary, none of them holding the office longer than two years. Cuvier was the third in order; and, in 1800, when Bonaparte, after his return from Egypt, and the revolution of the 18th Brumaire, which made him first consul, had assumed the title of President of the Institute, this great naturalist found himself placed in intimate relationship with that extraordinary man, then aspiring to every kind of glory, and having his views already turned towards the possession of sovereign power. During the same year M. Daubenton died, and the professor of comparative anatomy was appointed to teach in his stead the philosophy of natural history. In 1802, the first consul, wishing to remodel the system of public instruction, nominated six inspectors to establish lyceums in thirty French towns. Cuvier was one of these, and his commission directed him to superintend the establishment of the lyceums of Marseilles and Bordeaux, which are now royal colleges. During his absence from Paris the Institute was re-organized; perpetual secretaries were appointed, and Cuvier was elected to fill that office in the class of the natural sciences. It was in the latter capacity that, in 1808, he drew up his historical report of the progress of the natural sciences. Napoleon had asked merely for a report; but, under this unassuming title, the skilful reporter contrived not merely to show the road which had already been traversed, but to indicate that which ought still to be pursued. This report was read to the emperor in the council of state, and greatly admired. In the course of the same year the Imperial University was established, and Cuvier nominated one of the councillors of that body for his life. In 1809 and 1811 he was occupied in instituting academies in those parts of the Italian provinces which had been annexed to the empire; in 1811 he undertook a similar mission to Holland and the Hans Towns; and in 1813 he was sent to Rome, in order to organize a university. These successive journeys could not fail to be profitable to such an observer, whilst the intimate connection which they afforded him opportunities of forming with distinguished men of all countries, enabled him to accumulate most valuable materials for all the works in which he was then engaged. But his administrative talents had not escaped the penetration of Napoleon, who knew well how to estimate men at their real value, and he was soon called to act in a different sphere.

While at Rome he received the news of his being appointed a master of requests; and, once a member of the council of state, he was not long in raising himself to the first rank. Nor did the events of the year 1814, which overthrew the imperial power, retard his further advancement. He became a councillor of state in the month of September in that year; and soon afterwards he was repeatedly offered, but as often declined, the situation of superintendent of the *Jardin du Roi*, an office on which Buffon had conferred so much celebrity. In the month of February 1815 the university having been remodelled, a place was assigned him, under the title of chancellor, in the royal council of public instruction attached to that institution. But the new convulsion occasioned by the return of Napoleon from Elba prevented his continuing a member of the council of state; he was, however, retained in the Imperial University, where the absence of his name would have created too great a blank. About four months afterwards, when it became necessary to re-establish what the hurricane of the hundred days had overthrown, it was found that neither the system of the Imperial University, nor even that of the Royal University as it had been organised in February, could be fully carried into effect. A provisional arrangement was therefore judged necessary, and a commission appointed to exercise the powers which had been previously vested in a grand master, a council, a chancellor, and a treasurer. Of this commission Cuvier was named a member, and from the first the duties of chancellor devolved on him. He took an active part in the labours of the commission, to which he rendered very important services; and he acted as president on two occasions, each time for more than a year, but always provisionally, his religion disqualifying him for being regularly appointed to that office. In 1818 he visited England, and, on his arrival in London, learned that he had been elected a member of the French Academy; an important addition no doubt to the gratification which must then have been afforded him by the flattering reception which he met with in the British metropolis, from men who were certainly very competent judges of the merit which they honoured with their notice and regard. In 1819 he was appointed president of the section of the interior in the council of state, and from the moment when he entered on this office, the duties of which were alike important and laborious, he never quitted it until the period of his death. In 1824, when a minister of ecclesiastical affairs was appointed, and the new porte-feuille passed into the hands of a bishop who had previously been grand master of the university, the duties of the latter office, as far as they regarded Protestant theology, were entrusted to Cuvier, by whom they continued to be performed during the remainder of his life. In 1827 the superintendence of that department of the administration of the interior which related to the forms of worship not Catholic was committed to him; and, lastly, he was raised to the peerage about the end of the year 1831. But the brilliant career of this great naturalist was now fast drawing towards its close; and he expired on the 13th of May 1832, after four days' suffering, from an attack of paralysis in the throat, which soon reached his lungs, being then only in the sixty-third year of his age. He died surrounded by nearly all that remained of his domestic circle; by his wife, his daughter-in-law, and his brother, who united all their affection in consoling his last moments. In his family he had suffered severe afflictions, having lost three sons in infancy, whilst his daughter, a model of grace and virtue, was carried off on the eve of contracting a marriage which had received her father's entire approbation, and promised a long course of happiness. Of four children, also, which his wife had had by a former marriage, and which he had adopted, two were arrested by death at an age when all risks appeared to have ceased, and hope seemed to have become reality.

We have already mentioned the earliest work which procured him distinction in the natural sciences. In 1811 he published his *Recherches sur les Ossemens Fossiles*

de Quadrupèdes. This work has gone through three editions, and the preliminary discourse has often been reprinted. In 1817 appeared his *Mémoires pour servir à l'Histoire des Mollusques*, which effected a total change in one branch of zoological classification; and also *Le Règne Animal distribué d'après son Organization*, in four vols. 8vo, which soon became the foundation of all zoological studies, whilst, in most of the schools, the lectures, collections, and works of research, were all more or less elucidated or illustrated by an appeal to this great work. Cuvier was assisted by his friend Latreille in the part of the work connected with the class of insects, a class which is in itself more numerous than all the rest of the animal kingdom, and which would require for its illustration the whole life of a laborious man; but he had persuaded this skilful entomologist to deviate in some points from his usual system, in order that his labours might the better harmonize with the other parts of the work. During the last years of his life he was occupied with a great work on the natural history of fishes, in twenty volumes, of which eight had already appeared, and the materials for five others were prepared previously to his death. The preparation of the *Règne Animal* having showed Cuvier how much the study of fishes had fallen behind that of the other branches of zoology, and made him sensible of the difficulties of prosecuting it, owing to the obscurity in which the anatomy of these animals was involved, the impossibility of knowing with precision the laws deducible from the comparison of their organs, the want of good collections, and the somewhat artificial spirit which had hitherto prevailed in the study of ichthyology, he exerted himself to collect skeletons of fishes from all parts of the world, anatomised a great number with unusual care, associated with himself in the study of their details a man of merit, M. Valenciennes, to assist him, and, in a period comparatively short, became thus enabled to arrange the elements of that history of fishes; and the work has been completed under the superintendence of Valenciennes. Some years before his death Cuvier also undertook a course of lectures on the history of the natural sciences, which he delivered from notes, and which, according to the testimony of all who heard him, were remarkable for eloquence, precision, and lucid arrangement. He was, besides, occupied with a new edition of his lectures on comparative anatomy, and wished to devote the remainder of his life to a great treatise on the same science, for which, indeed, he had brought together the immense collection of the *Jardin du Roi*, whilst the greater number of the drawings necessary for the work were already completed, a very considerable portion of them having been executed by his own hand. "This," said he, "will be a work almost entirely new, because our immense collections, and the works executed by other anatomists, since the first publication, have furnished me with many new facts; but I see with pleasure that the system requires little change, and that it continues preferable, at least in my opinion, to those which have been adopted since by some learned men." This project, which was always present to his mind, and for which he had in fact laboured nearly forty years, seemed to him necessary for completing as it were the cycle of his works; but the melancholy doubt which he oftener than once expressed, that he should not live to complete his design, was but too soon verified; and he died leaving the work in the state which we have already described. Such indeed was the surprising fertility of genius for which this great naturalist was distinguished, that he left behind him unpublished works which, as De Candolle remarks, might well be supposed to have absorbed the labour of a whole lifetime.

Cuvier was a man of an extremely active and enterprising, yet sound and methodical mind. In him strong natural sagacity and almost unerring good sense were united with unwearied industry, an invincible love of labour, a habit of hearing and investigating every thing with patience, admirable correctness and precision in thinking, and singular clearness in the explanation of doctrines and systems, however complicated and refined these might be. Nor was he less remarkable for the variety than for the extent and completeness of his acquirements. In literature, in the sciences, in practical education, and in civil administration, his abilities were displayed, if not with equal brilliancy in all, at least with distinguished success. His Eloges are all masterpieces of their kind, which, while they enable us to form an idea of the extent of his knowlege in the natural sciences, evince, at the same time, great literary skill in the disposition and arrangement of his materials, and consummate address in the selection of those prominent points which are best calculated to convey a distinct general idea of the course or route which it was his object to trace out. Of this kind of composition some beautiful examples had previously appeared in France; and Fontenelle, D'Alembert, Condorcet, and Vicq-d'Azir, were each greatly distinguished, though often for very different qualities. But Cuvier may with justice be considered as having excelled all his predecessors in the art of analysing the principles and describing the origin and progress of a science, with such a degree of precision and perspicuity as to bring it to the level of every capacity. Aiming less at effect than Fontenelle, free from the disdainful and ill-disguised scepticism of D'Alembert and Condorcet, and possessed of more profound and varied knowledge than Vicq-d'Azir, he could intersperse, in the most attractive manner, his instructive and able expositions of the labours and discoveries of those whom he celebrated, with details of their history and private life, which generally attested the humble origin whence they had emerged to usefulness and celebrity. It is no doubt easy to conceive a style more correct and skilfully laboured than Cuvier's, but it is difficult to imagine one better adapted to his extensive erudition, or more appropriate to the subject of which he is treating, and the thought which, at the time, he requires to express. His varied talents, however, are perhaps best proved by the influence which he exerted on natural history. For, independently altogether of his discoveries, and the benefits which he conferred upon the science by his works, he may be said to have created, so much did he improve, the cabinet of comparative anatomy attached to the Museum of Natural History at Paris; and when placed by the choice of his colleagues at the head of this establishment, he contributed greatly to accelerate its progress, and carried into its general details that activity and that perfection of methodical arrangement for which he was ever distinguished. When called to co-operate in the direction of public instruction, whether in the council of the university, in the provinces, or in countries then dependent upon France, he everywhere made himself remarkable for the same qualities, and evinced a desire not merely to improve the general system of education, but also to render it more easily accessible. His remarks on the primary instruction of Holland sufficiently evince his solicitude for the diffusion of knowledge among the people; and the effects of his arrangements in the higher studies have proved extensively beneficial, not only by the correction of much that was evil, but also by affording greater scope and a fairer field for their advancement. In making the round of the administrative functions (with the exception of censor, which he nobly refused when the government wished to bestow it on him), he displayed the same superiority which distinguished his career in the more congenial pursuits of science, literature, and public instruction. He was in fact

Cuxhaven ‖ Cyanometer.

so well acquainted with laws, regulations, and official acts of all kinds, that his colleagues in the administration continually deferred to him, and were every day more and more surprised at the extent and accuracy of his information respecting subjects which seemed the least likely to engage the attention of a man so much devoted to the pursuits of science. In a word, the range of his knowledge was surpassingly great. He had all his life read much; he had been a constant and attentive observer; and he had never forgotten anything which seemed worth remembering. A powerful and retentive memory, sustained and directed by sound judgment and singular sagacity, formed the principal foundation of his immense works, and of the success which more or less attended him in all his employments. Nor in the midst of a life so occupied did he neglect the graces and accomplishments of society. His conversation, sometimes grave and solemn, sometimes piquant and lively, at all times distinguished for its propriety and correctness, made him the ornament of the saloons, and the delight of all those who had the honour of his acquaintance. He was a warm, sincere, and faithful friend; full of gratitude to those who had contributed to his early advancement in life; moderate in all his habits; and wholly unimpeachable in the different relations of social life. He engaged the minds and hearts of those who surrounded him; and whilst he displayed great ability in directing the efforts of others towards the accomplishment of his own views, he was wholly free from that engrossing selfishness which sometimes attends great mental superiority. In a word, Cuvier was a good as well as great man, combining with talents and accomplishments of the first order that high personal worth which conciliates universal esteem, disarms envy, and sheds fresh lustre even on the brightest and noblest mental endowments. (J.B—E.)

CUXHAVEN, a seaport-town of Northern Germany, at the mouth of the Elbe, on its left bank, 58 miles W.N.W. of Hamburg, to which city it belongs. It has about 1000 inhabitants, chiefly pilots and fishermen, and the harbour is good and secure. In summer it is a resort of sea-bathers.

CUZCO, or Casco, a large and handsome town of South America, capital of a cognominal department in Peru, 375 miles E. of Lima. S. Lat. 13. 30.; W. Long. 72. 4. It is situated in a valley at the foot of some hills, and is 11,380 feet above sea level. Pop. about 45,000. Cuzco was formerly the capital of the empire of the Incas, and when taken possession of by the Spaniards under Pizarro in 1534, was a place of great splendour and magnificence. The famous temple of the Sun, a splendid edifice, superbly adorned with gold and silver figures, speedily fell a sacrifice to the cupidity and fanatical zeal of the conquerors. Portions of its walls are still to be seen, forming part of a magnificent Dominican convent. Upon a hill north of the town are the ruins of a very extensive fortress of the Incas, composed of polygonal-shaped stones of enormous size, some of them said to exceed in weight 150 tons. They are fitted together without cement, but with such nicety that their interstices are scarcely perceptible. In the plain to the south of the town are extensive remains of ancient edifices in the same style. The town is built in the form of a square, having in the centre a large market-place, in which four wide and straight streets converge. The houses are built of stone and covered with red tiles, and many of them still consist of the walls of the earlier structures. The cathedral and convent of St Augustine are considered to be among the finest religious edifices in the New World. The town has a university, collegiate schools, a mint, and several hospitals. The inhabitants are chiefly employed in the manufacture of woollen and cotton stuffs, leather, embroidery, &c.

CYANOMETER (*κυάνος blue, μετρόν a measure*), an instrument contrived by Saussure, for measuring the variable intensity of the cærulean hue which the sky assumes in different climates and at different elevations. A circular band of thick paper is divided into 51 parts, each painted with a different shade of blue from the deepest to the lightest tint.

Cyathus ‖ Cybele.

CYATHUS (*κύαθος, a cup*), in *Antiquity*, a common measure among the Greeks and Romans. It was equal to one-twelfth of the sextarius, or of a pint English, and was used as a measure of things both of the liquid and dry kind. The cyathus frequently occurs as the name of a drinking-vessel used by the Romans; in which case it was made with a handle, like the modern ladle. With this vessel the drinking-cups at a banquet were supplied from the mixing-bowl by a slave. The cyathus is referred to as the measure of the quantity drank by a person on such occasions; and it was a common practice at convivial meetings to make the number of cyathi correspond to the number of the muses, or to that of the letters in a patron's name—a kind of compliment not very dissimilar to the modern practice of drinking a person's health. The word cyathus also denoted a cupping-glass; and it was likewise used to signify the hollow of the hand.

CYAXARES I., the son of Phraortes, and third king of Media, reigned B.C. 634–594. See Media.

Cyaxares II., an ancient Persian king, mentioned by Xenophon. Some identify him with Darius the Mede of Scripture, others deny his existence altogether.

CYBEBE, another form of the name of the Phrygian goddess Cybele.

CYBELE, in *Pagan Mythology*, the daughter of Cœlus and Terra, and wife of Saturn. She is supposed to be the same as Ceres, Rhea, Ops, Vesta, Bona Mater, Magna Mater, Berecynthia, Dindymene, &c. According to Diodorus, she was the daughter of a Lydian prince, and, immediately after her birth, was exposed on a mountain. But she was preserved by sucking some of the wild beasts of the forest, and received the name of Cybele from the mountain where her life had been preserved. When she returned to her father's court, she had an intrigue with Atys, a beautiful youth, whom her father mutilated. All the mythologists are unanimous in mentioning the amours of Atys and Cybele. In Phrygia the festivals of Cybele were observed with the greatest solemnity. Her priests, called *Corybantes* and *Galli*, were not admitted into the service of the goddess without undergoing a previous mutilation. In the celebration of the festivals, they imitated the manners of madmen, and filled the air with shrieks and howlings mixed with the confused noise of drums, tabrets, bucklers, and spears. This was done in commemoration of the sorrow of Cybele for the loss of her favourite Atys. Cybele was generally represented as a robust woman far advanced in pregnancy, to symbolize, it is said, the fecundity of the earth. She held keys in her hand, and her head was crowned with rising turrets, and sometimes with the leaves of an oak. She is also represented as riding in a chariot drawn by two tame lions, while Atys follows by her side, carrying a ball in his hand, and supporting himself upon a fir-tree, which is sacred to the goddess. Sometimes she is represented with a sceptre in her hand, and her head crowned with a tower. She is also seen with many breasts, to show that the earth gives aliment to all living creatures; and she generally carries two lions under her arms. From Phrygia the worship of Cybele passed into Greece, and was solemnly established at Eleusis under the name of the Eleusinian Mysteries of Ceres. The Romans, by order of the Sibylline books, brought the statue of the goddess from Pessinus into Italy; and when the ship which carried it had run on a shallow bank of the Tiber, the virtue and innocence of Claudia were vindicated by her drawing it back into deep water with her girdle. It is supposed that the mysteries of Cybele were first known about 257 years before the Trojan war, or 1451 years B.C.

Cyceon ‖ Cyclops.

CYCEON (from κυκάειν, to *mix* or *mingle*), a name given by the ancient poets and physicians to a mixture of meal and water, and sometimes of other ingredients. The coarser kind consisted of water and meal alone; the richer and more delicate was composed of wine, honey, flour, water, and grated cheese. Homer, in the eleventh book of the Iliad, speaks of cyceon made of cheese and the meal of barley mixed with wine, without mention either of honey or water; and Ovid, describing the draught of cyceon given by the old woman of Athens to Ceres, mentions only flour and water. Dioscorides extols the simpler kind, pronouncing it, when prepared with water alone, to be highly refreshing and nutritious.

CYCLADES, one of the two groups of islands in the Aegean Sea, the Sporades being the other. They were originally twelve in number, and derived their name from the fact of their lying in a circle round the sacred isle of Delos, which was the smallest of the group. These twelve were Andros, Ceos, Cythnos, Delos, Myconos, Naxos, Paros, Rheneia, Seriphos, Siphnos, Syros, and Tenos. To these three were afterwards added, Prepesinthos, Oliaros, and Cyaros, making in all fifteen. The most important of these islands will be found described under their respective heads.

CYCLAS, in *Roman Antiquity*, a kind of state-robe used by women, was of a circular form, and ornamented with an embroidered border. Suetonius relates that Caligula sometimes appeared in public in a robe of this description.

CYCLE (κύκλος a *circle*), in *Chronology*, a period or series of numbers, which regularly proceed from the first to the last, and then return again to the first, and so circulate perpetually: any periodical space of time.

Cycle of Indiction. See Calendar, vol. vi., p. 81; Chronology, vol. vi., p. 673.

Cycle of the Moon, called also the *Golden Number*, and the *Metonic Cycle*. See Calendar, vol. vi., p. 81.

Cycle of the Sun, or Solar Cycle. See Calendar, vol. vi., p. 80.

CYCLOID, a geometrical curve on which depends the doctrine of pendulums. It was demonstrated by Huygens, that from whatever point or height a heavy body oscillating on a fixed centre begins to descend, while it continues to move in a cycloid the time of its falls or oscillations will be equal to each other. It is likewise demonstrable, that it is the curve of quickest descent—that is, a body falling in it from any given point above, to another not exactly under it, will come to this point in a less time than in any other curve passing through those two points.

The genesis of a cycloid may be illustrated thus: If a wheel be made to roll along a right line till it has completed one revolution, a point fixed in that part of its circumference which at the commencement of the motion touches that right line, will have described a cycloid on a vertical plane—or, in other words, in its course through the air.

CYCLOPÆDIA, or more properly Encyclopædia (ἐν κύκλῳ παιδεία, *instruction in a circle*), signifies the circle or compass of the arts and sciences; a term used to denote a dictionary of arts, sciences, and miscellaneous literature. See Encyclopædia.

CYCLOPEAN (from *Cyclops*), a term applied to all the gigantic structures of pre-historic antiquity.

CYCLOPS (from κύκλος a *circle*, and ὤψ the *eye*), three famous Titans, distinguished by having one eye in the middle of their forehead. They were fabled to have been the sons of Uranus and Ge, and their names were Arges, Brontes, and Steropes. They are said to have been thrown into Tartarus by Saturn; but having been released by Jupiter they forged his thunderbolts, as well as the shield of Pluto and the trident of Neptune. In Homer the Cyclops appear as a band of gigantic Sicilian shepherds who indulged in cannibalism and other atrocities. A later tradition represents them as the assistants of Vulcan, and engaged in fabricating armour in their workshops under Mount Ætna.

Cyder ‖ Cynanche.

CYDER. See Cider.

CYDIAS, a celebrated artist, who painted a famous picture of the Argonauts about B.C. 360. It was bought by the orator Hortensius, and exhibited at Rome.

CYDNUS, in *Ancient Geography*, a small river of Cilicia, in Asia Minor, noted for the clearness and coldness of its waters. It rises in the range of Taurus, near the Pylæ of Cilicia; and, after a short course in a southerly direction, falls into the sea near the mouth of the Sarus. See Cilicia.

CYDONIA, in *Ancient Geography*, a very old and famous city of Crete, at the north-western end of the island. It is said to have been built by the Samians, who had established themselves in the island, but the traditions of Crete all point to a much earlier origin of the city. In later times the Æginetans colonized Cydonia, which on that account experienced the full hostility of the Athenians during the Peloponnesian war. In the sacred war Cydonia was attacked by Phalæcus, the Phocian general, who fell with the greater part of his army before the walls of the town. The first battle which was fought in Crete by the Romans against the natives took place close to Cydonia. Their army under Metellus was victorious. For an account of the feuds which prevailed between Cydonia and Cnossus, see Crete and Cnossus.

Cydonia, the quince, so called from Cydonia the above-mentioned city, the gardens in its neighbourhood abounding in this fruit.

CYGNUS, the swan. See index to Ornithology.

Cygnus, the *Swan*, in *Astronomy*, a constellation of the northern hemisphere, between Lyra and Cepheus. In Ptolemy's catalogue it contains 19 stars, in Tycho's 18, in Hevelius's 47, and in the British catalogue 81.

CYLINDER, in *Geometry*, a solid body supposed to be generated by the rotation of a rectangular parallelogram round one of its sides.

CYLINDROID, in *Geometry*, a solid body approaching to the figure of a cylinder, but differing from it in some respects, such as having the bases elliptical, but parallel and equal.

CYLLENE, in *Ancient Geography*, a mountain of the Peloponnesus, in the N.W. corner of Arcadia, and close to the confines of Argolis and Achaia. It is frequently alluded to in the Greek and Roman classics as the birthplace of Mercury, who from that circumstance is often called Cyllenius. There was a famous temple of that deity on the top of the mountain, which was believed by the ancients to be so high as to be beyond the reach of winds and rain. The modern name of Cyllene is Zyria; and its height, as determined by the French survey, is 7788 feet above the sea. It is thus inferior in height to Taygetus alone of all the mountains in the Morea.

Cyllene was also the name of a town in Elis. It was the seaport of the city of Elis, from which it was distant about 13 miles.

CYMA, or Cymatium. See glossary to Architecture.

CYMBAL (κυμβαλον), an ancient metallic instrument of percussion, of the same kind as the modern cymbals used in military bands; not a drum, as some authors pretend. See Music, § *Musical Instruments.*

CYNÆGIRUS, an Athenian soldier who distinguished himself at the battle of Marathon. He was the son of Euphorion, and brother of the poet Æschylus. In pursuing the Persians to their ships, he is said to have seized one of their vessels with his right hand, and when it was severed, with his left, and when this too was lost he still maintained his hold with his teeth.

CYNANCHE (literally, *a dog's collar*), a Greek word used to denote a disease in which the throat inflames and

Cynanchum ‖ Cynosura.

swells, so as to cause a difficulty of breathing; as in quinsy, croup, and malignant sore throat.

CYNANCHUM, a genus of plants of the natural order of *Asclepiadeæ*, the best known of which is a European plant, *C. Vincetoxicum*, that has drastic purgative qualities, and is considered by Orfila as a poison. Another species, *C. Argel*, has its leaves often mingled with those of the Egyptian senna, probably from the negligence or ignorance of the native herbalists.

CYNARA, the artichoke. See HORTICULTURE.

CYNICS (from κύων, *a dog*) a sect of ancient philosophers, deriving their name either from their snarling habits, or from the Cynosarges, in which Antisthenes, the founder of the school, used to lecture. It is not at all improbable that even the name of the place was derived from the characteristic mood of its occupants. The Cynics form one of the three great branches of the Socratic philosophy, the schools of Aristippus of Cyrene and Euclid of Megara being the other two. Its founder was Antisthenes; its prodigy, Diogenes; while, as secondary expounders of its doctrines, or rather mimic patterns of its discipline, we have Onesicritus, Monimus, and Crates. Perhaps no sect in ancient times was more indebted to the peculiar idiosyncrasy of its originators. Indeed, it originated entirely in their own inverted ambition, and, like all professional ribaldry and scoffing, it quickly changed its rude and caustic pantomime for open indecency and licentiousness. Mistaking the Socratic doctrine of man's superiority to circumstances, the Cynics not only gloried in the contempt of pleasure, but in an utter disregard of social distinctions, and a perfect insensibility to the decencies and charities of life. In this they seem to have imitated the discipline to the neglect of the doctrine of Socrates; and the entire absence of dogmatic principles may fairly entitle us to challenge their claim to the appellation of moral philosophers at all. Regarding themselves as out of the pale of civilized society, they aimed their taunts and sneers at all the minor moralities of life, and in their caricature of what they regarded as factitious they systematically destroyed the external defences of virtue. Their philosophy is of importance principally as furnishing the historical antecedents of Stoicism, which, while supplanting it, was deeply imbued with its misanthropical and unearthly morality. For the characteristic eccentricities of the leading Cynics, see their biographies.

CYNOPHONTIS, in *Grecian Antiquity*, a festival at Argos; so called from the killing of dogs on the occasion.

CYNOSARGES, a place in the suburbs of Athens, so named from the mythological story of a white or swift dog which snatched away part of the victim when Diomus was sacrificing to Hercules. In it was a gymnasium consecrated to Hercules, for the use of those who were not of pure Athenian blood; and also a court of judicature to try illegitimacy, and to examine whether persons were of the pure or of the half blood. Here the philosopher Antisthenes taught; and his followers were called *Cynics*, either from the place, or from the snarling disposition and coarse mode of life of that sect. See CYNICS.

CYNOSCEPHALÆ, in *Ancient Geography*, a rugged mountain range in Thessaly, running parallel with the course of the Apidanus. The range is only remarkable as having been the scene of two battles important in Greek history; in the first of which—fought between the Thebans and the Pheræans B.C. 364—Pelopidas the Theban general was slain; in the second, fought between the Greeks and Romans B.C. 197, Philip the last king of Macedon was defeated and taken prisoner by the consul Flamininus.

CYNOSURA, in *Mythology*, a nymph of Ida, in Crete, and one of the nurses of Jupiter, who placed her among the stars.

This was also the name of a promontory in Attica, to the south of Marathon.

Cynosure ‖ Cyprian.

CYNOSURE (κυνόσουρα, *dog's tail*), in *Astronomy*, the name given by the Greeks to *Ursa Minor*, the little bear. This constellation is near the north pole, and consists of seven stars, four of which are disposed like the four wheels of a chariot, and three lengthwise like the beam: hence it is sometimes called the *Chariot*, or *Charles's Wain*.

As seamen are accustomed to steer by this constellation, cynosure is sometimes taken for that which directs or attracts attention.

CYNTHIA and CYNTHIUS, in *Mythology*, surnames respectively of Diana and Apollo; derived from Mount Cynthus, in the island of Delos, their birthplace.

CYNURIA, in *Ancient Geography*, a territory in the Peloponnese, lying partly in Argolis and partly in Laconia, and inhabited by a tribe of half-barbarous marauders of Pelasgic origin, who on the approach of an enemy retired to their fastnesses on Mount Parnon. The Cynurians were first subdued by the Argives, to whom they remained subject with some small intermissions till the year 547 B.C., when they fell under the dominion of Sparta. The city of Thyrea, with a small tract of the surrounding country, is the only part of the Cynuria that can now be identified. At the beginning of the Peloponnesian war, it was assigned as a dwelling-place by the Spartans to the people of Ægina, who had been driven out of their island by the Athenians. In the eighth year of that war, however, the Athenians landed on the coast, took Thyrea, and carried away the inhabitants into captivity. By Philip of Macedon the Thyreatis was restored to the Argives; but quarrels for the possession of the district subsisted between that people and the Spartans till the days of Pausanias.

CYPHONISMUS, in *Grecian Antiquity*, punishment by the *cyphon*, a kind of pillory in which slaves or criminals were fastened by the neck. The word *cyphon* (κύφων), from which *cyphonismus* is derived, signifies strictly a crooked piece of wood, or the bent yoke of a plough. Some writers suppose that this is the punishment mentioned by Jerome in his life of Paul the Hermit (chap. ii.), in which the body was smeared with honey, and the person so bedaubed was exposed, with his hands bound, to the rays of the sun, in order to invite the attacks of flies and other vermin.

CYPRESS. See PLANTING.

CYPRIAN, *Thasius Cæcilius*, a celebrated Christian father, who suffered martyrdom during the persecution under Valerian and Gallienus. The precise date of his birth is uncertain, and little is known of his history until the period of his conversion to Christianity, A.D. 246, by Cæcilius, an aged Carthaginian presbyter. It seems certain that he was then nearly fifty years of age; and the statements of Jerome and Lactantius, that he had previously reaped a considerable fortune as a Pagan rhetorician, is quite borne out by the florid style of his Christian oratory. At his conversion he is said to have sold his estate for the benefit of the poor, and devoted himself wholly to a life of asceticism and study; but at a later period of life we find him again in possession of his original property. His liberality and previous renown, as well as his zeal and eloquence in behalf of Christianity, seems to have paved the way for his rapid advancement in the church. At his baptism he had been ordained a presbyter; and two years had scarcely elapsed when he was forcibly installed archbishop of Carthage—the populace thronging the avenues to his house and effectually preventing his escape. In the third year of his administration, the severe edicts of Decius fell like a thunderbolt upon the Christians of Africa; and Cyprian found himself surrounded by multitudes who, to use his own expression, "fell of their own accord before the violence of persecution had struck them down," and in the recoil of their fickle enthusiasm now eagerly clamoured that he should be thrown to the lions. Prudence suggested the necessity of a retreat; and with this view he retired into an

Cyprian. obscure solitude, from whence he could maintain a constant correspondence with the clergy and people of Carthage. In justification of what his enemies branded as a pusillanimous and criminal desertion of duty, Cyprian alleged the authority of a heavenly vision, which with him too often supplied the place of a second conscience. On his return to Carthage, internal dissension succeeded external persecution; and the eagerness of the Lapsed to be readmitted into the church, without the preliminary penance, occasioned more trouble to the archbishop than his hasty retreat from danger. Novatus and Felicissimus, the rival candidates for the see of Carthage, headed the opposition; but Cyprian resisted the dangerous indulgence, while the schemes of the dissentients to provoke a schism with Rome were thwarted by the firmness of the primate Cornelius. The death of Decius, however, soon put an end to the brief period of external peace. The suspicions of Gallus were chiefly aroused against the hierarchy, and the martyrdom of Lucius quickly following the banishment of Cornelius was little calculated to soothe the minds of the African bishops. The fury of the people was, however, mainly directed against the Christian laity, who, in the midst of pestilence and the fierceness of persecutors, not only refused to join in the propitiatory Pagan sacrifices, but resolutely justified these calamities as judgments on the state religion, and boldly prognosticated the dissolution of the world. A short but troubled interval of rest ensued upon the accession of Valerian. Six years after, however, the latent spirit of persecution broke out afresh, and Cyprian, summoned before the proconsul Paternus, was presented with an imperial mandate requiring that he should abjure the Christian religion. Cyprian boldly replying that he was a Christian and a bishop, devoted to the worship of the true and only Deity, was immediately condemned to banishment. He was conducted without delay to Curubis, a maritime city of Zeugitania, about forty miles from Carthage. Here the exiled bishop enjoyed all the conveniences of life, and his solitude was often cheered by the letters, visits, and congratulations of the faithful. On the arrival of a new proconsul in the province, the fortunes of Cyprian began to wear a more favourable aspect. He was recalled from banishment; and though not yet permitted to return to Carthage, his own gardens in the neighbourhood of the capital were assigned for his place of residence. At length, exactly one year after his first apprehension, the imperial warrant arrived for the summary execution of the Christian teachers; and Cyprian, resisting the temptations to flight, returned to his gardens to await the ministers of death. On his apprehension he was conveyed not to prison but to a private house, where at an elegant supper his friends were permitted for the last time to enjoy the society of their spiritual father. In the morning he was brought before the tribunal of the proconsul, and commanded to offer sacrifices to the gods of Rome. His refusal was firm and decisive, and the magistrate pronounced with reluctance the sentence of death. Surrounded by his faithful presbyters and deacons, who assisted him in doffing his upper garment, and spread linen on the ground to catch the precious relics of his blood, the martyr covered his face with his hands, and at one blow his head was severed from his body (A.D. 258). His corpse remained for some hours exposed to the curiosity of the Pagans; but in the night it was removed, and transported in a triumphal procession, and with a splendid illumination, to the burial-place of the Christians.

The works of Cyprian are numerous and valuable, and some of them—as, for instance, the treatise *On the Unity of the Catholic Church*—undoubtedly mark an epoch in the history of the questions of which they treat. All his writings bear evidence of having been written under strong emotion; and the disputes which marked the commencement of his ecclesiastical career imparted to his mind a tone of spiritual dogmatism, of which we find traces even to the close of his life. His tracts too not unfrequently degenerate from piety to enthusiasm, from righteous indignation to personal virulence and malice. Among his principal works his treatise *De Lapsis*, *i.e.*, concerning the treatment of those who, during the persecutions, had lapsed into idolatry, is greatly disfigured by a profusion of miraculous stories, which are curious as occurring in the works of a man too clear-headed to be deceived, and whose biography stands in marked contrast to the lives of the other Fathers in the prosaic and historical character of its details. His treatise *De Unitate Ecclesiæ Catholicæ* is interesting as marking the transition from the spiritual to the outward idea of church unity. Many of its most decisive passages, however, are controverted; but from an undisputed passage in his epistle to Cornelius, in which he styles "the chair of Peter the fountain of all ecclesiastical authority," it seems certain that he held the opinions expressed in his treatise. His more practical works, in regard to *Martyrdom*, *Mortality*, the *Dress of Virgins*, the *Duty of Almsgiving*, &c., are characterized by great firmness and earnestness, and are full of valuable incidental allusions to the manners and customs of his age. Most of his works have been translated into English. The great authority for his life is his biography by Pontius, a Carthaginian deacon. Cyprus.

CYPRIAN, belonging to Cyprus; hence used as an epithet of Venus, who is frequently styled in poetry the Cyprian Queen.

CYPRUS (*Kybris*) an island in the N.E. corner of the Levant, lying at about equal distances from the shores of Cilicia and Phœnicia. Its extreme length from the promontory of Dinaretum to that of Acamas is about 140 miles; its extreme breadth, from the promontory of Crommyon to that of Curias, about 70 miles. The area is roughly estimated at about 4500 English square miles. The greater part of the island is occupied by the central ridge and spurs of the Stavro-Vuno and Santo Croce mountains (the ancient Olympus). The loftiest peaks of this range attain a height of from 8000 to 10,000 feet above the sea. Their northern slopes are rocky and bare, but on the side of the south they are well-wooded and highly picturesque, and inclose in various parts of their course valleys of unrivalled fertility. The outline of these mountains is rugged and highly imposing in general effect, but they are not remarkable in the legends or traditions of early history. Santa Croce, however, is note-worthy, as on it stands a church said to have been built by Helena, the mother of Constantine; and another peak on the northern side of the island still shows an old castle and a monastery commanding a magnificent view. The whole island only contains two plains of any magnitude. The largest of these begins at the city of Salamis, on the eastern side of the island, and extends westward to the city of Tamasus; the other, which also extends westward, begins at the town of Citium, and stretches inland to the southern slopes of Mount Olympus. The first of these plains, whose fertility has always been remarkable, was called Messaræa, and was watered by the Pediæus; the other, which was no less fertile, was watered by the Tretus. Except these two districts and occasional valleys in the range of Olympus, the island is for the most part beyond the reach of cultivation.

Considerable part of the wealth of ancient Cyprus arose from its copper mines, the most important of which were those of Tamasus in the centre of the island, Soli on the north coast, and Amathus and Cyrium on the south coast. In these mines gold and silver were also found. The precious stones of Cyprus were also highly valued. The chief of these were the emerald, agate, malachite, jasper, opal, and the minerals asbestos and rock crystal.

The first settlers in Cyprus appear to have been of Phœnician origin, and as early as the days of Solomon acknow-

Cypselus. ledged the supremacy of the Syrians. To them the Greeks succeeded. They in turn were reduced by the Egyptians under Amasis, who kept the island until dispossessed by the superior power of the Persian Cambyses. An attempt made shortly after this by the Greek portion of the inhabitants to throw off the Persian yoke was put down, and the island remained subject to its oriental conquerors till the overthrow of their naval power at Salamis. Afterwards Cyprus was governed alternately by Greeks and Persians till the days of Alexander the Great, when it declared for that monarch, and sent a fleet to assist him in his eastern conquests. Upon Alexander's death Cyprus was incorporated with Egypt, and fell to the lot of Ptolemy. It was wrested from Ptolemy by Demetrius Poliorcetes, who retained it for about ten years; at the end of which period it once more fell into the hands of Ptolemy, by whose successors it was carefully watched over, and to whose annual revenues it contributed a very large proportion. It remained in the family of the Ptolemies as a sort of storehouse for the jewels and plate belonging to the Egyptian crown, till in B.C. 58 it became a province of the Roman empire, and in the political distribution of the Roman conquests was annexed to Cilicia, having, however, a quæstor and judicial courts of its own. Under Augustus it became an imperial province, and was governed by a proconsul with a staff of inferior officers. Before the close of the first century of the Christian era the Jewish population of the island had greatly increased, and in the reign of Hadrian is said to have risen in rebellion and slain 200,000 of the other inhabitants. In the seventh century Cyprus fell into the hands of the Saracens; and in the ninth it owned the supremacy of the "good" Haroun Al Raschid. At the close of the twelfth century it was conquered by Richard Cœur de Lion, who made it over first to the knights of the Temple, and ultimately to Guy of Lusignan, titular king of Jerusalem. For three centuries the island remained in the family of Lusignan, till in 1473 it became an appanage of the Venetian republic. Cyprus was retained by the Venetians till in 1571 it was overrun by an army of Turkish invaders, who stormed Lefkosia and Famagosta, and made a general massacre of the inhabitants. Since that date the island has remained in possession of the Turks, and now forms a pashalic in the Eyalet of Djizairs. Under the Turkish rule the material prosperity of Cyprus has greatly declined. In the times of the Venetian supremacy the island maintained a population of 1,000,000: its present population is only about 150,000, of whom the great majority are Greeks. Many parts of the island formerly healthy and fertile are now, from malaria and other causes, barren and uninhabitable. Its trade was at one time valuable and important; now the value of its annual imports does not exceed L.26,000; of its exports about L.60,000. Besides corn, of which it produces about 120,000 quarters annually, Cyprus yields in considerable quantities cotton, wine, various kinds of fruit, opium, and madder; while the mountain districts furnish olives, pines, and many species of valuable timber. On the island are found great quantities of the *Ferula græca*, which the Cypriote applies to a great variety of domestic purposes. This is the plant whose uses are feigned by the poets to have been taught to mortals of old by Prometheus.

Knights of CYPRUS, an order instituted by Guy of Lusignan, titular king of Jerusalem, to whom Richard I. of England, after conquering Cyprus, made over that island, A.D. 1191.

CYPSELUS, a tyrant of Corinth, and father of the more renowned Periander, flourished about the middle of the seventh century B.C. It had been foretold by the Delphic oracle that he would prove formidable to the reigning family, who accordingly despatched officers to destroy the child as soon as he should be born. His mother, however, concealed him in a chest, from the Greek word for which (*cypsele*) the boy derived his name. This chest was ever after preserved with peculiar care by the descendants of Cypselus. A minute description of it is given in Pausanias (v. 17). See CORINTH.

Cyr Cyrenaics.

CYR, ST, a village of France, Seine-et-Oise, arrondissement of Versailles, and three miles W. of that town. It is celebrated for an institution founded here by Louis XIV., at the suggestion of Madame de Maintenon, for the education of 250 young ladies of noble birth. Racine's tragedies of "Esther" and "Athalie" were written for and first acted by the pupils of this establishment. It was converted by Napoleon in 1806 into a training school for infantry officers, and is still used for that purpose.

CYRENAICA, or PENTAPOLIS, in *Ancient Geography*, a district of Africa, on the shores of the Mediterranean Sea, lying exactly opposite to Greece in a southerly direction, at the distance of about 250 miles. It received the name of *Cyrenaica* from Cyrene, its chief city; and that of *Pentapolis* from the fact of its containing five principal cities, Berenice or Hesperus, Barce, Cyrene, Apollonia, and Arsinoe. The district included that portion of the African continent which stretched from the borders of Africa Propria, beginning at the town of Ara Philemon on the west, to the frontier of Egypt on the east. The breadth of the district, measuring from the Mediterranean to the confines of the great desert, is about 80 miles. On its southern frontier Cyrenaica is protected from the scorching winds of the Sahara by a range of lofty mountains which descend in gradual slopes to the sea, producing thus within a small compass a great variety of climate and temperature. From this circumstance the vegetable products of Cyrenaica comprise almost every species to be found both in the tropical and temperate zones; and as its position was admirably adapted for commerce, nothing was wanting but an enterprising population to turn these advantages to account, and make the country one of the most valuable in the world. The people of Thera, under Battus a native of that island, were the first to colonize Cyrenaica. After a slight opposition from the native tribes, they established themselves in the country, and founded Cyrene B.C. 631. Other cities soon began to spring up in advantageous situations, which acknowledged Cyrene as the capital of the country, but were really quite independent of it, and at length threw off its yoke altogether. After the invasion of Cambyses the regal form of government was entirely abolished, and the republican substituted in its room. Under the Ptolemaic dynasty of Egypt (with which country Cyrenaica was incorporated B.C. 321), Cyrenaica rose into great importance from the extent and value of its commerce. At the beginning of the first century B.C. it was bequeathed by will to the Romans by Apion, the last lineal representative of the Ptolemies. Soon afterwards it became a Roman province, and along with the island of Crete was governed by a Roman proconsul. The commercial prosperity of Cyrenaica, however, continued unimpaired till the revolt of the Jews in the province during the reign of Trajan. This revolt was only quelled after the most bloody atrocities had been perpetrated on both sides; and the population was so much diminished in the contest, that the native tribes recommenced their incursions, and overran the province up to the walls of the principal cities. In the middle of the seventh century of the Christian era the whole country passed into the hands of the Saracens. From that time till the present the country has been occupied by tribes of wandering Arabs nominally subject to the pasha of Tripoli. See Beechy's *Expedition;* Pacho; Barth, &c.

CYRENAICS, an ancient philosophical sect, so called from Cyrene, the birthplace of Aristippus its founder. Like the Cynic and Megarian schools, it emerged directly from the Socratic philosophy; and while these schools afterwards combined to form the system of Stoicism, the Cyrenaic, after

receiving modifications from the hands of Hegesias, Anniceris, and Theodorus, was ultimately merged in the kindred philosophy of Epicurus.

With them the *summum bonum* was pleasure, and that not merely as identical with a general tranquillity of mind, but as composed of a great variety of individual pleasant sensations. The choice, then, of what is individually pleasurable, and the rejection of what is individually painful, becomes the great practical rule of life and action; and it is the intellectual faculty which strikes the balance and determines the choice. In this way, the Cyrenaic philosophy was a one-sided development of the Socratic, being based on the doctrine of that great sage in regard to the connection of reason and intellect with virtue; while the Cynic school confined its view almost exclusively to his rigid discipline.

CYRENE (*Ghrennah*), the capital of Cyrenaica, was situated on the northern slope of a lofty table-land nearly 2000 feet above the level of the sea, from which it was 10 miles distant. It was the first town of Cyrenaica founded by Battus and his Therian followers (see CYRENAICA), and very soon rose into great importance as a commercial mart. The policy of Battus led him to conciliate the aboriginal tribes of Libya, with whom his subjects began at an early period to form matrimonial alliances. In a short time the intermixture of African blood was so general that the royal family itself became affected by it. The natives, however, as in all colonies formed on the principles of Spartan policy, were scrupulously excluded from any participation in the government of the state. For eight generations, as had been foretold by the Delphic oracle, Cyrene continued to be governed by the dynasty of Battus, whose kings ruled under the names of Battus and Arcesilaus alternately. After this family had occupied the throne for 200 years, the kingly government was overthrown and a republic substituted. Cyrenaica now became an appanage of the Egyptian crown; and the Ptolemies, carrying out their usual policy, fostered Apollonia, the port of Cyrene, to such an extent that the latter city soon fell into decay. In later days, Cyrene was known as a Roman province under the name of Flavia.

Cyrene was noted among the ancients for the intellectual vitality of its inhabitants. Callimachus the poet, and Carneades the founder of the New Academy at Athens, were natives of Cyrene, which at an early period was noted for its medical school. Synesius, surnamed the Philosopher, one of the most elegant of the ancient Christian writers, was also a native of Cyrene. Aristippus, a pupil of Socrates, founded a school of philosophy, which, from the birthplace of the founder, was called the Cyrenaic School. The ruins of the town, to which the Turks have given the name of Ghrennah, are still distinctly visible. They cover a great extent of ground, but have been sadly defaced by the various races which have overrun the country.

CYRIL, ST, bishop of Jerusalem, was born in that city about A.D. 315. He was ordained priest by Maximus the patriarch, under whom he held the office of catechist; and chiefly through the influence of Acacius of Cæsarea he was chosen to fill the vacant see of his spiritual father (A.D. 351). The opening of his episcopate was signalized by the appearance, during the festival of Pentecost, of a luminous cross in the heavens, stretching for two miles from Golgotha to Olivet; but the prestige of the omen did not prevent the immediate outbreak of a quarrel between him and the rival metropolitan of Cæsaræa. The subject of dispute was the consubstantiality of the Son; but the real origin of the disagreement may be traced to the firmness of Cyril in maintaining the independence of his see. After contesting their claims with various success before the synod of the bishops of Palestine, the emperor Constantius, and the synod of Seleucia, Cyril was at length deposed by the council of Constantinople. After a short period of retirement spent at Tarsus, he returned to his see on the accession of Julian, but was a second time expelled by the Arian bishop of Constantinople. He was finally restored, under the Trinitarian Theodosius, by the council of Constantinople (A.D. 381). The principal works of Cyril are his *Eighteen Catechetical Discourses*, consisting of brief expositions of Christian doctrine to the catechumens of his diocese. The last five, entitled *Mystagogical Lectures*, are devoted chiefly to an exposition of the sacraments. Independently of the prodigy of the radiant cross that marked the commencement, and the prophecy of the miraculous interruption of Julian's attempt to rebuild Jerusalem, that signalized the close of his career, we have ample proof in his writings of the superstitious caste of Cyril's mind. He was particularly enthusiastic in inculcating the adoration of the cross, and firmly believed in the miraculous multiplication of its fragments. Amongst other doctrines, we find great prominence given to the perpetual virginity of Mary, and transubstantiation. His writings are valuable as giving elaborate accounts of the ritual of the church over which he presided.

CYRIL, *St*, patriarch of Alexandria, was educated under his uncle Theophilus, the bishop of that place, and spent a considerable part of his youth in the adjacent monasteries of Nitria. From this solitude, however, he was recalled by his uncle, who installed him as preacher in the cathedral, and instilled into his mind those lessons of zeal and dominion which the unscrupulous antagonist of Chrysostom was so well qualified to impart. On the death of Theophilus the clergy were divided in their choice of a successor; but a resistless multitude asserted the cause of their favourite archdeacon, and the ambitious Cyril was duly installed in the throne of Athanasius. Like Nestorius, the contemporary bishop of Constantinople, he began his patriarchal reign with a vigorous persecution of heretics; and the first victims were the Novatians, the most innocent of all the existing sects. His next stroke was aimed at the Jews, whom he attacked at the head of a seditious multitude, and levelled their synagogues with the ground. Hypatia, the daughter of Theon the mathematician, was the next to excite his jealousy; and having been represented as alienating the mind of the governor from the clergy, she was dragged to the church and murdered by a band of merciless fanatics. (See HYPATIA.) One step only remained to gratify his ambition; and the phraseology of Nestorius (acquired in the Syrian school) in regard to the two natures of Christ, afforded an admirable opportunity for the degradation of the Byzantine pontiff. After a short correspondence, the patriarch of Alexandria denounced to the emperor the heresy of Nestorius, and carried his plea to the Vatican. Pope Celestine, ignorant of Greek, and therefore incapable of realizing the defence of the accused, hastily assembled a council, which condemned Nestorius and degraded him from his rank. From Rome the contest travelled back to Ephesus, and there the arrival of the Eastern bishops under John of Antioch converted the ecclesiastical quarrel into a warlike feud. The intrigues of Cyril, however, triumphed over every obstacle; and after an appeal to Theodosius the emperor, the belligerents, partially reconciled, concurred in the condemnation of Nestorius. On returning to Alexandria, Cyril was engaged in a controversy with Theodoret, which lasted till his death, A.D. 444. The principal works of Cyril are his *Glaphyra*, or commentaries, and a variety of controversial treatises and epistles. The former are disfigured by a constant rage for allegorizing; and the latter, besides the obscurity arising from the abstruse nature of their subjects, are involved in additional uncertainty by the ruggedness and obscurity of his style.

CYRUS, surnamed the GREAT, or the ELDER, the founder of the Persian empire, was the son of Cambyses the Persian, by Mandane, the daughter of Astyages, king of the Medes. The two principal historians who have written the life of Cyrus are Herodotus and Xenophon; but

Cyrus. their accounts differ in this, that the latter represents his father as a king of Persia, and the former as a man of humble origin.

Herodotus relates that Astyages, king of the Medes, having dreamed that a vine sprung from the womb of his daughter Mandane, the branches of which overshadowed all Asia, consulted the soothsayers, by whom he was told that his dream portended the future power and greatness of a child which should be born of his daughter, and further, that the same child would deprive him of his kingdom. In order to prevent the accomplishment of this prediction, Astyages, instead of marrying his daughter to some powerful prince, gave her hand to Cambyses, a Persian of mean condition, and one who had no great capacity for forming any important design, or for supporting the ambition of his son by his own riches and authority. But Astyages did not stop here. As soon as he understood that his daughter was pregnant, he commanded one of his officers, named Harpagus, to destroy the infant whenever it came into the world. But Harpagus, dreading the resentment of Mandane, put the child into the hands of one of the king's shepherds, with orders to expose him. The shepherd's wife, however, was so touched with the beauty of Cyrus, that she desired her husband rather to expose her own son, who had been born some time before, and to preserve the young prince. In this manner Cyrus was saved from an early death, and brought up among the king's shepherds.

When Cyrus had grown up, Harpagus disclosed to him the whole secret of his birth, together with the manner in which he had delivered him from the cruel resolution of his grandfather; encouraged him to go into Media, and promised to furnish him with forces, in order to make him master of the country, and to depose Astyages. Cyrus agreed to these propositions, engaged the Persians to take up arms against the Medes, marched at their head to meet Astyages, defeated him, and possessed himself of Media. He also carried on many other wars; and at length sat down before Babylon, which, after a long siege, surrendered to his arms.

The relation given of the life of Cyrus by Xenophon, in his philosophical romance, is, however, very different. According to him, Astyages, king of Media, married his daughter Mandane to Cambyses, king of Persia, son of Achæmenes, king of the same nation. Cyrus was born at his father's court, and was educated with all the care which his birth required. When he was about the age of twelve years, his grandfather, Astyages, sent for him to Media, together with his mother Mandane; and some time afterwards, the king of Assyria's son having invaded Media, Astyages, with his son Cyaxares and his grandson Cyrus, marched against him. Cyrus distinguished himself in this war, and defeated the Assyrians. Cambyses afterwards recalled him, that he might have him near his own person. On the death of Astyages, his son Cyaxares, uncle of Cyrus by the mother's side, succeeded to the kingdom of Media.

At the age of thirty Cyrus was appointed, by his father Cambyses, general of the Persian troops, and sent at the head of 30,000 men to the assistance of his uncle Cyaxares, whom the king of Babylon—with his allies the Cappadocians, Carians, Phrygians, Cilicians, and Paphlagonians—was preparing to attack. But Cyaxares and Cyrus prevented them, by falling upon them and dispersing them. Cyrus advanced as far as Babylon, and spread terror throughout the whole country. From this expedition he retired towards the frontiers of Armenia and Assyria, and was received by Cyaxares in the tent of the Assyrian king whom he had defeated.

Afterwards Cyrus carried the war into the countries beyond the river Halys, and having entered Cappadocia, entirely subdued that country. Thence he marched against Crœsus, king of Lydia, defeated him in battle, besieged him in Sardis, his capital, and, after a siege of 14 days, obliged him to surrender. (See CRŒSUS.) After this, Cyrus having reduced almost all Asia, repassed the Euphrates, and made war upon the Assyrians. He marched directly to Babylon, took it, and there prepared a palace for the reception of his uncle Cyaxares. After all these expeditions, Cyrus returned to his father and mother in Persia, where they were still living; and having gone sometime afterwards into Media to visit his uncle Cyaxares, he married his cousin, the only daughter and heiress of all Cyaxares's dominions, and went with her to Babylon, whence he sent men of the first rank and quality to govern the various nations which he had conquered. He engaged again in several wars, and subdued all the countries situated between Syria and the Red Sea. He died at the age of 70, after a reign of 30 years; but authors differ very much concerning the manner of his death. Herodotus, Justin, and Valerius Maximus state that he died in the war against the Scythians; and that, having fallen into an ambush which Tomyris, queen of the Scythians, had laid for him, by her orders his head was cut off and cast into a vessel full of blood, the queen saying, "Thou hast always thirsted after human blood, now glut thyself with it." According to Diodorus, he was taken in an engagement and hanged; while Ctesias relates that he died of a wound which he had received in his thigh; but by Xenophon's account he died peaceably in bed, amidst his friends and his servants; and certain it is, that in Alexander's time his monument was shown at Pasargada, in Persia. Cyrus

From all this it is easy to conclude, that we are but imperfectly acquainted with the history of this mighty prince, the founder of the Persian and the destroyer of the Chaldean empire. We learn fewer particulars of it from Scripture, but then these are more certain than any that we have produced. Daniel, in the famous vision in which God showed him the ruin of several great empires, which were to precede the birth of the Messiah, represents Cyrus under the idea of a ram which had two horns. The ram's horns signify the two empires which Cyrus united in his person, namely, that of the Medes, and that of the Persians, which was greater and more powerful than the empire of the Medes; or otherwise, these horns signify the two branches of Cyrus's successors. His son Cambyses having died, the empire was transferred to Darius the son of Hystaspes, and was continued down to Darius Codomannus, who, as Calmet thinks, is the great horn which the he-goat, denoting Alexander, run against. Daniel also compares Cyrus to a bear, with the three ribs in its mouth, to which it was said, "Arise, devour much flesh." Cyrus succeeded his father Cambyses in the kingdom of Persia, and Darius the Mede (by Xenophon called Cyaxares, and Astyages in the apocryphal chapter of Daniel) in the kingdom of the Medes and the empire of Babylon. He was monarch of all the East, or, as it is said, "of all the earth," when he permitted the Jews to return to their own country, in the year of the world 3466, and before Jesus Christ 538. The enemies of the Hebrews prevailed on him to put a stop to the building of the temple at Jerusalem. The prophets frequently foretold the coming of Cyrus; and Isaiah has been so particular as to declare his name 200 years before he was born. Josephus says, that the Jews of Babylon showed this passage of the prophet to Cyrus; and that the prince, in the edict which he granted them for their return, acknowledged that he had received the empire of the world from the God of Israel. On account of his services to the Jews after their captivity, Cyrus is called in Scripture the righteous servant of Jehovah, and the shepherd of Israel. According to the best accounts he was born in B.C. 594, and died B.C. 530. Cyrus

CYRUS II. was the younger son of Darius Nothus and of Parysatis, and the brother of Artaxerxes. He was sent by

Cythera ‖ Cyzicus.

his father at the age of sixteen to assist the Lacedæmonians against the Athenians. Artaxerxes succeeded to the throne at the death of Nothus; and Cyrus, who deemed himself, according to the Persian law, his father's legitimate successor, attempted to dispossess him. His attempt was discovered, and he would have been punished with death, had not his mother Parysatis saved him from the hands of the executioner by her tears and entreaties. This circumstance did not in the least check the ambition of Cyrus. He was appointed satrap of Lydia and of Asia Minor, where he secretly fomented rebellion, and levied troops under various pretences. At last he took the field with an army of 100,000 barbarians, and 13,000 Greeks, under the command of Clearchus; and Artaxerxes met him with 900,000 men near Cunaxa. The battle was long and bloody, and Cyrus might perhaps have obtained the victory, had not his rashness proved his ruin. It is said that the two royal brothers met in person, and that their engagement ended in the death of Cyrus, B.C. 401. Artaxerxes was so anxious to have it universally reported that his brother had fallen by his hand, that he put to death two of his subjects for boasting that they had killed Cyrus. The Greeks who were engaged in the expedition obtained much glory in the battle, and after the death of Cyrus they remained victorious in the field without a commander. Though at the distance of above 600 leagues from their country, and surrounded on every side by a powerful enemy, they were not discouraged. Having united in the election of commanders, they commenced their homeward march in face of the vastly superior numbers of the enemy. This march is known in history as the retreat of the Ten Thousand, and forms the subject of Xenophon's most popular work, the *Anabasis*.

CYTHERA (now *Cerigo*), an island in the Mediterranean, off the southern coast of Laconia. Its greatest length is about 19 miles from N. to S.; its greatest breadth about 10 from E. to W. It is for the most part rocky and barren, and is chiefly interesting from its association with the early worship of Venus. That goddess, whose worship was originally introduced into this island from Syria, was fabled in the ancient mythology to have sprung from the foam of the sea near Cythera. From this circumstance she was called by the Greeks Aphrodite. Cythera originally belonged to the Argives, from whom it passed to the Spartans. In the Peloponnesian war it was seized by the Athenians under Nicias. Before the close of the war it once more reverted to Sparta, but in 393 B.C. the Athenians again got possession of it. The chief towns of the island were Scandeia and Cythera. See IONIAN ISLANDS.

CYST (κυστις, a *bladder*), a bag or tunic inclosing morbid matter in animal bodies.

CYSTIC, pertaining to or contained in a cyst. For explanation of the terms *cystic duct* and *cystic artery*, see ANATOMY.

CYZICENA, among the ancient Greeks, magnificent banqueting halls looking towards the north, and usually opening upon gardens: so called from Cyzicus, a city famous for the grandeur of its buildings.

CYZICUS, in *Ancient Geography*, a town of Mysia, in Asia Minor, situated on the narrowest part of a considerable peninsula which juts out into the Propontis on its southern shore. This peninsula was at one time an island, and was believed to have been joined to the mainland by Alexander the Great with moles and bridges. During the Peloponnesian war, Cyzicus was alternately subject to the Athenians and Lacedæmonians, as the power of either state predominated. At this period, however, it was a very unimportant place. At the peace of Antalcidas, Cyzicus, like the other Greek cities in Asia, was made over to Persia. The greatness and prosperity of the town did not commence till about B.C. 74, when the Cyzicenes, under circumstances of great difficulty, repelled Mithridates from their walls, and kept the town till relieved by Lucullus. For their bravery and devotion at this time they were rewarded with peculiar honours and privileges by the Romans, and presented with a large tract of the rich land adjoining their city. Cyzicus was seriously injured by an earthquake in the reign of Antoninus Pius, and from that period gradually declined. The ruins of Cyzicus, which once boasted a very large number of splendid temples and public buildings, are still traceable among the orchards and vineyards that have overgrown its site.

Czar ‖ Czegled.

CZAR, a title assumed by the grand dukes, or, as they are now styled, emperors of Russia.

The natives pronounce it *tzar*, *tsar*, or *zaar*; and this, it has been supposed, by corruption from *Cæsar*. But this etymology does not seem correct. When the Czar Peter formerly required of the European courts an acknowledgment of his imperial titles, and that the appellation of Emperor should never be omitted, there was great difficulty made about it, especially at the court of Vienna; a circumstance which led him to produce the famous letter, written in German, from Maximilian I. emperor of Germany to Vassili Ivanovitch, confirming a treaty of alliance offensive and defensive against Sigismund, king of Poland. In this despatch, which is dated the 4th of August 1514, and is ratified with the seal of the golden bull, Maximilian addresses Vassili by the titles *Kayser* and *Herrscher aller Russen*, emperor and ruler of all the Russias. But independently of this document, there could be no doubt that the foreign courts, in their intercourse with that of Moscow, styled the sovereigns indiscriminately *Great Duke, Czar*, and *Emperor*. With respect to England, in particular, it is certain that, in Chancellor's *Account of Russia*, published as early as the middle of the sixteenth century, Ivan Vassilievitch II. is called *Lord and Emperor of all Russia*; and in the English despatches, from the reign of Elizabeth to that of Anne, he is generally addressed under the same appellation. When the European powers, however, styled the czar *Emperor of Muscovy*, they by no means intended to give him a title similar to that which was peculiar to the emperor of Germany; but they bestowed upon him that appellation as upon an Asiatic sovereign, in the same manner as we now speak of the emperors of China and Japan. When Peter, therefore, determined to assume the title of emperor, he found no difficulty in proving that it had been conferred upon his predecessors by most of the European powers; yet when he was desirous of affixing to the term the European sense, it was considered as an innovation, and was productive of more negotiations than would have been requisite for the termination of the most important state affair. At the same time it occasioned a curious controversy among the learned concerning the rise and progress of the titles by which the monarchs of the country in question have been distinguished. From their researches it appeared that the early sovereigns of Russia were called great dukes; that Vassili Ivanovitch was probably the first who styled himself *tzar*, an expression which in the Sclavonian language signifies *king*; and that his successors continued to bear, within their own dominions, that title as the most honourable appellation, until Peter the Great first assumed that of *Povelitel*, or emperor. After many delays and objections, the principal courts of Europe consented, about the year 1722, to address the sovereign of Russia by the title of Emperor, without prejudice, nevertheless, to the other crowned heads of Europe.

CZASLAU, a town of Bohemia, situated near the left bank of an affluent of the Elbe, 48 miles E.S.E. of Prague. The church is surmounted by a lofty spire, and contains the tomb of the celebrated Hussite leader Ziska, who died in 1424. Here Frederick the Great defeated the Austrians, May 17, 1742. Pop. about 4000.

CZEGLED, a large market-town of Hungary, 40 miles S.E. of Pesth. Pop. about 30,000. Its chief products are corn and wine.

D.

D
‖
Dacca.

D, in the English alphabet. the fourth letter, and the third consonant, is the medial of the order of dentals or palato-dentals. It is the fourth letter also in the Hebrew, Chaldee, Samaritan, Syriac, Greek, and Latin alphabets. The form of our D is the same with that of the Latins; and the Latin D is no other than the Greek Δ, with the angle on the right hand rounded off into a curve. The Δ of the Greeks, again, is borrowed from the ancient character of the Hebrew *Daleth*.

D is sometimes put for the aspirate *Th*, as *Theos*, *Deus*; sometimes it is converted into B, as *Duellum*, *Bellum*, *Duellona*, *Bellona*. It has also an affinity with T, as Quintilian has observed (lib. i. c. 4); and hence we meet with *Alexanter* and *Cassantra*, for *Alexander* and *Cassandra*, and, vice versâ, *quodannis* and *adque*, for *quotannus* and *atque*. In like manner, it is interchanged with R for the sake of euphony, as in *meridies* for *medidies*. In prænomens D stands for *Decimus*, and in the titles of emperors for *Divus*. It is also a numeral letter, representing *five hundred*. This arises from the circumstance that the letter D is analogous in form to IↃ, the half of CIↃ, which is the Roman numeral expression for *a thousand*. With a dash placed on the top thus, $\overline{D}$, its value is increased tenfold, or, in other words, it stands for *five thousand*. Used as an abbreviation, D has various significations, for which see the article Abbreviations.

DACCA Jelalpore. See Fureedpore.

Dacca, an extensive and rich district in the eastern quarter of the province of Bengal, situated between the 24th and 25th degrees of north latitude, and within the 91st degree of east longitude. It is bounded on the north by Mymunsingh, on the south by Backergunge, on the east by Tipperah, and on the west by Dacca Jelalpore, or Fureedpore; and has an area of 1960 square miles. Prior to the arrangement adopted in 1800, by which this province was separated from the Backergunge jurisdiction, it was one of the largest and most valuable in Bengal, stretching as far south as the sea, and reaching north to the Garrow Mountains. The country is divided into a great number of valuable zemindaries or estates. It is intersected by offsets from the Ganges and Brahmapootra, two of the largest rivers in the world, which, with their branches crossing the country in all directions, form a complete inland navigation, every town and village having its canal or river, —the general mode of travelling or conveying goods being by water. By the confluence of these two great rivers rushing impetuously to the sea, great changes are often made in the boundaries of estates, the river encroaching on some parts and abandoning others. Hence it almost invariably happens that as much is gained on one side as is lost on the other by the operation of the current and the opposing tides; whilst repeated overflowings, with rich deposits of mould washed down by the stream, give extraordinary fertility to the extensive inundated borders of the river. In point of general fertility and productiveness the district of Dacca ranks below the neighbouring zillahs of Fureedpore and Mymunsingh. The principal articles of cultivation are sugar, indigo, tobacco, cotton, betel-nut, and hemp. The grain produced is not sufficient for the consumption of the inhabitants, and supplies are obtained from Sylhet, Backergunge, Mymunsingh, and Tipperah. Attempts have been made to introduce the American cotton, but the climate appears to be unsuitable for the purpose.

This province is distinguished for its various fabrics of cotton. It has manufactures of plain as well as flowered, striped, or chequered muslins; and the beautiful fabrics of Dacca surpass in fineness the produce of any other country. Dimities of various kinds and patterns, and cloths resembling diaper and damask linen, are also made. The export of all these articles has, however, greatly decreased. Dacca.

This country is entirely alluvial, and in the rainy season is mostly overflowed, exhibiting the appearance of an inland sea, with towns and villages rising out of the water. The principal towns of this district are Dacca, Narraingunge, and Islampoor. During the Mohammedan government this district was ruled by a deputy of the nabob, called the naib nazim. The last person who held the office was Jessarut Khan, who having been ordered by Cossim Ali Khan in the year 1763 to put all the English at Dacca to death, very humanely sent them under the protection of a trusty guard to Calcutta. Upon the acquisition of the Dewanny in 1765 an adequate provision was made for the Dacca Nawaub; and his successors continued stipendiaries of the British government until the year 1845, when the title became extinct by the death of the last possessor without heirs. The population of the district is estimated at 600,000, which indicates a relative density of 306 to the square mile. (E. T.)

Dacca, the capital of the above district, a large city, and for eighty years the capital of Bengal, of which it is still the third city in point of extent and population. It is situated beyond the principal stream of the Ganges, on the northern bank of a very large branch of that river, called the Boor Gunga, or Old Ganges, at the distance of a hundred miles from the mouth of the Ganges. Its position is admirably well adapted for inland trade, as the river which flows past it communicates with all the other inland navigations by a direct course. The present town covers a great deal of ground, extending four miles along the bank of the river, though it is not of proportional breadth. The houses of the wealthy are built of brick, but there are many thatched houses, with very narrow and crooked streets; the bazaars are only tiled or thatched; and as every vacant spot is covered with trees, the town looks from a distance like a grove. The ancient citadel was situated on the western side of the town; but it is now in ruins, great part of the wall having been washed away by the river. An extensive and magnificent palace, built by Azim Ushaun, Aurungzebe's grandson, who resided here towards the end of the seventeenth century, is also in ruins.

Owing to the irresistible effects of British competition, the manufactures of Dacca are at this time scarcely deserving of notice; but here were formerly manufactured the most beautiful muslins, which were exported to all quarters of the world, and which had long been famed for their delicacy and beauty. The spinning of the thread was carried on with wonderful nicety. The operation was performed with the fingers on a fine steel spindle by young women, who could only work during the early part of the morning while the dew was on the ground; for such was the extreme tenuity of the fibre that it would not bear manipulation after the sun had risen. Such was the skill of the darners that they could remove an entire thread from a piece of muslin, and replace it by one of a finer texture. From their wonderful fineness these muslins were called Abrawan, or "flowing water," and Shabnam, "evening dew." The same violent heats do not prevail here as in Benares, Patna, and other places in Bahar. This is owing to the low lying situation of the surrounding country, which is always covered with verdure, even during the dry months.

Dace ‖ Dacier.

The unhealthy season is in autumn, from the 20th of August to the 10th of October, when the rivers and inundation are subsiding. During the remainder of the year the city and its vicinity are salubrious and pleasant, though the climate is more relaxing than that of the northern provinces.

Dacca is comparatively a modern city, its name not being mentioned in the Ayeen Acberry, nor by Ferishta. The houses being formed of combustible materials, it suffers frequently by conflagrations. Dacca still continues very populous. The number of its inhabitants has been estimated at 66,989, of which number 31,429 were Brahminists, 35,238 Mussulmans, and 322 Armenians and others; the whole residing in 16,279 houses. Distance from Calcutta, N.E. 150 miles. Lat. 23. 43.; Long. 90. 25. (E. T.)

DACE. See ANGLING, and ICHTHYOLOGY.

DACIA, in *Ancient Geography*, a large district of country in Europe, bounded N. by the country of the Bastarnæ, E. by the river Tyras and the Euxine Sea, S. by the Danube, and W. by the river Pathissus, or Tibiscus, the modern Theiss. It comprehended the modern provinces of Transylvania and Wallachia, the Buckowina, the Banat of Temesvar, and parts of Hungary, Galicia, and Moldavia.

The original inhabitants of Dacia were the Getæ, a rude and barbarous tribe of Thracian extraction. The earliest notice that we have of them in history is the fact of their attempting to obstruct the passage of Alexander the Great across the Danube, when that prince was subduing the hordes of northern barbarians who had risen against him in rebellion shortly after his accession to the throne. About forty years later Lysimachus, king of Thrace, who had begun a war of aggression against the Getæ, and had penetrated a considerable way into their territory, was defeated and taken prisoner; but after a short detention, generously set at liberty. We next hear of the Getæ as being at war with the Gauls, by whom they were defeated, and many of them sold as slaves to the Athenians and other Greeks.

In later days the Getæ appear in history under the name of Daci. Why or by whom their original name was changed is not known; but ancient and modern ethnographers all agree in identifying the Daci with the Getæ. In the days of the Roman empire, the Dacians had attained to great power, and their name had become a watchword of terror in the Roman capital itself. Their reputation was heightened by the submission which they exacted from the tyrant Domitian, and the tribute with which that prince was obliged to purchase immunity from their attacks. At the close of the first century of the Christian era, however, Trajan, who had succeeded to the purple, set out against them in person, and defeated them with great slaughter at a place which is still called *Prat de Trajan*. In A.D. 104, he again invaded Dacia, routed Decebalus, who soon after committed suicide, and reduced Dacia into a Roman province. It was in honour of this campaign that the famous column of Trajan was erected at Rome. In order to secure his conquests in this direction, Trajan built over the Danube his famous bridge (which was one of the architectural wonders of the world, and of which some small remains still exist), as well as three great military roads. Dacia remained a Roman province till the time of Aurelian, when the colonists retired in a body to the south bank of the Danube, and the Goths took possession of the unoccupied territory. After this time Dacia was overrun by the Huns, the Gepidæ, the Lombards, and the Scythians, till in the tenth century the Magyars conquered it, and occupy it till this day. Deep traces of the Roman occupation of the province are to be found in the language of its modern inhabitants, the upper classes of whom speak a Latin that is wonderfully pure, while the common people use a dialect in which the Roman vocables are still the predominating element.

DACIER, ANDRÉ, was the son of a Protestant advocate at Castres, and was born in that town in 1651. His father resolved to give him a classical education, and accordingly sent him first to the academy of Puy Laurens, and afterwards to Saumur, where a distinguished scholar, Tanneguy Lefèvre, was at that time [illegible] with great success. Such rapid progress did the young scholar make, that when Lefèvre sent away all his other pupils, he kept Dacier and taught him privately for an entire year. On the death of this kind friend, he returned home, whence, after a short sojourn, he betook himself to Paris to seek his fortune. By the Duc de Montausier, his name was put on the list of scholars who were then engaged in preparing the Delphin edition of the ancient classics. He was shortly after made warden of the library of the Louvre. In 1695 he was admitted into the Academy of Inscriptions; and in the same year into the French Academy. His marriage with the daughter of his old teacher at Saumur had taken place in 1683. From the classical pursuits of the contracting parties, this event was called by Bosnage the *marriage of Greek and Latin*. The most important of Dacier's works were his editions of Pomponius Festus and Valerius Flaccus, Paris, 4to; a translation of Horace, with notes, 10 vols. 12mo; a translation of Aristotle's *Poetics*; of the *Electra* and *Œdipus* of Sophocles; and of the entire works of Hippocrates. His last important undertaking was a translation of Plutarch, 8 vols. 4to. Dacier died Sept. 18, 1722.

Dacier ‖ Dactyliomancy.

DACIER, *Anne Lefèvre*, the wife of the preceding, and still more celebrated than himself for her knowledge of the classical languages, was born at Saumur in 1651. The first work which brought her into notice was her translation of the Greek poet Callimachus. This established her reputation so thoroughly, that she was soon requested to edit others of the ancient classics for the use of the Dauphin. In this collection she published successively Florus, Eutropius, Aurelius Victor, and Dictys Cretensis. Her translations of the ancient classics are very numerous. Among these may be mentioned the *Amphitryon*, *Rudens*, and *Epidicus* of Plautus, the whole of Terence, the Iliad and Odyssey of Homer, the *Plutus* and *Clouds* of Aristophanes, and the whole of Sappho and Anacreon. Madame Dacier died in 1720, two years before her husband.

DACTYL, the name given to a metrical foot in the Greek and Latin poetry, consisting of a long and two short syllables, as in the word *cārmĭnă*.

DACTYLI IDÆI (*i. e.* the *Fingers of Mount Ida*), fabulous beings, regarding whom there are various accounts. The Cretans rendered them divine worship as the persons who had nursed and brought up the god Jupiter; and hence they have been identified with the Corybantes and Curetes. Strabo, however, relates, that the tradition in Phrygia was, that the Curetes and Corybantes were descendants of the Dactyli Idæi; that there were originally a hundred men in the island who were called *Dactyli Idæi*, from whom sprang nine Curetes, and each of these nine produced ten men, as many as the fingers of a man's two hands; and that this gave the name to the ancestors of the Dactyli Idæi. He also mentions another opinion, namely, that there were but five Dactyli Idæi, who, according to Sophocles, were the inventors of iron; that these five brothers had five sisters, and that from this number they received the name of *Fingers of Mount Ida*, because they were ten in number, and worked at the foot of this mountain. Diodorus Siculus, however, represents the matter a little differently. He says that the first inhabitants of the land of Crete were the Dactyli Idæi, who had their residence on Mount Ida; that some said they were a hundred, others only five in number, equal to the fingers of a man's hand, whence they had the name of *Dactyli*; that they were magicians and addicted to mystical ceremonies; that Orpheus was their disciple, and carried their mysteries into Greece, &c. Other accounts are given by other ancient authors. See CORYBANTES, &c.

DACTYLIOMANCY (*Dactyliomantia*, from δακτύ-

Dactylology ‖ Dædala.

λιος, *a ring*, μαντεια, *divination*), a kind of divination by means of a ring. It was performed by holding a ring, suspended by a fine thread, over a round table, on the edge of which were made various marks with the twenty-four letters of the alphabet. The ring, in vibrating over the table, stopped over certain of the letters, which, being joined together, composed the answer required. The operation was preceded and accompanied by several ceremonies; which are detailed at large by Marcellinus in his 29th book.

DACTYLOLOGY, the art of spelling or communicating ideas with the fingers; the most useful application of which is what has been called the *Manual Alphabet* for the instruction of the deaf and dumb. It has also been employed as the medium of communication between the deaf and dumb and the blind. The invention of the one-handed alphabet is attributed to Bonet, the Spanish instructor of the deaf and dumb. The first English work on this subject is the rare tract by Dalgarno, published in 1680, and reprinted by the Maitland Club; in which the vowels are represented by the extreme joints of the five fingers of the left hand, the consonants by the other joints, taken in horizontal ranges; T, V, W, and X, by the metacarpal bones of the fore, middle, and little fingers, and thumb; and Z by the space in a line with the metacarpus of the thumb. A very perfect system for arithmetical computation is that invented by Mr O. Stansbury, superintendent of the deaf and dumb institution of New York. It is now extensively employed, both in this country and America, in such establishments. The fingers of the left hand are raised in succession, so as to represent the units, and the closed fist represents 0. To represent tens, the position of the hand is changed from the vertical to the horizontal; hundreds by pointing the hand downwards; thousands by placing the left hand across the body towards the right shoulder; and millions by putting the same hand towards the left.

DADO. See glossary to ARCHITECTURE.

DADUCHI (torch-bearers), in *Antiquity*, priests of Ceres. When that goddess commenced her travels in search of her daughter Proserpine, it was night; and in order to pursue her journey through the dark she lighted a torch. In commemoration of this circumstance, at the feasts and sacrifices of the goddess, it was customary for her priests to run about the temple with torches in their hands. One of them took a lighted torch from off the altar, and ran with it to another part of the temple, where he delivered it to a second; the next proceeded in like manner and gave his torch to a third, and so of the rest. From this ceremony the priests were called δαδοῦχοι, torch-bearers.

DADUR, in Beloochistan, a town of Cutch Gundava, situate near the base of the Hala mountains, five miles east of the Bolan Pass. It is described as a place of considerable size, and contains a population of about 3000. The heat is intense, and probably exceeds that of any other place in the same parallel of latitude. The Rev. J. N. Allen, who resided there in the month of February, thus describes its state in this respect at that early season. "It is indeed a dreadful place, and seems from its situation formed to be, as it really is, one of the hottest places in the world. It receives the reflected heat of the sun from the towering bank of bare rocky mountains under which it lies, and which, surrounding it on three sides, casts down the rays upon it as upon the focus of a reflecting mirror." Here, in November 1840, a British force was attacked by Nusseer, the son of Mehrab Khan, who had fallen in the storm of his capital, Kelat. Nusseer's army, amounting to 4000 Beloochees, was quickly routed; and in the pursuit, the headless body of Lieutenant Loveday, who had been stationed at Kelat as political agent to the British government, was found fastened on a camel. Lat. 29. 26.; Long. 67. 41. (E. T.)

DÆDALA, the name of a mountain and city of Lycia, where according to Pliny, Dædalus was buried; and also of two festivals celebrated in Bœotia. One of these was observed by the Platæans at Alalcomene, in a great oak-forest, where they exposed pieces of boiled flesh, and carefully noticed whither the ravens which came to prey upon them directed their flight. Those trees upon which any of the birds alighted were immediately cut down, and out of them were formed statues, called *Dædala*, in honour of Dædalus. The other festival was of a more solemn kind. It was celebrated every sixty years throughout all the cities of Bœotia, as a compensation for the intermission of the smaller festivals during that number of years, on account of the exile of the Platæans. Fourteen of the statues called *Dædala* were distributed by lot among the Platæans, Lebadæans, Coroneans, Orchomenians, Thespians, Thebans, Tanagræans, and Chæroneans; the smaller towns taking one statue in common. The Bœotians assembled on the banks of the Asopus, where a statue of Juno was adorned and placed in a chariot; the procession being headed by a young woman habited as a bride. This procession was attended to the top of Mount Cithæron by many of the Bœotians, who had places assigned them by lot. Here an altar of square pieces of wood cemented together like stones was erected, and upon it were thrown large quantities of combustible materials. Afterwards a bull was sacrificed to Jupiter, and an ox or heifer to Juno, by every one of the cities of Bœotia, and by the most opulent individuals who attended. The poorer citizens offered sheep; and all these oblations, together with the Dædala, were thrown into the common heap, set on fire, and totally reduced to ashes. The origin of the observance was this: When Juno, after a quarrel with Jupiter, had retired to Eubœa, and refused to return to his bed, the god, anxious for her return, went to consult Cithæron, king of Platæa, in order to find some effectual measure for breaking her obstinacy. Cithæron advised him to dress a statue in woman's apparel, carry it in a chariot, and publicly report that it was Platæa, the daughter of Asopus, whom he was going to marry. Juno, informed of her husband's approaching marriage, repaired in haste to meet the chariot, and was greatly pleased when she discovered the artifice he had employed to effect a reconciliation.

Dædalus ‖ Dæmon.

DÆDALUS, a mythical personage, whose name is taken as the symbol of artistic perfection. According to one account he was the son, and according to another the grandson, of Eupalamus, the son of Erechtheus. He was condemned to death by the Areopagus on account of the murder of his nephew Talus or Perdix, whom he had instructed in his art to a degree that roused his jealousy; and fled to Crete, where he was imprisoned by Minos for having constructed the labyrinth. He was released from prison by Pasiphae, and by the help of artificial wings escaped to Sicily. His son Icarus was the companion of his flight, but having flown too near the sun, the cement of his wings melted, and he was precipitated into the sea. From Sicily Dædalus passed to Sardinia; and at some period of his career he is said to have executed a variety of works in Egypt. He is principally renowned for the perfection of his carpentry, and was the reputed inventor of the saw, gimlet, plumb-line, and other tools. All the early works seem to have been attributed to Dædalus; and the story of his having constructed automata seems to point to him as the introducer of a lifelike style of statuary. His flight is generally explained by regarding him as the inventor or improver of sails.

DÆMON (Δαίμων), a name given by the ancients to certain spirits or genii, which they say appeared to men, either to do them service or to injure them.

The word δαίμων is derived according to Plato, from δαήμων, *knowing* or *intelligent*; but according to others, from δαιομαι, *to distribute*. This is the derivation given by the scholiast on Homer. Either of these derivations agrees with the office ascribed to dæmons by the

Dæmon. ancient heathens, as the spirit intrusted with the inspection and government of mankind. For, according to the philosophers, dæmons held a middle rank between the celestial gods and men upon earth, and carried on all intercourse between them; conveying the addresses of men to the gods, and the divine benefits to men. It was the opinion of many, that the celestial divinities did not themselves interpose in human affairs, but committed the entire administration of the government of this lower world to these subaltern deities: *Neque enim pro majestate deûm cœlestium fuerit hæc curare.*[1] *Cuncta cœlestium voluntate, numine, et auctoritate, sed dæmonum obsequio, et opera et ministerio fieri arbitrandum est.*[2] Hence they became the objects of divine worship. "If idols are nothing," says Celsus,[3] "what harm can there be to join in the public festivals? If they are dæmons, then it is certain that they are gods, in whom we ought to confide, and to whom we should offer sacrifices and prayers to render them propitious."

Several of the heathen philosophers held that there were different kinds of dæmons: that some of them were spiritual substances of a more noble origin than the human race, and that others had once been men.

But those dæmons who were the more immediate objects of the established worship among the ancient nations, were human spirits, such as were believed to become dæmons or deities after their departure from their bodies. Plutarch teaches,[4] "that according to a divine nature and justice, the souls of virtuous men are advanced to the rank of dæmons; and that from dæmons, if they are properly purified, they are exalted into gods, not by any political institution, but according to right reason." The same author says in another place,[5] "that Isis and Osiris were, for their virtue, changed from good dæmons into gods, as were Hercules and Bacchus afterwards, receiving the united honours both of gods and dæmons." Hesiod and other poets, who have recorded the ancient history or traditions on which the public faith and worship were founded, assert that the men of the Golden Age, who were supposed to be very good, became dæmons after death, and dispensers of good things to mankind.

Though *dæmon* is often used in a general sense as equivalent to a deity, and is accordingly applied to fate or fortune, or whatever else was regarded as a god, yet those dæmons who were the more immediate objects of divine worship amongst the heathens were human spirits, as is shown by Farmer in his Essay on Miracles.

The word *dæmon* is used indifferently in a good and in a bad sense. In the former sense, it was very commonly employed amongst the ancient heathens. "We must not," says Menander, "think any dæmon to be evil or hurtful to a good life, but every god to be good." Nevertheless, those are certainly mistaken who affirm that *dæmon* was not used to signify an evil being until after the times of Christ. Pythagoras believed in dæmons who afflicted with diseases both men and cattle.[6] Zaleucus, in his preface to his laws,[7] supposes that an evil dæmon might be present with a man, to influence him to injustice. The dæmons of Empedocles were evil spirits, and exiles from heaven; and Plutarch, in his Life of Dion, says that it was the opinion of the ancients that evil and mischievous dæmons, out of envy and hatred to good men, oppose whatsoever they do. Scarcely did any opinion more generally prevail in ancient times than this, that as the departed souls of good men became good dæmons, so the departed souls of bad men became evil dæmons.

It has been generally thought that by *dæmons* we are Dæmoniac. to understand *devils*, in the Septuagint version of the Old Testament; but others think that the word in that version is applied to the ghosts of such dead men as the heathens deified. That *dæmon* often bears the same meaning in the New Testament, is shown at large by Mr Joseph Mede in his works; and that the word is applied *always* to human spirits in the New Testament, Mr Farmer has attempted to show in his Essay on Dæmoniacs. As to the meaning of the word *dæmon* in the writings of the fathers of the Christian church, it is used by them in the same sense as it was by the heathen philosophers, especially the latter Platonists; that is, sometimes for departed human spirits, and at other times for such spirits as had never inhabited human bodies. In the fathers, indeed, the word is more commonly employed in an evil sense than in that of the ancient philosophers. Besides the two kinds of dæmons before mentioned, the fathers, as well as the ancient philosophers, believed in a third, namely, such as sprang from the congress of superior beings with the daughters of men. In the theology of the fathers, these were the worst kind of dæmons.

Different orders of dæmons had different stations and employments assigned them by the ancients. Good dæmons were considered as the authors of good to mankind; whereas evil dæmons brought innumerable ills both upon men and beasts. Amongst evil dæmons there was a great distinction with respect to the offices assigned them; as some compelled men to wickedness, and others stimulated them to madness.

DÆMONIAC (from *dæmon*), a human being whose volition and other mental faculties are overpowered and restrained, and his body possessed and actuated by some created spiritual being of superior power.

Such seems to be the determinate sense of the word; but it is disputed whether any of mankind ever were in this unfortunate condition. It is generally agreed that neither good nor evil spirits are known at present to exert such authority over the human race; but in the ancient heathen world, and amongst the Jews, particularly in the days of our Saviour, evil spirits are thought by many to have been much more troublesome.

The Greeks and Romans imagined that their deities, in order to reveal future events, frequently entered into the prophet or prophetess who was consulted, overpowered their faculties, and uttered responses by their organs of speech. Apollo was believed to enter into the Pythoness, and to dictate the prophetic answers received by those who consulted her. Other oracles besides that of Delphi were supposed to unfold futurity by the same machinery. And in various cases either malignant dæmons or benevolent deities were thought to enter into and to actuate human affairs. The *Lymphatici*, the *Cerriti*, and the *Larvati* of the Romans, were all of this description; and the Greeks, by the use of the word δαιμονιζομενοι, show that they referred to this cause the origin of madness. Among the ancient heathens, therefore, it appears to have been a generally received opinion, that superior beings entered occasionally into men, overpowered the faculties of their minds, and actuated their bodily organs. They might imagine that this happened in instances in which the effects were owing to the operation of different causes; but an opinion so generally prevalent had surely some plausible foundation.

The Jews, too, appear, both from the sacred writings and from Josephus, to have believed in dæmoniacal posses-

[1] Apuleius De Deo Socratis, p. 677.
[2] Id. p. 675
[3] Apud Orig. contr. Celsum, lib. viii., p. 393.
[4] Vit. Romul., p. 36, ed. Paris.
[5] De Is. et. Osir., p. 361.
[6] Diog. Laert. in Vit. Pythagor., p. 514, ed. Amstel.
[7] Apud Stobæum, Serm. 42.

Dæmoniac. sion. The case of Saul may be recollected as one among many in which superior created beings were believed by the Jews to exert in this manner their influence over human life. The general tenor of their history and language, and their doctrines concerning good and evil spirits, prove that the opinion of dæmoniacal possession had been well known and generally received among them.

In the days of our Saviour, it would appear that dæmoniacal possession was very frequent amongst the Jews and the neighbouring nations. Many were the evil spirits whom Jesus is related in the gospels to have ejected from patients who were brought unto him as possessed and tormented by these malevolent dæmons. His apostles too, and the first Christians, who were most active and successful in the propagation of Christianity, appear to have frequently exerted the miraculous powers with which they were endowed on similar occasions. The dæmons displayed a degree of knowledge and malevolence which sufficiently distinguished them from human beings; whilst the language in which the dæmoniacs are mentioned, and the actions and sentiments ascribed to them in the New Testament, show that our Saviour and his apostles did not consider the idea of dæmoniacal possession as being merely a vulgar error concerning the origin of a disease or of diseases produced by natural causes.

The more enlightened cannot always avoid the use of metaphorical modes of expression; which, though founded upon error, have yet been so established in language by the influence of custom, that they cannot be suddenly dismissed. When we read in the book of Joshua that the sun on a certain occasion stood still, in order to allow that hero time to complete a victory, we easily find an excuse for the conduct of the sacred historian, in accommodating his narrative to the popular ideas of the Jews concerning the relative motions of the heavenly bodies. In all similar instances we do not complain much of the use of a single phrase, originally introduced by the prevalence of some groundless opinion, the falsity of which is well known to the writer.

But in descriptions of characters, in the narration of facts, and in laying down systems of doctrine, we require very different rules to be observed. Should any person, in compliance with popular opinions, talk in serious language of the existence, dispositions, declarations, and actions of a race of beings whom he knew to be absolutely fabulous, we surely could not praise him for candour or integrity, but must suppose him to be either exulting in irony over the credulity of those around him, or taking advantage of their weakness, with the dishonest and the selfish views of an impostor. And if he himself should pretend to any connection with this imaginary system of beings, and should claim, in consequence of his connection with them, particular honours from his contemporaries, whatever might be the dignity of his character in all other respects, nobody could hesitate for a moment to brand him as an impostor.

Precisely in this light must we regard the conduct of our Saviour and his apostles, if the ideas of dæmoniacal possession were to be considered merely as a vulgar error. They talked and acted as if they believed that evil spirits had actually entered into those who were brought to them as possessed with devils, and as if those spirits were actually expelled by their authority out of the unhappy persons whom they had possessed. They expected, they demanded too, to have their profession and declarations believed, in consequence of their performing such mighty works, and to be honoured as having thus triumphed over the powers of hell. The reality of dæmoniacal possession stands upon the same evidence with the gospel system in general.

Neither is there any thing absurd or unreasonable in Dæmoniac. this doctrine. It does not appear to contradict those ideas which the general appearance of nature and the series of events suggest concerning the benevolence and wisdom of the Deity, and the councils by which he regulates the affairs of the universe. We often fancy ourselves able to comprehend things to which our understanding is wholly inadequate; and we persuade ourselves, at times, that the whole extent of the works of the Deity must be well known to us, and that his designs must always be such as we can fathom. We are then ready, whenever any difficulty arises, in considering the conduct of Providence, to model things according to our own ideas; to deny that the Deity can possibly be the author of things which we cannot reconcile; and to assert that he must act on every occasion in a manner consistent with our narrow views. This is the pride of reason; and it seems to have suggested the strongest objections that have been at any time urged against the reality of dæmoniacal possession. But the Deity may surely connect one order of his creatures with another. We perceive mutual relations and a beautiful connection prevalent throughout all that part of nature which falls within the sphere of our observation. The inferior animals are connected with mankind, and subjected to their authority, not only in instances in which it is exerted for their advantage, but even where it is tyrannically abused to their destruction. Amongst the evils to which mankind have been subjected, why might not their being liable to dæmoniacal possession be one? Whilst the Supreme Being retains the sovereignty of the universe, he may employ whatever agents he thinks proper in the execution of his purposes; he may either commission an angel or let loose a devil, as well as bend the human will, or communicate any particular impulse to matter.

All that revelation makes known, all that human reason can conjecture, concerning the existence of various orders of spiritual beings, good and bad, is perfectly consistent with, and even favourable to, the doctrine of dæmoniacal possession. It was generally believed throughout the ancient heathen world; it was equally well known to the Jews, and equally respected by them; it is mentioned in the New Testament in such language, and such narratives are related concerning it, that the gospels cannot well be regarded in any other light than as pieces of imposture, and Jesus Christ must be considered as a man who dishonestly took advantage of the weakness and ignorance of his contemporaries, if this doctrine be nothing but a vulgar error. But it teaches nothing inconsistent with the general conduct of Providence; it is not the caution of philosophy, but the pride of reason, which suggests objections against this doctrine.

Those, again, who are unwilling to allow that angels or devils have ever intermeddled so much with the concerns of human life, urge a number of specious arguments in opposition to such a supposition. The Greeks and Romans of old, say they, did believe in the reality of dæmoniacal possession. They supposed that spiritual beings did at times enter into the sons or daughters of men, and distinguish themselves in that situation by capricious freaks, deeds of wanton mischief, or prophetic enunciations. But in the instances in which they supposed this to happen, it is evident that no such thing took place. Their accounts of the state and conduct of those persons whom they believed to be possessed in this supernatural manner, show plainly that what they ascribed to the influence of dæmons were merely the effects of natural diseases. Whatever they relate concerning the *larvati*, the *cerriti*, and the *lymphatici*, shows that these were merely people disordered in mind, or in the same unfortunate situation with those madmen and idiots and melancholy persons whom we have

Dæmoniac. among ourselves. Festus describes the *larvati* as being *furiosi et mente moti*. Horace says,

> Hellade percussa, Marius cum præcipitat se,
> Cerritus fuit.

And Lucian describes dæmoniacs as lunatic, and as staring with their eyes, foaming at the mouth, and speechless.

It appears still more evidently, that all the persons spoken of as possessed with devils in the New Testament, were either mad or epileptic, and precisely in the same condition with the madmen and epileptics of modern times. The Jews, amongst other reproaches which they threw out against our Saviour, said, "He hath a devil, and is mad: why hear ye him?" The expressions, *he hath a devil, and is mad*, were certainly used on this occasion as synonymous. With all their virulence, they would not surely ascribe to him at once two things which were inconsistent and contradictory. Those who thought more favourably of the character of Jesus, asserted concerning his discourses, and in reply to his adversaries, "that these are not the words of him that hath a dæmon," meaning, no doubt, that he spoke in a more rational manner than a madman could be expected to speak. The Jews appear to have ascribed to the influence of dæmons, not only that species of madness in which the patient *is raving and furious*, but also *melancholy* madness. Of John, who secluded himself from intercourse with the world, and was distinguished for abstinence and acts of mortification, they said, "He hath a dæmon." The youth whose father applied to Jesus to free him from an evil spirit, describing his unhappy condition in these words, "Have mercy on my son, for he is lunatic and sore vexed with a dæmon; for oft times he falleth into the fire, and oft into the water," was plainly epileptic. Every thing indeed that is related in the New Testament concerning dæmoniacs, proves that they were people affected with such natural diseases as are far from being uncommon amongst mankind in the present age. When the symptoms of the disorders cured by our Saviour and his apostles as cases of dæmoniacal possession, correspond so exactly with those of diseases well known as natural in the present age, it would be absurd to impute them to a supernatural cause. It is much more consistent with common sense and sound philosophy to suppose, that our Saviour and his apostles wisely, and with that condescension to the weakness and prejudices of those with whom they conversed, which so eminently distinguished the character of the author of our holy religion, and must always be a prominent feature in the character of the true Christian, adopted the vulgar language in speaking of those unfortunate persons who were groundlessly imagined to be possessed with dæmons, though they well knew the notions which had given rise to such modes of expression to be ill founded; than to imagine that diseases, which arise at present from natural causes, were produced in days of old by the intervention of dæmons, or that evil spirits still continue to enter into mankind in all cases of madness, melancholy, or epilepsy.

Besides, it is by no means a sufficient reason for receiving any doctrine as true, that it has been generally received throughout the world. Error, like an epidemical disease, is communicated from one to another. In certain circumstances, too, the influence of imagination predominates, and restrains the exertions of reason. Many false opinions have extended their influence throughout a very wide circle, and maintained it long. On every such occasion as the present, therefore, it becomes us to inquire, not so much how generally any opinion has been received, or how long it has prevailed, as from what causes it has originated, and on what evidence it rests.

When we contemplate the frame of nature, we behold a grand and beautiful simplicity prevailing throughout the whole. Notwithstanding its immense extent, and although it contains such numberless diversities of being, yet the simplest machine constructed by human art does not display greater simplicity, or a happier connection of parts. We may therefore venture to draw an inference, by analogy, from what is observable of the order of nature in general to the present case. To permit evil spirits to intermeddle with the concerns of human life, would be to break through that order which the Deity appears to have established throughout his works; it would be to introduce a degree of confusion unworthy of the wisdom of Divine Providence. Daghestan ‖ Dahomey.

Such are the most rational arguments which have been urged on both sides in this controversy. Perhaps the dæmonists have the stronger probabilities on their side; but the antidemoniacal theory does not detract from the divine authority of the Saviour, the reality of his miracles, or the integrity of the sacred historians.

Farmer's *Essay on the Dæmoniacs of the New Testament*; Winer's *Biblisches Realworterbuch*, article *Bessessene*; Moses Stuart's *Sketches of Angelology* in *Bibliotheca Sacra*, 1843.

DAGHESTAN, a country lying on the western shores of the Caspian Sea, chiefly between N. Lat. 41. and 43. and E. Long. 46. and 50. As its name implies, it is of a very rugged and mountainous character, with the exception of a narrow strip along the sea-coast. Though nominally belonging to Russia, the inhabitants do not acknowledge the supremacy of that power, but are governed by independent chiefs. See CAUCASUS.

DAGO, an island in the Baltic near the entrance to the Gulf of Finland, belonging to Russia, and forming part of the government of Esthonia. It is separated from the island of Oesel on the south by a small channel called the Selle-Sand. It is about 40 miles in length by 30 in breadth, with about 10,000 inhabitants, employed in husbandry, grazing, and fishing.

DAGON, the name of a national god of the Philistines at Gaza and at Ashdod, or, as the Greeks called it, Azotus. Some philologists derive the term from the Hebrew *dagan*, corn, but it is more probably derived from the Hebrew *dag*, *fish*, with the ending *ôn* (Ewald, *Hebr. Gram.* § 341). This derivation is not only more in accordance with the principles of formation, but it is most decisively established by the terms employed in 1 Sam. v. 4. It is there said that Dagon fell to the earth before the Ark, that his head and the palms of his hands were broken off, and that "*only Dagon was left on him.*" If Dagon is derived from *dag, fish;* and if the idol, as there is every reason to believe, had the body of a fish with the head and hands of a man; it is easy to understand why a *part* of the statue is there called *Dagon* in contradistinction to the head and hands; but not otherwise. That such was the figure of the idol is admitted by most modern scholars. It is also supported by the analogies of other fish deities among the Syro-Arabians. The temple of Dagon at Ashdod was destroyed by Jonathan the brother of Judas the Maccabee, about the year B.C. 148. (1 Mac. x. 84.)

DAGUERREOTYPE. See PHOTOGRAPHY.

DAHL, MICHAEL, a Swedish portrait-painter of considerable merit, who came to England, according to Walpole, in 1678. He afterwards travelled for improvement in his art in France and Italy; but finally settled in England, where he died in 1743. The portrait of Charles XI. of Sweden on horseback, at Windsor, and the portrait of Lady Walpole, are among his best performances.

DAHLIA. See HORTICULTURE, § *Flower-Garden.*

DAHOMEY, an extensive kingdom of Africa, lying inland from the Guinea coast, extending from the banks of the Niger to those of the Volta, and comprehending the entire country from the coast between the mouths of these

Dahomey.

rivers to the bases of the Kong mountains. It is difficult to decide what is the actual extent of the kingdom, but it is probably about 180 miles from east to west, and nearly 200 from the sea-coast to its most northern boundary. The very name of the Dahomans was scarcely known to Europeans previous to the commencement of last century, but they came prominently into notice after 1724, when Guadjo Trudo or Trudo Audati, the king of Dahomey, overran the kingdom of Ardrah, that lay between his capital and the sea-coast. In this expedition Mr Bulfinch Lamb, agent of the English African Company, was taken captive and carried to Abomey; but he was treated with great kindness, and shortly after obtained his liberty. In two successive expeditions Trudo again invaded the countries of the coast, and destroyed the Dutch, English, French, and Portuguese forts at the town of Jaquin. On his death in 1732 he was succeeded by his son Bossa Ahadee. The recent struggles between the Dahomans and the neighbouring states were attended with various success. For some time the Dahomans were tributary to the Eyeos, but they have latterly obtained the mastery over this people and various others, and are now rapidly extending their dominions. Lieutenant Forbes, who was there in 1849, states that the population of the kingdom, owing to its devastating wars, did not at that time exceed 200,000; that the regular army amounts to 12,000, of whom 5000 are women, and that when the king goes to war, he levies in all about 24,000 fighting men, and an equal number for the commissariat.

The country of Dahomey is said to be very beautiful and fertile. The soil is a deep rich clay of a reddish colour, with a little sand on the surface; but there was not observed in the whole country a stone as large as a walnut. Of farinaceous vegetables, the country, when duly cultivated, yields a plentiful supply; as maize, millet or Guinea corn; a kind of peas, or rather kidney beans, called callavances; and also a species of vegetable called ground beans. The Dahomans also cultivate yams, potatoes, the plantain, and the banana. Pine-apples, oranges, limes, guavas, and other tropical fruits, abound in this fertile country; nor is it destitute of productions adapted for commerce, such as indigo, cotton, the sugar cane, tobacco, palm oil, together with a variety of spices, particularly a species of pepper scarcely distinguishable from that raised in the East Indies. The greatest injury to health in the climate of Dahomey arises from the periodical rains, which are accompanied by tornadoes. These, however, are the grand source of fertility, and are immediately succeeded by the most luxuriant vegetation. The Dahomans possess a considerable knowledge of agriculture, but are extremely indolent, and have not more than a tithe of the land in cultivation. In the cultivated portions the land though rich is highly manured; corn and beans grow together; and in the palm plantations are also grown corn, yams, and ground nuts. Indeed in this branch of industry they are said to rival the Chinese. Industrial pursuits, however, are not encouraged, as the advancement of these would tend to diminish the desire for warlike expeditions, on which the prosperity of the state is supposed to depend. All the most arbitrary forms of despotism seem to be mild and liberal when compared with the tyranny established in this barbarous state. The despotism is not founded upon force and terror, nor is it connected with any timid or effeminate character in its subjects, since they are the most furious and desperate soldiers in Africa. It rests on a blind and idolatrous veneration for the person of the sovereign, as for that of a superior being. It is a crime to suppose that the king of Dahomey can eat, drink, sleep, or perform any of the functions of an ordinary mortal. Bossa Ahadee, on his accession, caused all the persons of the name of Bossa in his dominions to be put to death, conceiving it to be an unpardonable presumption that any subject should bear the same name as himself. The greatest lords are only allowed to approach the king lying flat on their faces, and rolling their heads in the dust. The attempts thus made to inspire the people with reverence for their monarch seem completely successful. The Dahoman rushes to battle with the same blind intrepidity in the cause of his king as the Spartans formerly did for their nation and laws. Norris having asked a Dahoman before battle if he did not think the enemy too numerous, the man replied, "I think of my king, and then I dare engage five of the enemy myself." He declared his indifference whether he survived or not; adding, "It is not material; my head belongs to the king, not to myself; if he pleases to send for it, I am ready to resign it; or if it be shot through in battle, it is no difference to me,—I am satisfied." Human skulls form the favourite ornament in the decoration of the palaces and temples. The king's sleeping chamber has the floor paved with skulls, and the roof ornamented with the jaw-bones of chiefs whom he has overcome in battle. Every year a grand festival is held, which lasts for several weeks, and during which the king waters the graves of his ancestors with the blood of human victims. The bodies of those unhappy men are not interred, but are suspended by the feet to the walls, and thus left hanging till they putrefy. But the most extraordinary exercise of despotism consists in the treatment of the female sex, all of whom in Dahomey are considered as the property of the king, and entirely at his disposal. After retaining an immoderate number for his own use, he distributes the rest, first among his chief men, and then among the commons. The distribution of wives takes place once a-year at the grand festival, when each individual gives in such a sum as he is able to spare for the purchase, and receives in return such a wife as the king chooses to bestow. There is no room for discussion or complaint; be she old, ugly, or deformed, she must equally be accepted. He himself has about three thousand wives, a large proportion of whom exercise functions which do not in other countries devolve upon the female sex. They are trained to arms, and compose a regiment of royal guards, divided into companies, armed with muskets and bows, and provided with drums, flags, and all the apparatus of war. At the death of the king a horrid scene commences; the wives, after the most extravagant demonstrations of grief, after breaking and destroying everything that belongs to them, attack and murder each other, till they are stopped by order of the new sovereign. The throne descends rightfully to the eldest son; but as it is judged indispensable that this fierce nation should be swayed by a vigorous hand, where there appears any deficiency in the eldest, the chiefs select one of the younger brothers. This arrangement, however, often gives rise to bloody contentions.

Daillé.

DAILLÉ (*Dallaeus*) JEAN, 1594–1670, one of the most learned Protestant divines of the seventeenth century, was born at Châtellerault, and received his education at Poitiers and Saumur. He was tutor to two of the grandsons of the illustrious M. du Plessis Mornay, and accompanied them in their tours through Italy, Switzerland, Germany, Flanders, Holland, and England. Having been ordained to the ministry in 1623, he preached for some time in the family of M. du Plessis Mornay; and on the death of his patron, he devoted himself to the grateful task of drawing up his *Memoirs*. In 1625 Daillé was appointed minister of the church of Saumur, and in 1626 he removed to Paris. Of his works, which are principally controversial, the most important is the celebrated treatise *On the Use of the Fathers*, originally published both in French and English. He was greatly esteemed, even by his antagonists; and his mild and amiable disposition, united to his learning and genius, led Balzac to exclaim, "*Cum talis sis, utinam noster esses.*" In his famous *Sermons on the Philippians and Colossians*. Daillé has vindicated his claim to be ranked as one of

the first of preachers, as well as one of the most able polemics. Daillé's life was written by his son Adrien, who retired to Zurich at the revocation of the edict of Nantes.

DAIMIEL, a town of Spain, New Castile, province of Ciudad Real, and 20 miles E.N.E. of the town of that name. This is one of the richest and most flourishing towns in La Mancha, and has extensive manufactories of woollen and linen goods and fire-arms, besides brandy distilleries, brickworks, limekilns, &c. In the vicinity are several salt marshes. Pop. (1845) 9128.

DAIRI, or DAIRO, the sovereign pontiff of the Japanese, or, according to Kæmpfer, the hereditary ecclesiastical governor of Japan, and next in dignity to the emperor, who bears the title of *kubo*.

DAIRY.

MILK, either in its natural state, or in the form of butter and cheese, is an article of diet so wholesome and so palatable, that the health and comfort of our people, especially such of them as dwell in cities, depend much upon their having a pure and plentiful supply of it at all seasons. DAIRY MANAGEMENT, which includes everything about the production and treatment of milk, is consequently a very important branch of husbandry, and one in which everybody feels interested. The physical conditions of the different countries of the world have determined in each case the particular milk-yielding animal most suitable to be there used for dairy purposes. The Laplander obtains his supplies of milk from his rein-deer, the roving Tartar from his mares, and the Bedouin of the desert from his camels. In the temperate regions of the earth many pastoral tribes subsist mainly upon the milk of their sheep. In some rocky regions the goat is invaluable for this purpose; and the buffalo is equally so amid the swamps and jungles of tropical climates. The milking of ewes was once a common practice in Great Britain; but it has fallen into disuse because of its hurtful effects upon the flock. A few milch asses and goats are here and there kept for the benefit of infants or invalids; but with these exceptions the Cow is the only animal now used for dairy purposes in this country.

Cows of every variety are used for the dairy; but there are several of our native breeds of cattle which possess such peculiar merit in this respect that they are called *par excellence* "the dairy breeds." As an account of these has already been given in this work (see article AGRICULTURE, vol. ii., p. 342), it may here suffice to say, that for the production of butter or cheese from pasturage of medium quality the Ayrshire cow is the best that can be found. For the city dairy, where an animal is wanted that in return for very generous feeding will give a large quantity of milk for a long time, and be easily fattened when the daily yield at length falls below a remunerative measure, or in districts where the business of the grazier is conjoined to that of the dairyman, the short-horn breed is undoubtedly the most profitable. Wherever, as in private families, the quality of the dairy produce is more regarded than its quantity, the preference is deservedly given to cows of the Channel Island breed. But whatever the breed, the quality is much influenced, 1st, by the age of the cow, and, 2d, by the way in which she is fed. So clearly is it ascertained that the milk of cows not exceeding four years of age yields a larger proportion of curd and of a richer quality than can be obtained from the milk of the same animals when kept beyond that age, that it is customary in those parts of England where cheese-making is chiefly carried on, to draft off the cows to the grazier after they have borne two or at most three calves each. Cows that show unusual excellence for the dairy, or that are prized for their pedigree, are of course kept for longer periods. Taking into account the superior quality of the produce of three and four year-old cows, and their higher value for grazing purposes at that age, as compared with what it is at six years old and upwards, the practice of drafting at the earlier age is well worthy of being more generally adopted.

The influence which the food of the cow exerts upon the amount and qualities of her milk has always been recognised. At one time, provided that a large yield of milk, free from any unpleasant taste, was obtained, little regard was paid to its other qualities. It has accordingly been the practice in new-milk dairies to feed the cows chiefly with soft sloppy food, such as boiled turnips, brewers' grains, and distillery wash. The milk produced from such food contains an undue proportion of serum, and is deficient in butter, caseine, sugar, and phosphates—the very elements which give to milk its value as an article of food, and in particular which fit it so peculiarly for building up the frame of young animals. When these elements are wanting in the food which is given to the cow, they are to a certain extent imparted to her milk by being withdrawn from her own system. And hence it is well known that cows which give a very large quantity of milk generally lose the fat and flesh which they had accumulated before calving. In order therefore, to maintain the condition of the cow, and enable her to give milk of the best quality, it is necessary that her food contain an adequate supply of these elements which are required in good milk. Her food, in short, must be substantially the same as that which is found to be most efficacious in promoting the increase of flesh and fat in cattle which are preparing for the butcher. It is now pretty well ascertained that the fattening process is accomplished most economically by giving a moderate allowance of linseed or rape cake, and of the meal of beans and other grains in addition to the pasturage, green forage, roots, and fodder, which constitute the bulk of the food of such animals. The following dietary for milch cows we have gleaned from an anonymous contribution entitled "Rape Cake for Feeding" in the *Agricultural Gazette* of 30th Sept. and 7th Oct. 1854, in which the topics now under discussion are handled more satisfactorily than in any other work we have met with. This writer states that the daily fare of his fattening cattle consists of—

	lbs.
Chopped oat-straw, shells of oats and bean-straw....	18
Rape cake 4 lbs., bran 2 lbs.	6
Swedish turnip (if mangold, 50 lbs.)...	60
	84

The rape-cake, bran, and 16 lbs. of the chopped straw, after being intimately mixed, are cooked by steaming, and so given to the cattle. The Swedes or mangold are given raw, and the other 2 lbs. of the chopped straw are given as dry fodder. On such rations he finds his cattle to make good progress; so much so, that heifers of from 7 to 9 cwt. each increase at the rate of 14 lbs. per week, and larger cattle at the rate of from 14 to 18 lbs. per week, over the whole period of fattening, which (according to the condition of the animals at starting) ranges from 16 to 24 weeks. From October to May he gives his milch cows the same *cooked* mess as has been described for the fattening of stock, with 12 lbs. of meadow hay and 30 lbs. of roots. For the first half of the period the roots consist of kohl-rabi, and of mangold for the remainder of it. From May to October the cows are turned out to pasture during the day, and are

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housed at night. The same cooked mess continues to be given daily in two equal portions at morning and evening; but its quantity is somewhat diminished during the height of summer, when the pasturage is at its best. They receive also in the house a morning and evening feed of green forage. On this fare the cows yield a very abundant flow of rich well-flavoured milk; and they besides maintain their condition at the height of their milking, and gain flesh as it diminishes. It is from a regard to the flavour of the milk, that roots are given to them more sparingly than to fattening stock; and that kohl-rabi and mangold are used in preference to turnips or cabbages. Gorse, bruised and chopped, has been found to be a peculiarly suitable kind of green winter forage for milch cows.

The best pasturage for cows is that obtained from good old grass land, in sheltered inclosures of moderate size, and in which there is a constant supply of pure water. To have dairy produce of the best quality, the grass must never be allowed to get too rank, and must therefore be so stocked as to have it always fresh grown and sweet. This is most easily secured by frequently changing the cows from one field to another; and hence the advantage of having small inclosures, one of which can be rested, while another is keeping the stock of both. When soiling is resorted to, Italian rye-grass is at once the cheapest and best forage that can be used; but it can be varied, as circumstances dictate, with clover, sainfoin, vetches, or green rape. When cows are kept entirely at pasture during the summer, from 1½ to 2 acres of grass land is required for each animal; and if hay alone is given in winter (as is the practice in Gloucestershire), the produce of another 1½ acre of meadow is required to supply their winter keep. As 1 cwt. of green forage is an ample daily allowance for a cow, and as two cuttings of clover or Italian rye-grass, averaging 8 tons each per acre, can with suitable manuring be easily obtained, it is obvious that by soiling in summer and feeding on roots and cooked food in winter, half the extent of land will suffice to maintain a cow on the latter system that is found requisite on the former. The dung produced under the soiling system is also richer, and can be more economically used. And, above all, the produce in milk, besides being of richer quality, is greater in quantity by fully one-fourth. The average yield of milk per cow per annum in Gloucestershire is estimated at 525 gallons. Under the more generous house-feeding system an average of 680 gallons is obtained. All changes of diet must be made with caution. The utmost vigilance must also be used in order to insure regularity in the times of feeding and milking, in seeing that the latter process is thoroughly performed, and in guarding the cows from exposure to extremes of heat or cold. Through inattention to these particulars the flow of milk may easily be so diminished as altogether to neutralize the profit of a dairy.

Dairies are of three kinds, viz.:—

1. New-milk dairies.
2. Butter dairies.
3. Cheese dairies.

New-milk dairies.

1. *New-Milk Dairies.*—Dairies whose produce is sold as new milk have hitherto existed only in or near to towns, or amidst the dense population of mining and manufacturing districts. This branch of dairy business is to a large extent in the hands of a class of frugal industrious persons, possessing each from one to a dozen of cows, and who, with the aid of their own families, overtake the whole management of their cows, and the delivery of the milk to their customers. But in our large towns there are now also to be found gigantic establishments, in some of which so many as a thousand cows may be seen at one time. In these town dairies the cows are usually purchased when they have newly calved, or at the point of calving. They are retained as long as they continue to give a remunerative quantity of milk daily. From the generous feeding which they receive, they are usually by that time so well in flesh that they either go at once to the shambles or are fit for doing so in a very short time after being put dry. The stalls thus vacated are at once refilled by the purchase of cows that have newly calved, and so the number of cows and the supply of milk is kept up all the year round. This, at least, is the way in which such dairymen would prefer to conduct their business; but the prevalence for several years past of the dreaded epizootical lung disease has altogether broken up many of the lesser dairies, and has constrained the owners of the larger ones to adopt to some extent a different mode of management. It being found that cows which recover from this disease are afterwards exempt from its attacks, it becomes an object of some importance to retain them as long in the dairy as possible. Such cows are accordingly put to the bull, and during the period of rest which they are allowed before calving again are sent to country quarters, where they are kept at less expense than in town, and whence they are brought up as soon as they are again in milk. In these dairies the cows are milked twice a-day. The milk is conveyed at once to the milk-room, where it is strained, measured, and delivered over to retailers, or to servants of the establishment, by whom it is distributed to the customers. A portion, in some cases a half, of the new milk is, however, retained in the dairy for twelve hours. It is then skimmed, and the cream either retailed as cream or made into butter; and the milk being mixed with an equal quantity of new milk, the whole is disposed of under that character. This business requires the employment of a large capital: it is attended with much risk, and calls for much skill and vigilance in carrying out its various details. When well managed, it is, however, a remunerative one to those engaged in it, and has undoubtedly tended to improve the quality of the milk supplied to the community, as well as to make that supply more ample and regular.

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Railways, which have revolutionized so many things, bid fair to introduce important changes in this branch of dairy business. Instead of keeping the cows in or near cities, where housing, food, and litter are costly, it is becoming a common practice to keep the cows on farms near railway stations, and to forward the new milk in suitable vessels twice a-day to parties who retail it to the citizens. This plan has many things to recommend it. It is much easier to carry the milk only to the point of consumption, than first to convey thither the cows and all the litter and food which they require, and then to recarry to the country the manure which they produce. It may also be fairly presumed that a rural residence, with sweet pasturage and pure air, will be more conducive to the health of the cows and the wholesomeness of their milk, than their being cooped up in city byres or cow-houses, and fed largely on the refuse of breweries and distilleries.

Butter dairies.

2. *Butter Dairies.*—These are the most common form of the dairy, inasmuch as the making of butter admits of being combined with various uses of the milk. We have seen that a portion of the cream in new-milk dairies is thus employed, and the same thing occurs in the cheese-making districts. Indeed, wherever cows are kept for any purpose, some portion of the milk is used for the production of butter. There are, however, extensive districts both in England and Scotland where such prominence is given to this particular product that the dairies of these districts are with propriety spoken of as "butter dairies." In the midland and western counties of England, where the breeding of cattle is extensively carried on, the calves receive new milk for the first two or three weeks only, and are afterwards fed upon skimmed milk and a gruel composed of bruised linseed and oatmeal cooked together. This admits of the greater part of the cream being converted into butter. When the calves are all weaned, the skim milk is employed in fattening pigs. In many parts of the country butter-milk

Dairy. is much relished by the labouring classes. Whenever milk can be disposed of readily in this form, dairy farmers direct their attention chiefly to the production of butter.

New milk of average quality contains about four per cent. of oily or fatty matter, which is suspended in minute globules, inclosed in a membrane composed of a cheesy substance. When the milk is allowed to settle, these globules, being lighter than the general mass, gradually rise to the surface in the form of cream. In the process of churning, these globules are broken by the mechanical agitation, aided by the action of the lactic acid which is formed from the sugar of the milk. When the globules are thus ruptured, the contents cohere in a mass and assume the familiar form of butter. Until this acidity takes place, butter cannot be formed by mere mechanical force. The invariable practice, therefore, is to allow the cream, whether separated from the milk or not, to stand until the formation of this acid has at least begun; for when once commenced it is rapidly accelerated by the air, which is introduced in the process of churning.

Butter is made either from cream only, or by churning the whole milk and cream together. The best butter is obtained from the cream which rises during the first twelve hours after milking, and the next best by churning the whole milk. In the former case the new milk, after being carefully strained, is poured into shallow vessels of glazed earthenware, glass, tinned iron, wood, lead, or zinc, of which the three first-named sorts are the best. The wooden vessels are objectionable from the difficulty of cleaning them thoroughly; and the two last from the noxious salt which is produced by the action of the acid of the milk on the metal. When it is intended to extract as nearly the whole of the butter from the milk as is practicable, the first skimming takes place at the end of twenty-four hours, and is followed up by one or more skimmings at further intervals. The cream is stored in jars, which should be kept in a place separate from the milk-room, that the milk in the coolers may not be prematurely acidulated by the proximity of the sour cream. The latter is either stirred repeatedly, or poured from one vessel to another, to prevent the formation of a tough coat upon it before enough is accumulated for a churning. In large dairies it is usual to churn daily. Three days is as long as the cream can ordinarily be kept with safety to the quality of the butter. When a cow has recently calved, her milk is comparatively rich in butter and poor in curd; but by and by the relative proportions of these constituents gradually change places, the cream diminishing and the milk becoming thicker. A very sensible change in the quality also usually takes place when a cow again becomes pregnant. In not a few cases the cream is so affected by this circumstance, that double or treble the length of time is required to churn it that sufficed before, and the butter is at the same time of inferior quality. If cows are flurried and heated, either by gadding in the pasture, or by being overdriven in bringing them home for milking, their milk becomes peculiarly liable to corrupt, the yield of butter is sensibly lessened, and its quality is impaired. The success of the process of churning depends much on the temperature of the cream being nicely regulated. A mean temperature of 60° Fahrenheit seems to be the best. The temperature of the cream usually rises about 10° during the process of churning. About 55° is therefore the desirable starting point. Advantage is derived from rinsing the churn with cold water in summer and with warm water in winter. The addition to the cream of small quantities of cold or hot water, as the case requires, is also found beneficial. Box or barrel churns are preferred when the cream only is churned, the former being best adapted for small dairies, and the latter for large ones. When the whole milk and cream are churned together, it is indispensable that acidity and coagulation should first take place. The time required to produce butter in this case is much longer than with cream alone, three hours being an average period. The plunge churn is most appreciated for this practice; and in large dairies it is usually worked by steam, water, or horse-power. Forty strokes of the piston per minute is found the best rate of working. Dairy

In Devonshire a method of treating the milk has long been in use by which what is called "clouted cream" is produced. To effect this, the new milk is strained into shallow earthenware pans, into each of which half a pint of water has previously been placed to prevent the milk adhering to the pan in the subsequent process of scalding. After standing twelve hours, these vessels are placed over a charcoal fire, or on a hot plate, or are immersed in cold water in a shallow boiler, which is then heated until the temperature of the milk rises to 180°, after which they are again replaced in the milk-room (great care being taken to preserve the surface of cream unbroken), and allowed to stand the usual time. The effect of this scalding is to separate the whole of the cream from the milk, and greatly to facilitate its conversion into butter. This is readily accomplished by placing the cream in a small tub, and working it with the hand or a piece of flat wood. The thickened or "clouted" cream is frequently eaten in this state of half-formed butter, in which it is removed from the milk. It has then a very rich appearance and agreeable flavour The butter made from it is asserted by some persons to keep better and to be altogether superior to that made without scalding; whereas others assert, and with good show of truth, that it contains an undue proportion of cheesy matter, and that in consequence it is more liable to rancidity than other butter. Clouted cream

A mode of procedure in use in some Lancashire dairies has been much commended. In milking the cows, the first drawn and larger portion of the milk is set aside, and the cream in due time skimmed from it in the usual way. The strippings or afterings, which are known to contain the greater part of the butter obtained at any one milking, are kept separate, and mixed with the cream of the other portion at the time of churning. The labour of churning is less in this way than when the whole of the milk is subjected to that process, and at the same time a larger yield of butter is said to be obtained than when only the cream is churned. Lancashire method.

Although the process of churning, in a popular sense, completely separates the butter from the other parts of the milk, this is not done so thoroughly as to exclude the retention of some oily matter in the whey, and, on the other hand, of a portion of caseous matter in the butter. Cheese, being a nitrogenous substance, is peculiarly susceptible of putrefaction, and hence even the smallest portion of it when left in butter is sure in a very short time to corrupt and to impart to the whole mass a rancid flavour. Besides this liability to taint, arising from an element inherent in itself, butter, in common with other fatty substances, has a peculiar affinity for smells of all kinds. If cream or butter be kept in the same apartment with tainted meat, or other decaying matter, or is stored in vessels that have previously contained any rancid substance, or is exposed to unsavoury odours from the proximity of dung-heaps, stables, &c., it is sure to retain unmistakeable tokens of having been in such evil neighbourhood. The inherent tendency to rancidity is to be combated by carefully washing the newly-churned butter in repeated baths of pure cold water, and by working a little salt into the mass while the washing is in progress. By this means not only the whey, but the greater part of the caseous matter above referred to, can be removed. If the butter is to be used fresh, it is immediately made into rolls or pats; but if it is to be cured, fine salt, at the rate of half an ounce to the pound, is thoroughly incorporated with it, and the mass, after lying a day, again worked over,

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and then tightly packed into a perfectly clean air-tight vessel. In domestic use the most convenient vessels are jars of glazed earthenware. That intended for market is put into casks called half-firkins, firkins, and tubs, containing respectively twenty-eight pounds, fifty-six pounds, and eighty-four pounds. These should be of well-seasoned oak, and made perfectly tight, as otherwise the butter is sure to be tainted. From the facilities which railways afford for cheap and rapid carriage, a very great proportion of our home-made butter is now sent to market in a fresh or slightly powdered state.

The unpleasant flavour imparted to milk or butter when cows are fed on turnips or cabbages can be removed or avoided; 1*st*, by cooking these esculents and giving them in mixture with chopped straw, in quantities not exceeding sixty pounds a-day, given at two feeds; or, 2*d*, by adding to each gallon of the new milk a table-spoonful of a saturated solution of nitre, or the same quantity of a solution prepared by dissolving half an ounce of chloride of lime in one gallon of water.

The average yearly product of butter per cow in the butter dairies is usually estimated at 170 to 200 pounds. This is in addition to the new milk used in rearing the heifer calves required to keep up the stock, and to the butter consumed in the farmer's family. With uniform good feeding an average of 227 pounds per cow per annum has been obtained in a dairy of forty cows belonging to Mr David Young, Lochtyside (near Kirkcaldy, Fife), of which a most interesting account is given in Morton's *Cyclopædia*, from which we quote the following particulars. The quantity of milk yielded on an average by Mr Young's cows is nine quarts daily for ten months, or 680 gallons annually. The average proportion of milk, cream, and butter, to each other, is one gallon of cream to nine of milk, and three pounds of butter to one gallon of cream, or one pound of butter to three gallons of milk as it comes from the cow. The following is a tabular view of the annual produce and cost of each cow:—

Expense from May 1 *to October* 1.

2 acres of grass at 45s.	L.4	10	0
Clover and tares	1	0	0
Draff in Summer	0	6	5½

From October 1 *to May* 1.

14 tons. 4 cwt. of turnips, at 7s. 6d.	L.5	6	6
5 bushels of linseed, at 7s.	1	15	0
Draff in Winter	1	2	1
Interest on L.14, at five per cent	0	14	0
Carriage of milk and tolls	0	15	0
Attendance, fuel, &c.	0	10	0
Total	L.15	19	0½

Produce per Cow = 680 *gals. of milk.*

227 lbs. of butter, at 10½d.	L 9	18	7½
600 gals. of skimmed milk, at 4½d.	11	5	0
50 gals. of butter milk, at 2½d.	0	9	4½
Calf at a week old	0	15	0
Total value of produce	L.22	8	0
Deduct expense of food, &c	15	19	0½
Net profit per cow	L.6	8	11½

Cheese dairies.

3. *Cheese Dairies.*—Cheese-making is by far the most difficult department of dairy management. Although the art is universally practised, and the raw material is everywhere substantially the same, there is perhaps no equally common product which varies so much in its quality and market value, from mere diversity in the skill with which it is made. The difficulty of producing really good cheese, arises from the peculiar susceptibility in milk to be influenced by a great variety of external causes, and the extreme facility with which its component parts enter into chemical changes of the most decisive kind. An average sample of milk has been found to consist of— Dairy.

Caseine	4·48
Butter	3·13
Milk sugar	4·77
Saline matter	0·60
Water	87·02
	100·00

The caseine, which forms the chief ingredient of cheese, and which is almost exactly of the same composition as animal flesh, is held in solution in the milk by means of an alkali. Any acid which removes this alkali converts the caseine into an insoluble curd, which when dried forms cheese. When milk is allowed to stand until it sours, coagulation takes place from the action of the acid which is formed spontaneously in itself. But there are various substances which when added to new milk have the property of forming lactic acid, and thus of causing it to coagulate speedily. The substance which is invariably used for this purpose in British dairies is rennet, prepared for the most part from the stomachs of sucking calves. To adapt them for this purpose, these stomachs, usually called bags or vells, as soon as taken from the animal are turned inside out, carefully freed from all impurities, and salted. They are then packed one upon another, with a layer of salt between each, into a deep earthenware vessel, covered over with salt, and excluded from the air by a close-fitting lid. In the best English dairies the skins are invariably kept for a year before being used. About a month before the rennet is needed, a sufficient number of the skins are from time to time taken out of the jar, and when the brine has drained from them, they are spread out upon a table, powdered on both sides with fine salt rolled with a paste roller, distended with a splint of wood, and hung up to dry. The rennet, provincially called *steep* or *yearning*, is an infusion of these cured stomachs. A portion of the dried bag, at the rate of a square inch to 10 gallons of milk, is put the day before it is needed into a cup containing half a pint of lukewarm water and a tea-spoonful of salt; and it is by mixing this infusion with the milk that coagulation is obtained. It would appear that the power of producing this effect is due to a certain degree of decay having begun in the skin. If this has gone too far, the milk is not merely curdled, but an unpleasant taste is imparted to it, and the cheese so made corrupts prematurely, and is unwholesome. The careful cleaning and salting regulates this principle; and when skilfully managed, a sweet and wholesome curd is obtained. In some dairies, as much of this rennet is infused at one time as serves for several weeks, or even months; but the practice of the best dairies is in favour of its daily, or at most weekly, preparation. To produce cheese of the best quality, it is indispensable that the rennet be sweet and good; that only so much of it, and no more, be added to the milk, as will suffice to produce perfect coagulation; and that this take place at the proper temperature. Too much rennet makes a tough curd and a poor ill-flavoured cheese. From 80° to 85° appears to be the proper temperature of the milk when the rennet is mixed with it, and from an hour to an hour and a quarter the time which it should take to coagulate.

A cheese-dairy farm must be provided with suitable buildings, apparatus, and utensils. The buildings required are byres for the whole of the cows, a calf-house, yards for the heifers, and piggeries. The byres should not be less than 17 feet in width, distributed as follows:—

Passage in front of stalls	3½ feet.
Manger	2
Stalls	6
Urine grip	1½
Passage behind	4
	17

Dairy. It is usual to rear one heifer calf for each three cows, and to have the heifers to calve for the first time at 3 years old; so that the young stock of all ages are equal in number to the cows. As many pigs are kept as suffice to consume the whey; the proportion, in summer, being one pig to two cows. The dairy comprises a milk-room, working-room, salting and drying room, and cheese-room. The working-room is provided with two boilers; a smaller one for heating water, and a larger one for heating whey. There are also lead tanks for containing the fresh whey, and a cistern in which, after being scalded, it is stored for the pigs. The cheese-tub is of wood or brass—the latter being best, as it admits of being thoroughly washed and burnished; whereas, a wooden vessel, being porous, is exceedingly apt to retain minute particles of milk or whey, which, souring in the wood, become a source of mischief to the future contents. The other utensils are lever presses; cheese vats of elm, turned out of the solid and hooped with wood; pans of tinned iron or brass for heating milk by immersion in hot water; cheese-ladder; curd-breaker; curd mill, thermometer, &c.

The cows are milked twice a-day; at 5 A.M. and 5 P.M. The whole available hands are engaged at this work, that it may be accomplished speedily. Usually, each person has seven or eight cows to his or her share, and occupies about ten minutes in the milking of each of them. The milk is carried to the dairy as fast as it is drawn from the cows, and is there consigned to the care of the dairy-maid, who proceeds in her treatment of it according to the variety of cheese which it is designed to produce. The kinds of cheese in best estimation and of greatest market value are Stilton, Cheddar, Cheshire, and Gloucester. The first variety is made in Leicestershire, and contains the cream of one milking added to the new milk of the next. The Cheddar and Cheshire cheeses are made from new milk, or rather from milk in which all its own cream is retained. Gloucester cheese is usually deprived of a small portion of its cream. Double and single Gloucester differ only in the former being twice the thickness and weight of the latter, and consequently taking longer to ripen. The Scotch variety called Dunlop, and the Gouda of Holland, are full-milk cheeses, but are much inferior in quality, and sell for a much smaller price than the same class of English cheeses. As there are good grounds for supposing that this inferiority is entirely, or chiefly due to unskilfulness in the manufacture, the Ayrshire Agricultural Association in the summer of 1854 sent a deputation into the counties of Gloucester, Wilts, and Somerset, to inquire into the methods of cheese-making there practised. The followiug is an extract from their report:—

"We are indebted to Mr Titley, cheese factor, Bath, for an introduction to Mrs Harding, Marksbury, and her nephew, Mr Joseph Harding, Compton Dando, who make first-rate Cheddar cheese. In their dairies, as well as in the other establishments which we visited, we were fortunate not only in seeing the manufacture of the best cheese of their respective kinds, but also in meeting with people who were ready to give clear explanations of the various processes, and excellent reasons for what they were doing.

There is an appearance of ease and simplicity about the method of making Cheddar cheese, as we saw it practised in Somersetshire. In the dairies of Mr Harding and his aunt a regular system is followed; and those undeviating guides, the thermometer and the clock, are frequently referred to in the different stages of the process. The more that a regular system is introduced into the manufacture of cheese—subject to such modifications as the superintendent may occasionally think necessary for varying circumstances—there is the greater probability of obtaining uniform results.

The points of excellence aimed at in these dairies are the manufacture of the best quality of cheese in the most cleanly manner, and with the smallest amount of labour. In their attempts to accomplish this, Mr and Mrs Harding have been highly successful.

In addition to the girls who do the work of the dairy, several men and boys are employed to milk the seventy-three cows belonging to Mrs Harding at Marksbury. The men carry the milk, but they do not enter the dairy in doing so. It is poured through a sieve into a receiver outside, from which a pipe conveys it through the wall to the cheese tub, or to the coolers. A canvas bag is also placed over the inside end of the pipe, so that a double precaution is used against impurities entering with the milk.

Immediately after the morning milking, the evening and morning milk are put together into the tub. The temperature of the whole is brought to 80 degrees by heating a small quantity of the evening milk. Mrs Harding, who has had long experience in cheese-making, can tell the precise temperature within two or three degrees by merely passing her hand through the milk. Her grand-niece, who now relieves her of most of the duty of superintendence, can usually tell very nearly; but even with individuals whose senses are acute there is a liability to deception, from the varying heat of the hand when it is put into the milk, in different states of the weather. The thermometer, therefore, is found to be the surest guide, and it is regularly used.

In spring and towards winter a small quantity of anatto is used to improve the colour of the cheese. It is put into the milk along with the rennet at seven o'clock. After the rennet is added, an hour is requisite for coagulation. At eight o'clock the curd is partially broken and allowed to subside a few minutes, in order that a small quantity of whey may be drawn off to be heated. This whey is put into a tin vessel and placed in a boiler in an adjoining apartment, to be heated in hot water. The curd is then most carefully and minutely broken, Mrs Harding and her niece performing this part of the work with utensils called shovel breakers. The servants are never intrusted with this duty. When the curd is completely broken, as much of the heated whey is mixed with it as suffices to raise it to 80 degrees, the temperature at which the rennet was added. Nothing more is done to it for an hour.

A little after nine o'clock the work is resumed. A few pailfuls of whey are drawn off and heated to a higher temperature than at eight o'clock. The curd is then broken as minutely as before; and after this is carefully done, an assistant pours several pailfuls of heated whey into the mass. During the pouring in of the whey the stirring with the breakers is actively continued, in order to mix the whole regularly, and not to allow any portion of the curd to become overheated. The temperature at this time is raised to 100 degrees, as ascertained by the thermometer, and the stirring is continued a considerable time until the minutely broken pieces of curd acquire a certain degree of consistency. The curd is then left half an hour to subside. At the expiry of the half hour the curd has settled at the bottom of the tub. Drawing off the whey is the next operation, and the case with which it is performed would astonish an Ayrshire dairy manager. The greater proportion of the whey is lifted in a large tin bowl, and poured through a hair sieve into the adjoining coolers. As it runs into the leads it appears to be very pure. When the whey *above the mass of curd* is thus removed, a spigot is turned at the bottom of the tub, and the remainder is allowed to drain off, which it does very rapidly without any pressure being required. To facilitate this part of the work the tub is made with a convex bottom, and the curd is cut from the sides of the tub and placed on the elevated centre. It is carefully heaped up, and then left for an hour with no other pressure than its own weight.

After this interval it is cut across in large slices, turned over once on the centre of the tub, and left in a heap as before for half an hour. The whey drips away toward the sides of the tub, and runs off at the spigot; and, no pressure being applied, it continues to come away comparatively pure.

After undergoing these simple and easy manipulations, and lying untouched during the intervals that have been mentioned, the curd is ripe for the application of pressure. But great care is taken not to put it into the vat to be pressed at too high a temperature. If the heat be above 60 degrees, and it usually is higher at this time, the curd is broken a little by the hand and thrown upon a lead cooler until it is brought down to the desired temperature."

When curd has by such means as these been brought to a somewhat firm consistency, it is enveloped in coarse linen cloths and put into perforated wooden vats, which are placed in a lever press and subjected to gradually increased pressure until the whey is expelled, and the cheese has acquired sufficient consistency to retain its shape when turned out to the shelves of the drying room. Very rich cheeses are usually supported for some weeks after leaving the press by being tightly bound round with a fillet of stout linen cloth. During the first day's pressing, the incipient cheese is frequently taken out of the vat, has its edges pared, receives dry cloths, and is reversed in the vat to keep its sides uniform. In the Cheshire dairies iron skewers are thrust into the curd through the perforations of the vat, and then withdrawn to form drains for the readier emission of the whey. Salt is applied sometimes by crumbling down the curd after

Dais ‖ Dalgarno.

its first hour in the press, and mixing fine salt with it at the rate of 1 lb. of salt to 42 lbs. of curd, and then returning it to the vat. This crumbling is effected by passing it through a simple curd mill, which tears it into minute fragments. In other cases the salt is merely rubbed into the cheese externally at each changing of the cloths while it is in the press, and for some days after its removal to the drying room. As soon as its degree of dryness and firmness admits, it is placed in the cheese-room, and is then wiped with a cloth and turned at first daily, and afterwards twice weekly until it is ready for market. The cheese-room is kept at a temperature of 60°, and has light and currents of air excluded from it. The darkness is a protection from flies, and a still and moderately warm atmosphere promotes its ripening.

When the process of making new-milk cheese is skilfully conducted, it consists not only of the caseine, but includes nearly all the butter of the milk. A portion of the latter is, however, carried off in the whey, from which it is recovered by a simple process. The whey is heated in a boiler to 180°, at which point a small quantity of sour buttermilk is stirred into it, which has the instantaneous effect of causing all the buttery matter to rise to the surface, from which it is skimmed off and put into a jar. As soon as the buttermilk is put in, the fire is withdrawn to prevent the whey from reaching the boiling point. The whey thus deprived of its cream is run into a cistern, whence it is dealt out to the pigs. The whey-cream is kept for three or four days until it thickens, and is then churned like ordinary cream. About half a pound of this whey butter is obtained weekly from each cow. It is worth about three-fourths of the value of cream butter.

Dalkeith ‖ Dalmatia.

A gallon of good milk produces 1 lb. of cheese. The average produce per cow per annum is from 3 to 5 cwts., exclusive of the milk used in rearing calves. (J. W—N.)

DAIS (French *d'ais*), a platform or raised floor at the upper end of ancient dining halls, where the principal persons sat at table. It was also used to signify a seat with a high back, and sometimes surmounted by a canopy, for those who sat at the high table.

DALECARLIA or DALARNE, an old province of Sweden, now forming the laen of Falûn, and celebrated for its valuable mines. The Dalecarlians were the first and most faithful adherents of Gustavus Vasa. See SWEDEN.

DALECHAMPS, JACQUES (1513-1588), a French physician and botanist, was born at Caen, in Normandy. He was distinguished for his industry and erudition, both in science and in literature. He edited Pliny, Athenæus, Paulus Ægineta, Cælius Aurelianus, and the two Senecas. To the Dioscorides of Ruellius he added thirty plates of rare plants; and in his *Historia generalis Plantarum in libros xviii. per certas classes artificiose digesta*, Lugd. 1587, 2 vols. fol., he aimed at including all the botanical discoveries previous to his own time, as well as those which he himself had made in the vicinity of Lyons and the Alps. Dalechamps was also the author of a work on surgery, and another on the Plague, in three books. During the last six years of his life he practised as a physician at Lyons.

D'ALEMBERT. See ALEMBERT.

DALGARNO, GEORGE, an ingenious, but now almost forgotten writer, born at Old Aberdeen about 1626. He appears to have studied at Marischal College; and in 1657 he went to Oxford, where, according to Wood, "he taught a private grammar-school with good success for about 30 years." (*Athen. Oxen.* vol. ii., p. 506-7.) He died of a fever Aug. 28, 1687, and was buried "in the north body of the Church of St Mary Magdalen." In his work entitled *Didascalocophus or the Deaf and Dumb Man's Tutor*, printed at Oxford in 1680, he has the merit of anticipating some of the most scientific conclusions of the present age on the education of the deaf and dumb. "In prosecution of his general idea," says an eminent philosopher, who has done much to rescue the name of Dalgarno from oblivion, "he has treated, in one short chapter, of *a Deaf Man's Dictionary*; and, in another, of a *Grammar for Deaf Persons*; both of them containing a variety of precious hints, from which useful practical lights might be derived by all who have any concern in the tuition of children during the first stage of their education." (Dugald Stewart's *Account of a Boy born Blind and Deaf, in Transactions of the Royal Society of Edinb.*, vol. vii.) Twenty years before the publication of his *Didascalocophus*, Dalgarno had given to the world a very ingenious piece entitled *Ars Signorum*, from which, says Mr Stewart, it appears indisputably that he was the precursor of Bishop Wilkins in his speculations concerning "a real character and a philosophical language." According to the testimony of Wood, Dalgarno communicated this piece to Wilkins before it was published, and it was from it that the latter took the hint of his celebrated work. It is highly discreditable to Wilkins that he takes no notice whatever of the name of Dalgarno; and Dr Wallis must share the same censure. That notice which the English professors, who borrowed from them, ungenerously withheld from the writings of the Scottish schoolmaster, was liberally bestowed upon them by Leibnitz, who has, on various occasions, alluded to the *Ars Signorum* in commendatory terms. The works of Dalgarno, which had become exceedingly rare, have been lately reprinted by the Maitland Club.

DALKEITH, a burgh of barony and market-town of Edinburghshire, situated on a narrow strip of land between the North and South Esk, 6½ miles S.E. of Edinburgh. It is a place of considerable antiquity, having gradually risen into existence from the proximity of a castle long known as one of the chief baronial strongholds south of the Forth. The town has lately undergone considerable improvements, and is now for the most part clean and well-built. The town church, an old Gothic edifice partly in ruins, was originally the chapel of the castle: in 1406 it was raised to the dignity of a collegiate church, and after the Reformation it became the parish kirk. A splendid new church in the early English style, with a steeple 167 feet high, was built by the Duke of Buccleuch in 1840; and there is an elegant Episcopal chapel within the grounds of Dalkeith palace. Dalkeith is the largest country town in the county, and is the seat of one of the largest corn-markets in Scotland, held every Thursday. There are extensive corn-mills, breweries, iron-foundries, tanneries, two market-houses, grammar-school, subscription library, &c. In the vicinity is Dalkeith palace, the principal seat of the Duke of Buccleuch, surrounded by an extensive park, through which the two Esks flow and unite their streams a short way below the palace. It was the temporary residence of Charles I. in 1633, of George IV. in 1822, and of her present Majesty in 1842. Pop. (1851) 5086.

DALMATIA, an ancient Roman province on the N.E. shore of the Hadriatic, forming part of the country known as Illyricum. It was bounded N. by Liburnia, E. by the Savus (the *Save*), a southern tributary of the Danube, S. by the Montes Bæbii and the Hadriatic, and W. by the Hadriatic. The limits of Dalmatia varied in ancient times. Originally they comprehended only the country lying between the rivers Tilurus and Naron, though they were afterwards widely extended. When the country had thus attained its maximum of superficial area, it was erected by the inhabitants into a republic, a form of government that lasted till the country was subdued and made a Roman province by

Dalmatia.

Tiberius. The interior of the country is for the most part rugged and hilly, in some places even mountainous. Along the sea-shore the coast is flat and swampy, and almost uninhabitable. The soil of Dalmatia, though not the best, is far from being bad; but as the original inhabitants were rude and predatory, and utterly neglected agriculture, it never reared sufficient corn to maintain its own population. The vine and olive throve everywhere, especially on the northern slopes of the hills. The mineral resources of the country, which were afterwards so successfully worked by the Romans, were unknown to the original inhabitants. It was in the year 180 B. C. that the Dalmatians, separating themselves from the other Illyrians, abolished the regal form of government, established a republic, and selected Dalminium as their capital. From this town they took the name by which they are known in history. In 156 B.C. Dalmatia was for the first time attacked by the Romans. Within the next hundred years it was invaded by that people three times, sometimes successfully, sometimes with loss and disgrace to the assailants. The country was not made a Roman province till in A.D. 9 it was overrun and completely subdued by Tiberius. Under the empire Dalmatia was renowned as the native country of Diocletian. It was to Salona, the new capital of Dalmatia, that that emperor retired after resigning the purple. When Arcadius and Honorius divided the empire of Rome between them, Dalmatia fell to the lot of Arcadius. After a time it fell into the hands of Odoacer, from whom it was taken by Theodoric. At the beginning of the next century we find it in the possession of Justinian. Not long afterwards the Ostrogoths made themselves masters of it, and were in turn expelled by Belisarius. In the seventh century the Serbs were driven out by the Sclaves. By this latter people Dalmatia was retained as a separate and independent kingdom, till in 1005 it was overrun by Ladislaus, and the Magyars annexed to Hungary the whole country except the maritime towns. One portion of the country became so identified with Hungary, that it lost its own name altogether, as did also another part, which was incorporated with Turkey. By the treaty of Campo Formio, the Austrians got possession of that part of Dalmatia which had belonged to the Venetian republic. In 1805 it was seized by Bonaparte, who remained master of it till his downfall in 1814. Since that date the Austrian supremacy in Dalmatia has never been questioned.

Dalmatia, as it now exists, is the most southerly dependency of the Austrian crown. Its area, exclusive of the islands off the coast which belong to it, is about 6000 square miles. Its present population is about 394,000. It is divided into Old and New Dalmatia; the former of which, for political and governmental purposes, is subdivided into the circles of Zara and Spalatro, and the latter into those of Ragusa and Cattaro. The mountain ranges which intersect Dalmatia are, with a single exception, spurs of the Dinaric Alps. Dinara, the loftiest of these summits, is nearly 6000 feet high; and Biokovo, the next in height, is upwards of 5500 feet. Of the rivers in the province the most important is the Narenta (*Naro*), the Cettina (*Nestus* or *Tilurus*), the Kerka (*Titius*), noted for its waterfalls and the wild magnificence of its scenery, and the Zermanaya (*Tedanius*); all which streams, with others of minor importance, flow into the Hadriatic from east to west.

The general character of the Dalmatian soil in modern as in ancient times is not very favourable to agriculture. The summer heat is too great, and the want of water too general; yet both climate and soil are well adapted for the olive and the vine. Large quantities of olive oil are consumed by the natives, yet there is annually a surplus of about 20,000 barrels, which is exported. About 8,000,000 gallons of wine of good quality are annually made, of which one-eighth is reserved for home consumption, while the remainder is exported. The fruits of the country constitute one of its most valuable productions. Of these the most important are figs, of which a million of pounds are annually exported, besides large quantities of almonds, raisins, dates, oranges, &c. Of corn only enough is grown to serve the inhabitants for six or eight months of the year; the deficiency being supplied from Hungary and Turkey. The sardine and tunny fisheries give employment to nearly 10,000 persons. The rearing of cattle is as backward as the husbandry; the breeds found in the country being both small in size and few in number.

Dalry || Dalrymple.

The manufactures of Dalmatia are conducted on so small a scale as to be scarcely worth mentioning. The most important of these is the distillation of spirits and liqueurs, of which Maraschino is the most famous and the best. (See AUSTRIA.) The total annual value of exports is estimated at about half a million of pounds sterling, and of imports about four-fifths of that sum.

The chief towns of Dalmatia are Spalatro, Ragusa, Lara Cattaro, and Curzala, the most important of which will be found described under their respective heads.

When Dalmatia was subject to Napoleon at the beginning of the present century, it gave the title of duke to Marshal Soult, while the adjoining republic of Ragusa gave a similar title to Marshal Marmont.

DALRY, a thriving village of Ayrshire, situated on an eminence, and nearly surrounded by the waters of the Garnock, Rye, and Caaf, 18 miles north of Ayr. Pop. (1851) 2071, chiefly engaged in coal and iron works, and in weaving.

DALRYMPLE, JAMES, Viscount of Stair, who bears the greatest name in the annals of Scottish jurisprudence, was the son of James Dalrymple of Stair, by his wife Janet, the daughter of Fergus Kennedy of Knockdaw, and was born in the month of May 1619, at Dunmorchie in the parish of Barr and county of Ayr. The family from which he descended was at an early period distinguished by its love of religious liberty: Dalrymple of Stair is mentioned among the Lollards of Kyle. Before he had attained the fifth year of his age, he lost his father, and the care of his education devolved upon his mother, who is described as a woman of an excellent spirit, and who survived her husband for nearly forty years. The first elements of learning he acquired at Mauchline school, and at the age of fourteen was sent to the university of Glasgow, where he took the degree of A. M. in 1637. He repaired to Edinburgh in the course of the ensuing year, and obtained a commission in the earl of Glencairn's regiment, but he did not long adhere to the military profession. In 1641 he was encouraged to offer himself as a candidate for a vacant professorship of philosophy at Glasgow. In those old-fashioned times, the comparative merit of candidates was a circumstance not entirely disregarded: their comparative merit was ascertained by a fair and open competition; on this occasion, Captain Dalrymple presented himself in buff and scarlet, and was with great applause declared to be the successful competitor. He retained his commission for some time after he became professor of philosophy. He was admitted on the 12th of March, and became bound by an oath to resign his professorship in case of marriage. As a preparation for such a step, he accordingly resigned it on the 4th of September 1643, and was immediately re-elected. On the 21st of the same month, he married Margaret, the eldest daughter of James Ross of Balneil in the county of Wigton, with whom he acquired a large estate. They are said to have lived together in great happiness; but, according to the statement of one of his descendants, Lord Hailes, his happiness must have been in his own mind, for "he could not have much happiness from the complacency of his wife."

After his return to Glasgow, he appears to have applied

Dalrymple. his vigorous faculties to the discharge of his particular functions, and to the enlargement of his stock of general learning. His lectures were attended by many young men of rank and fortune,[1] and he thus had an opportunity of forming connexions which he afterwards found to be of considerable advantage. Not satisfied with his present acquisitions, he devoted much attention to the study of the Greek and Latin languages, with the history and antiquities of Greece and Rome; and to all his other pursuits he added the study of the civil law, in which he must have been his own preceptor. His colleagues had easily discovered his talents for business, and he frequently had occasion to visit the seat of government in the prosecution of some of the university suits: he was thus rendered familiar with the forms of judicial procedure, and became acquainted with the most eminent men on the bench and at the bar. Having adopted the resolution of betaking himself to the profession of the law, he resigned his chair in the year 1647, and was admitted an advocate on the 17th of February 1648, being then in the twenty-ninth year of his age. He soon rose to professional eminence. After the execution of the king, the committee of estates dispatched certain commissioners to his son at Breda, for the purpose of inviting him to Scotland: Dalrymple was appointed to act as their secretary, and he appears to have acquitted himself to the satisfaction of both parties in this weighty negociation. In Holland he visited several learned men, and particularly Salmasius, who held an honorary professorship in the university of Leyden. He returned home in the course of the ensuing year, 1650; but during his absence, he had been nominated by the estates one of the commissioners for revising the old books of law, the acts of parliament, and the practice of the different judicatures. On the 29th of May he was sent to the north, along with Arthur Erskine of Scotscraig, with instructions to attend the king's landing.[2] He experienced a favourable reception, and appears to have engaged very zealously in the royal cause; but it is well known that the efforts of the Scottish royalists to place Charles on the English throne were unavailing to him, and pernicious to themselves.

Dalrymple continued his practice at the bar till the imposition of what was called the Tender, when several other eminent lawyers likewise retired. He however resumed his place when Cromwell's government either dispensed with the oath, or connived at its omission. In the year 1656, he was included in a deputation of four advocates who were sent to remonstrate with the commissioners for the administration of justice, on the expediency of restoring the ancient practice of the outer-house, which these republican judges had suppressed. This remonstrance was attended with the desired effect. On the 26th of June 1657, Sir James Learmonth of Balcomy, one of the judges, expired on the bench; and on the very same day, a commission, appointing Dalrymple in his place, was signed by General Monk in the name of the protector's council in Scotland. In a letter written three days before, the general had recommended him to Cromwell as "a person fit to be a judge, being a very honest man, a good lawier, and one of a considerable estate;" and now, describing him as a person of eminent abilities, he craved his highness's approbation of the choice which the council had been induced to make.[3] The annual salary of the Dalrymple judges was then three hundred pounds sterling. This was a preferment which he had not solicited, and of which he did not accept without considerable reluctance. Whatever might be his views or feelings as to Cromwell's government, it is probable that his practice at the bar may have been more lucrative. He was admitted on the 1st of July, and his appointment was confirmed by the protector on the 25th of the same month. In this situation, his interest was beneficially exerted in procuring for the gentlemen connected with the counties where his estates were situated, a redress of grievances from the council or the English officers; and by thus enlarging the sphere of his utility, he encreased his connexions, and strengthened his personal influence. He obtained so considerable a share of Monk's confidence, that the day before he began that march which decided the fate of three kingdoms, he held a private conference with Dalrymple, and requested him to deliver his unreserved opinion as to the best method of restoring tranquillity and regular government. The learned judge readily answered that "the wisest and fairest way was to procure a meeting of a full and free parliament." This sound advice was ultimately adopted, at least to a certain extent; and of Monk, "who was determined to make his own fortune, without regard to any party,"[4] it must at least be admitted that he acquitted himself with sufficient dexterity.

Soon after the Restoration, Dalrymple accompanied the earl of Cassillis to London, in order to pay his respects to the king. On this occasion he received the honour of knighthood; and his name was inserted in the first commission to the judges of the court of session, dated on the 13th of February 1661. During the absence of the lord president, it was customary to appoint a vice-president; and, except in one instance, when he was himself absent at the same time, the choice uniformly fell upon Sir James Dalrymple. After an interval of two years, he was exposed to some degree of uneasiness by the operation of the statutes which required the oath of allegiance to be accompanied with a declaration against the national covenant adopted in 1638, and the solemn league and covenant adopted in 1643, as being contrary to the fundamental laws and liberties of the kingdom. Dalrymple was in the country attending the funeral of his mother when this ill-timed declaration was tendered to his colleagues, and when all who were in town subscribed it, with the solitary exception of Sir James Dundas of Arniston. The earl of Glencairn, lord chancellor, communicated to him the king's order to the privy council to declare vacant the places of such judges as refused to subscribe; and in his answer, dated at Ayr on the 15th of January 1664, he stated that he had already resigned his commission into the king's hands.[5] After the lapse of a few months, he was invited to court, and was favoured with an audience of his majesty, who graciously received his explanations, and was pleased to inform him that he would not accept his resignation. The conscientious judge stated that he was willing to "declare against no more than what was opposite to his majesty's just right and prerogative." A letter from the king, dated on 21st of April, restored him to his seat on the bench, and his declaration was afterwards received with this qualifica-

[1] In the Advocates Library there is an octavo MS. which bears the following title: "Compendium Logicæ sub viro non parum erudito Magistro Jacobo Dalrymple, anno Domini 1643." It contains notes of the professor's lectures on logic, taken by a student named Robert Law.

[2] Balfour's Annales of Scotland, vol. iv. p. 18.

[3] Thurloe's State-Papers, vol. vi. p. 367. 372.

[4] Brodie's Hist. of the British Empire, vol. iv. p. 484.

[5] Of this letter to the earl of Glencairn, the original is in the possession of Thomas Thomson, Esq. to whose kindness we are likewise indebted for the use of various other documents connected with the personal history of Lord Stair.

Dalrymple. tion. During the interval, he had made an excursion to France: he left London on the 22d, and reached Paris on the 29th of April.[1] On the 2d of June ensuing, he was created a baronet. While at the bar, he had refused all employment in criminal cases, and under the protectorate he had declined to act in the criminal court. After the Restoration, he was offered the place of king's advocate, or that of a judge in the court of justiciary: but, says Forbes, "he excus'd himself, alledging for his reason the danger of acquitting the guilty, or wounding the innocent in such offices; and no doubt the gentleness of his nature, as well as the hazard he foresaw in deciding concerning state-crimes, had influence on that resolution."[2] The various regulations which altered and improved the practice of the court from the period of the Restoration to the year 1669, are in a great measure imputed to his influence. He was one of the commissioners appointed under the great seal for regulating judicatures; and the regulations which they recommended were embodied and confirmed by acts of parliament passed in 1669 and 1672. He opposed the distinction which was then projected between lawyers who practised in the inner and those who practised in the outer-house; and he equally opposed the scheme of tendering to the advocates an oath that they would not accept higher fees than were fixed by the authority of the court. For his conduct in resisting these unpalatable measures he received the thanks of the faculty: but in the midst of the arbitrary proceedings which were so prevalent at that period, it was difficult to escape the general odium; and in 1674, during the great schism which took place between the bench and the bar, on the subject of appeals from the court of session to the parliament, he felt the force of that envy which his merit and his good fortune had frequently provoked. In his Apology he has expressly declared that he had no personal concern in the violent measure of banishing the advocates from Edinburgh.

The project of a union between the two kingdoms had been revived in the year 1670, and Sir James Dalrymple was then appointed one of the Scottish commissioners. By his wit and address upon this occasion, he strongly recommended himself to the good graces of Lauderdale.[3] He was soon afterwards nominated a member of the privy council, which at that period was invested with very undefined and arbitrary powers. The office of president of the court of session having become vacant by the resignation of Sir John Gilmour of Craigmillar, he was appointed to succeed him on the 13th of January 1671; and his place as an ordinary judge was supplied by his kinsman Sir Thomas Wallace of Craigie. On the 15th of December 1676, the common council of Edinburgh, having taken into consideration the many great and signal services done to the city by the lord president, resolved that his houserent should be paid from the funds of the corporation, and that the same benefit should be extended to his successors in office. This municipal act continued in force till the year 1741, when the lord president Forbes declined to avail himself of the privilege which it conferred.[4]

Dalrymple's connexion with so corrupt an administration necessarily exposed him to suspicion and obloquy. Dalrymple. Having afterwards been charged with subserviency to the duke of Lauderdale, a name devoted to infamy, he replied that the accusation was "general and calumnious, without an instance given;" and he then proceeded to state that his influence had always been applied to the most beneficial purposes. The duke, he remarks, "came to Scotland in the year 1677; and upon representations made by me and others, he concurr'd in making several acts of council, correctory of the abuses that then run; as particularly, that persons were cited for church-disorders, without special circumstances of time or place, but generally in one or other of the days of all the months for several years; and were put to their oaths upon the whole libel, whereby many had been holden as confest, and thereupon fined, imprisoned, and transported like slaves to foreign plantations: whereupon the then arch-bishop of St Andrews did represent to the bishops in England, and to the court, that he was overturning the settlement of this nation; and he likewise said that in one moneth after he came hither, he had put the king's interest further back than could be retrived in seven years. To make up which, he was instigated to bring in the Highland host upon the west of Scotland, who treated them as enemies, not only by free quarter, but by all insolencies and oppressions; and to obtain an order of council to enjoin a bond to be taken by all in publick trust, and others in that countrey, to delate, apprehend, and bring to judgment all the presbyterian ministers that came ever in their power, that had keeped any conventicles: against both which I did with all freedom and faithfulness disswade him and dissent; and I do not remember of any one person in council or session that could never be induced to subscribe that bond, or to approve that road, but my self. And when in the year 1679 several complaints were made to K. Charles against Lauderdale and his brother, which were published in print,[5] and whereupon K. Charles gave a publick audience, though I was there present, there was not the least insinuation against me."[6] What he here states in reference to that pillar of the apostolical church Dr Sharp, is sufficiently characteristic. Any departure from the most violent and oppressive measures, was to be construed as hostile to church and state. In a private letter addressed to Lord Melville on the 1st of January 1690, he thus expresses himself, in homely language, but with no undignified sentiment: "I ador God's providence in permitting so much dust against me, thogh the matter, separat from the railing, imports nothing bot my embracing first and last the statione God hath called me to, and the malitious ly of my being author, actor, or approver of the cruelties in the former reigns, which your Lordship and all unbyassed and enformed men know to be fals as hell could make it; bot I thank God I have the peace of my conscience, and I am confident your Lordship will bear witnes for me to his Majestie."

In the year 1679, the duke of York came to reside at Holyroodhouse, and the judges and other members of the College of Justice made him a visit of ceremony. The lord president addressed him in a congratulatory speech,

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[1] These dates we copy from a letter which he addressed to the earl of Argyle, from Paris, on the 30th of April 1664. The original also belongs to Mr Thomson. Forbes has stated that he made an excursion to France with his eldest son, who was then beginning his continental travels; and having returned by way of London, that he had then the honour of waiting upon his majesty. But the king's letter, restoring him to his office, was dated on the 21st of April, and he left London for Paris on the following day.

[2] Forbes's Journal of the Session, p. xxxiii. Edinb. 1714, fol.

[3] Mackenzie's Memoirs of the Affairs of Scotland, p. 214. Edinb. 1821, 4to.

[4] Brunton & Haig's Historical Account of the Senators of the College of Justice, p. 367. Edinb. 1832, 8vo.

[5] He apparently alludes to a well-known publication, without date or place of printing, "An Accompt of Scotlands Grievances by reason of the D. of Lauderdales Ministrie, humbly tendred to his Sacred Majesty." 4to. It is supposed to have been partly written by James Stuart, who was afterwards knighted, and became lord advocate.

[6] Apology for Sir James Dalrymple.

Dalrymple. which contained the following uncourtly sentiment: "'Tis matter of great joy to this nation to see one of the royal family among them, after being for so many years deprived of that honour; and the nation being entirely protestant, it is the fittest place your Royal Highness could have made your recess to at this time." He took other opportunities of endeavouring to impress the duke with a conviction, that it was not for his own advantage to attempt any measure which might have the least tendency to injure the protestant establishment. In the parliament of 1681, in which the duke acted as his majesty's commissioner, Sir James Dalrymple sat as a member for the county of Wigton, and was nominated one of the lords of the articles. When the test was under the consideration of the house, he proposed and carried a clause, that all persons holding public offices should swear that they sincerely professed the protestant religion as contained in the Confession of Faith approved by parliament in 1567. According to the statement of one historian, he drew up such an oath as was neither consistent with itself, nor with his own principles, nor such as could be taken without the guilt of perjury.[1] He was dissatisfied with a test which described the presbyterians as fanatics; and as he could not prevent its being adopted, he seems to have devised the expedient of introducing one clause in order to nullify another. As soon as the act was passed, the duke of York declared that the president had ruined all honest men, that is, all papists, by introducing that Confession. For subscribing this test with a particular explanation, the earl of Argyle was subjected to a prosecution, which formed one of the most flagrant acts of that disgraceful era of our national history. Dalrymple himself declined to subscribe it; and in the month of October he proceeded to London, for the purpose of explaining his conduct to the king, and perhaps of recommending his eldest son as his successor;[2] but before his arrival, a new commission, appointing Sir George Gordon president, and superseding Sir Thomas Murray of Glendoick, and Sir John Baird of Newbyth, had been issued under the great seal. As he had quitted Scotland without obtaining leave from the commissioner, the king refused him an audience, and Murray, the secretary of state, commanded him to leave England. "That quarrel," he remarks in his Apology, "with my freedom to the then duke, at his first coming to Scotland, against attempting to weaken the protestant interest, in a publick speech I had at his entry, made me to be the first person laid aside that ever was looked after. I was cited before the criminal judges, before the council, before the parliament, and hundreds of examinations and re-examinations were taken against me, even of my most intimate domestick servants, and my sisters in law, not in the regular way of probation, but by way of inquisition to found a process upon any special matter, which was never done, because nothing was found against law. Can any judge in Christendom show such a trial of integrity, who did so long a time serve in such an eminent station? No man was found to witness the least malversation or baseness, by indirect interest in any cause, by taking any bribe or reward, by partiality or insolency, though nothing would have been more acceptable to the court, than by one blow against my fortune and fame, to have ruined me upon malversation in my trust as a judge." The only offence that could be traced amounted to a suspicion that some presbyterians, who had been at the battle of Bothwell-Bridge, lived upon his estates, or lurked about his house in the country, when he was occupied with his public duties in town. This was considered as an adequate ground for Dalrymple. proceeding against him for "harbour and reset of rebels;" a charge sufficiently indefinite to leave ample room for the operation of laws arbitrary in themselves, and administered with little regard to substantial justice. Dalrymple had previously found it expedient to quit the kingdom. His tenants were harassed in the various modes devised by the instruments of oppression, his rents were arrested, and on applying to the king's advocate, Sir George Mackenzie, he found that he himself incurred the danger of being committed to prison: he therefore sought a place of refuge in Holland, where he arrived towards the close of the year 1682. He chiefly resided at Leyden, the seat of a very famous university.

While he was exposed to these persecutions, he prepared for the press those works which have chiefly recommended him to the notice of posterity. His first and greatest work was printed before he went into exile. "The Institutions of the Law of Scotland, deduced from its originals, and collated with the Civil, Canon, and Feudal Laws, and with the customs of neighbouring nations."[3] Edinb. 1681, fol. This volume includes a "*Modus Litigandi*, or Form of Process observed before the Lords of Council and Session." After a considerable interval, his Institutions appeared in a "second edition, much enlarged." Edinb. 1693, fol. A much longer period elapsed before the appearance of "the third edition, corrected and enlarged, with notes." Edinb. 1759, fol. This edition was begun by John Gordon, who only conducted it to the eighty-fifth page, and the undertaking was completed by William Johnstone, afterwards more conspicuously known by the name of Sir William Pulteney. But the labours of these editors appear very insignificant, when compared with those which are exhibited in "the fourth edition, with commentaries and a supplement, by George Brodie, Esq. Advocate." Edinb. 1826–31, 2 vols. fol. It is a proof of the estimation in which the author continues to be held, that another elaborate edition has since been given to the public, "with notes and illustrations by John S. More, Esq. Advocate." Edinb. 1832, 2 vols. 4to. Of the Institutions of Lord Stair there are no fewer than ten manuscript copies in the Advocates Library, and many others are to be found in private collections. It must apparently have been considered as a useful exercise for apprentices in the law to make a complete transcript of a book which was sufficiently accessible in print. During his exile, he published a work which, although requiring less genius and learning in its author, was at that time of great practical utility. "The Decisions of the Lords of Council and Session, in the most important Cases debated before them: with the Acts of Sederunt." Edinb. 1683–7, 2 parts, fol. This work comprehends a report of cases decided from the re-establishment of the court to the month of August 1681.

His next publication was of a very different nature. It bears the following ample and descriptive title: "Physiologia nova Experimentalis, in qua generales Notiones Aristotelis, Epicuri, et Cartesii supplentur, Errores deteguntur et emendantur, atque claræ, distinctæ, et speciales causæ præcipuorum experimentorum, aliorumque phœnomenωn naturalium aperiuntur, ex evidentibus principiis quæ nemo antehac perspexit et prosecutus est: authore D. de Stair, Carolo II. Britanniarum Regi a Consiliis Juris et Status. Nuper Latinitate donata." Lugduni Batavorum, 1686, 4to. The expression "nuper Latinitate donata," would seem to indicate that the book had first appeared in an-

[1] Cunningham's Hist. of Great Britain, vol. i. p. 50.
[2] Wodrow's Hist. of the Sufferings of the Church of Scotland, vol. ii. p. 197.
[3] Lord Elchies, who died in the year 1754, wrote *Annotations on Lord Stair's Institutions of the Law of Scotland.* Edinb. 1824, 4to.

Dalrymple. other language: we cannot discover that this was actually the case, but he may have employed some person to translate his manuscript into Latin.[1] The learned author had at an early period of his life been accustomed to read lectures in that language, and could himself have performed such a task. This publication received a very favourable notice from Bayle.[2]

In the mean time, Dalrymple and his family were not exempted from persecution. On the charge of absenting herself from church and frequenting conventicles, his lady was cited before the privy council in the year 1683;[3] and their eldest son Sir John Dalrymple was harassed by many vexatious proceedings. On the complaint of Graham of Claverhouse, he was in the course of the same year compelled by the council to pay L.500 sterling, on the pretext that, as heritable bailie of Glenluce, he had interfered with the jurisdiction of the sheriff, and exacted too small fines from his own and his father's tenants for frequenting conventicles. Although he had taken no share in the political measures of the time, he was in September 1684 seized during the night in his own house at Newliston, and, without any colour of law or justice, was next day committed to prison like a common malefactor. After having been detained for three months, he was released on giving security to the amount of L.5000 sterling.[4] By his talents and dexterity, he not only prevented the escheat of his father's estate, but speedily raised himself to power and influence. The father having been implicated in the Ryehouse plot, was prosecuted for treason, and sentence of outlawry was pronounced against him on the 17th of March 1685,[5] but his son, who was appointed lord advocate towards the close of the ensuing year, had sufficient interest and address to procure a pardon, not only to him, but likewise "to his mother, his brethren and sisters, and particularly for their reset and converse with traitors, and to his little son, who had accidentally shot his brother."[6]

His own experience had rendered him too familiar with the miseries inseparably connected with arbitrary government, and he was therefore sufficiently prepared to engage in an attempt to rid the kingdom of an incorrigible tyrant. When the prince of Orange was on the eve of embarking for his memorable expedition, Dalrymple enquired into the real object of his enterprise; and when the prince declared that he designed the glory of God, and the security of the protestant religion, the venerable exile pulled off his wig, and pointing to his head, exclaimed, "Though I be now in the seventieth year of my age, I am willing to venture *that*, my own, and my children's fortunes in such an undertaking." It is stated by Forbes, that "the kindness and tender affection express'd by his Royal Highness upon that occasion to my Lord Stair, exposed him to the envy of several persons; which afterwards broke out in pamphlets stuff'd with personal reflec- Dalrymple. tions, and other injurious writings against restoring him to his rightful office of president of the session, and aspersing his administration thereof. This good old man, with all imaginable cheerfulness, came over in that glorious expedition, to preserve our constitution, when religion, liberty, and property, the dearest concerns of mankind, seem'd to be at stake. The prince, upon his landing at Torbay, sent to inquire concerning my Lord Stair's health; and perceiving that his horses were not come up, ordered a Neapolitan horse belonging to himself to be sent to the Lord Stair for his accommodation." When he arrived in Scotland, his influence was very usefully exerted in providing that the election in boroughs should be conducted by a general poll of freemen, and thus securing a majority of Whigs and presbyterians in the convention of estates.

Sir George Lockhart, president of the court of session, fell by the hand of an assassin on the 31st of March 1689, and on the 28th of October Sir James Dalrymple was reinstated in his former office. This appointment, so equitable and judicious in itself, excited a considerable degree of popular clamour, on the alleged ground, that when the court was entirely dissolved by this change in the government of the kingdom, it was not competent for the crown to restore it without the authority of parliament. The lord president was very fiercely attacked in an anonymous pamphlet ascribed to Robert Ferguson, a restless and unscrupulous individual, who was known by the descriptive appellation of the Plotter, and who was "remarkable for serving his party, and saving himself in all plots."[7] This publication produced "An Apology for Sir James Dalrymple of Stair, President of the Session, by himself." Edinb. 1690, 4to.[8] He appears to us to have defended his character and conduct in a manner at once able and satisfactory. In the course of the same year, on the 21st of April, he was elevated to the peerage, by the title of Viscount of Stair, Lord Glenluce and Stranraer, with limitations to the heirs male of his body. He had now acquired great influence in the management of affairs in Scotland; and this influence derived no inconsiderable support from his son, who was conspicuous for the elegance of his person, and the power of his eloquence. The last publication of the distinguished author was worthy of his declining years, and of his former reputation. It bears the title of "A Vindication of the Divine Perfections, illustrating the Glory of God in them, by Reason and Revelation: methodically digested into several Meditations. By a Person of Honour." Lond. 1695, 8vo. A preface, written by Dr Bates and Mr Howe, two eminent individuals among the English non-conformists, contains a very high commendation of the author and his performance. "The clearness and vigor of his spirit," they remark, "are

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[1] A curious document, in the form of a ratification, under the privy seal, of a contract between Sir James Dalrymple and his printer, enumerates among other works a "Treatise containing four Inquiries concerning Humane Knowledge, Natural Theologie, Moralitie, and Phisiologie." (Dallas's System of Stiles, p. 152. Edinb. 1697, fol.) The ratification is dated on the 11th of April 1681. This Inquiry concerning Phisiologie was probably the first sketch of the work afterwards published in Latin. What related to natural theology he perhaps incorporated in his Vindication of the Divine Perfections. In his Apology he mentions another work which was never published, namely, a treatise on the rights of kings and subjects.

[2] Nouvelles de la Republique des Lettres, Decemb. 1685, p. 1336.—Bayle gives the date of 1685. The Physiologia must have been published at the end of that year, and dated on the following.

[3] Fountainhall's Decisions of the Lords of Council and Session, vol. i. p. 224. Edinb. 1759, 2 vols. fol.

[4] Fountainhall, vol. i. p. 191. 201. 217. 220. 303. 386.

[5] Fountainhall, vol. i. p. 353. Wodrow, vol. ii. p. 492.

[6] Fountainhall, vol. i. p. 447. See likewise Wodrow, vol. ii. p. 586.

[7] Dalrymple's Memoirs of Great Britain and Ireland, vol. i. p. 20.—The pamphlet bears the following title: "The late Proceedings and Votes of the Parliament of Scotland, contained in an Address delivered to the King, signed by the Plurality of the Members thereof, stated and vindicated" Glasgow, 1689, 8vo. This title is not to be found in Ferguson's list of "all the pieces he ever wrote before the present August 1712." See Original Letters, fol. Adv. Libr.

[8] This pamphlet, which consists of four leaves, has a colophon, but no title-page. It has lately been reprinted for the Bannatyne Club. Edinb. 1825, 4to.

Dalrymple. illustriously visible in managing a subject so deep and difficult. And as in the blessed God there is a union of all glorious and amiable excellencies as are perfective of our minds, and attractive of our wills; so in our author's unfolding them, there is joined with the strength of argument, that beauty of perswasion as may enlighten and engage all understanding readers to be happy in the entire choice of God for their everlasting portion." He must apparently have been indebted to some of his English friends for purifying his style from provincial idioms, which are sufficiently numerous in his other works. But his long and eventful life had nearly reached its close: he died on the 25th of November 1695, after having attained the seventy-seventh year of his age, and his remains were interred in St Giles's church.

He left behind him a numerous and prosperous family.[1] Lady Stair had died in the year 1692. John, his eldest son, who became a judge, and secretary of state, was created earl of Stair: he was equally distinguished by his talents, but possessed less consistency of character; and his concern in the massacre of Glenco has affixed an indelible stain upon his memory.[2] The second earl acted a very conspicuous part in the wars and diplomacies of his own age. Sir James Dalrymple, Bart. the second son of the lord president, was one of the principal clerks of session; and, as an antiquary, he is favourably known by his "Collections concerning the Scottish History." Edinb. 1705, 8vo. Sir Hugh Dalrymple, Bart. the third son, succeeded his father as president of the court of session. The fourth son was Thomas Dalrymple, M. D. physician in ordinary to the king in Scotland. The youngest son, Sir David Dalrymple, Bart. was, like many other members of the same family, bred to the legal profession, and was successively solicitor general, lord advocate, and auditor of the Scottish exchequer. He was the grandfather of the late Lord Hailes. The president had four daughters, all of whom were married, two of them into the noble families of Cathcart and Dumfries.

Lord Stair, like every other individual who has rendered himself highly conspicuous in times of great public excitement, is mentioned by different writers with a very different measure of praise or censure. According to Bishop Burnet, he was "a man of great temper and of a very mild deportment, but a false and cunning man, and a great perverter of justice; in which he had a particular dexterity of giving some plausible colours to the greatest injustice." This general and heavy charge of perverting justice we have not found supported by any particular instances. The fountains of justice were at that unhappy period very extensively polluted, but we are disposed to class him among the most unexceptionable judges who had then sat upon the Scottish bench. We must not however conceal the fact, that, when he resumed his seat after the Revolution, his conduct as a judge was a frequent and angry topic of discussion;[3] nor can we venture to determine how far this circumstance is to be imputed to the force of political animosity. It was his misfortune to live in most flagitious times, and by his public station to be necessarily connected with a government which evinced a total disregard of the first principles of justice and humanity. The arbitrary proceedings of Lauderdale he seems to have resisted, with consummate prudence indeed, but still with decent firmness; and of the integrity of his character he exhibited repeated proofs, by preferring the loss of office and emolument to a compliance with the iniquity of the times. At a period when the nobility and gentry of Scotland furnished so many and such flagrant examples of cool and deliberate villany, Lord Stair acted with a very unusual degree of moderation and consistency; nor would it perhaps be easy to mention any person of rank in the profligate reign of Charles II. whose character could so well endure a severe scrutiny. He was a man of the most gentle deportment,[4] joined with a prudence which seemed to be constitutional; and as extreme prudence not unfrequently lingers on the verge of meanness or artifice, it may in some cases be difficult to trace the line where virtue ends and vice begins. The force of his talents and the respectability of his character rendered him an acquisition to any party in the state. He was importuned to accept of a seat on the bench under the government to which, as an advocate, he had declined to take the oath of allegiance; and when he was admitted, it only appears that he took an oath to discharge his office with fidelity. A similar line of conduct was pursued in another kingdom by Sir Matthew Hale, whose name can never be mentioned but with high respect. When Stair became a member of the privy council, he was indeed associated with men whose breath was contamination, but even in this difficult situation he seems to have maintained his integrity, and to have resisted to the utmost of his power the pernicious and profligate measures which then disgraced the nation. An individual of a more bold and decided character might have signalized his opposition by more prominent acts; but, in the midst of such associates, it must have proved less beneficial to the community, and more ruinous to himself.[5] In all the relations of private life, his enemies have not denied him the praise of being mild and amiable. He was zealously attached to the protestant faith, and exhibited an edifying example of domestic piety.[6]

His character as a lawyer is too well known to require any illustration in a work of this nature. He was evidently a man of a great capacity, and of various learning; he was not only skilled in ancient literature and in jurispru-

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[1] Wood's Peerage of Scotland, vol. ii. p. 522.

[2] See Laing's History of Scotland, vol. iv. p. 238.

[3] Carstares's State-Papers and Letters, p. 154. 167. 257. Edinb. 1774, 4to.

[4] Sir George Mackenzie has given him the following character: "Stair was a gentleman of excellent parts, of an equal wit, and universal learning; but most considerable for being so free from passions, that most men thought this equality of spirit a meer hypocrisy in him. This meekness fitted him extremely to be a president; for he thereby receiv'd calmly all men's informations, and by it he was capable to hear, without disorder or confusion, what the advocates represented. But that which I admir'd most in him was, that in ten years intimacy, I never heard him speak unfriendly of those who had injur'd him." (Memoirs of the Affairs of Scotland, p. 214.)

[5] In Carstares's State-Papers, p. 143, we find a characteristic instance of his smooth and skilful management. In the privy council, he recommended the measure of calling out the militia during the year 1691; and the mode in which he endeavoured to remove the opposition of some of the members is here detailed by the earl of Crawfurd, one of their number.

[6] "He knew not," says Professor Forbes, "what it was to be idle, and took a strict account of his time; dividing himself between the duties of religion, and the studies of his profession, which he minded more than the raising of a great fortune. He was sober, temperate, and mighty regular. He duly prayed always and read a chapter of the Bible to his family before they sat down to dinner, and performed the like divine service after supper; which he would not interrupt upon any consideration of business, how important soever. He had a great spirit, and equal temper in the harshest passages of his life: by the constant bent of his thoughts to what was serious or profitable, he knew how to divert them from any uneasy impression of sorrow. He was apt to forget, at least not to resent injuries done to him, when it was in his power to requite them." (Journal of the Session, p. xxxix.)

Dalrymple. dence, but likewise in philosophy, and even in theology. He was the first writer who reduced the law of Scotland to the form of a system, and confessedly the ablest writer who ever made such an attempt.[1] Sir Thomas Craig, who preceded him by nearly a century, found it a rude and undigested mass, and in arranging and methodizing one extensive and important branch, he exerted no mean talents or learning. Lord Stair adopted a more general design, and, with great sagacity extracting order out of confusion, combined his loose and heterogeneous materials into a compact and lucid form; nor would it perhaps be easy to mention an instance of another individual having effected so signal an improvement in the jurisprudence of any modern nation. (D. I.)

DALRYMPLE, *Sir David*, a Scottish lawyer and judge, was born in Edinburgh on the 28th of October, new style, 1726.[2] His father was Sir James Dalrymple of Hailes, in the county of Haddington, Bart., auditor-general of the exchequer in Scotland, and his mother Lady Christian Hamilton, a daughter of Thomas, sixth earl of Haddington. His grandfather Sir David Dalrymple, lord advocate from 1709 to 1720, was the youngest son of James, first Viscount Stair, president of the Court of Session, and author of the Institutions of the Law of Scotland; and he is said to have been the ablest of a family of whom several, in their different capacities, civil, military, and judicial, were so eminently distinguished for ability. Sir David Dalrymple received his classical education at Eton, where he was remarkable for his proficiency in classical learning and for exemplary conduct, and where he acquired a marked predilection for English manners and customs, which adhered to him through life. From thence he went to Holland, and studied civil law at the university of Utrecht, being intended for the Scottish bar. On his return to his native country, after passing the ordinary trials, he was admitted advocate on the 24th of February 1748. Although possessing an ample fortune (his father having died on the 24th of February 1751), and attached to the pursuits of elegant literature, he was not seduced from close application to the study of a dry profession. As a barrister, however, his success was not equal to the expectations which had been formed of him; and as he did not attain any high distinction or very extensive practice in his profession, he was still enabled to pursue his favourite literary and antiquarian researches. This want of success at the bar was, it is said, chiefly owing to the circumstance of his being unfitted to shine as a public speaker, by an ill-toned voice, an ungraceful elocution, and a dryness of manner too much in contrast with the eloquence and fluency of some of his more popular brethren. The character, however, which he had secured for sound knowledge, acuteness, unwearied application, and strict probity in his profession, made up for the want of more imposing attractions, and eminently fitted him for filling a judicial situation. He was elevated to the bench, and took his seat as one of the senators of the college of justice on the 6th of March 1766; and ten years later, on the 3d of May 1776, he was also appointed a lord of justiciary, having on the former occasion, according to the usage of the court, assumed the title of Lord Hailes, the name by which he is generally known among the learned of Europe. Dalrymple.

As a judge of the supreme civil and criminal courts, it is here sufficient to observe, that he merited and obtained high confidence and approbation; and he is particularly remembered for the solemnity of his demeanour when it fell to him to pass sentence upon criminals. We shall therefore proceed to consider his literary character and pursuits, in which, although not ambitious of mere literary fame, he had early in life attained considerable eminence. This led to an extensive and friendly intercourse with many persons of learning and genius in England, and in the number of his correspondents were such men as Bishop Warburton, Lord Hardwicke, Dr Percy, afterwards bishop of Dromore, T. Warton, Dr Birch, Dr Kippis, Bishop Hurd, and Horace Walpole.[3] It may also be noticed, that the honorary distinction of doctor of laws was conferred on Sir David Dalrymple by the university of Edinburgh on the 5th of December 1760.[4] With what assiduity he must have devoted his leisure hours to literary and antiquarian pursuits will appear from the list which is subjoined of his various publications.[5] From this list it will be evident that the objects of his investigation may almost exclusively be referred to two distinct classes; the one connected with the history and literary antiquities of his own country, and the other with the earlier state of the Christian church; and a few remarks may be made in reference to the most important of his works in each of these classes.

His inquiries regarding Scottish history and antiquities were at first more particularly directed to objects connected with the ancient ecclesiastical and statute laws of the country. In regard to the latter of these subjects, he never carried his intentions into full effect, having left only partial "Specimens," to evince what were his intentions. His "Canons of the Church of Scotland," and "Historical Memoirs concerning the Provincial Councils of the Scottish Clergy," are tracts of great importance. But so little attention did they excite at the time, that of the first he thought proper to state, "for the benefit of those who may be inclined to publish any tracts concerning the Antiquities of Scotland, *that twenty-five copies of the Canons were sold.*" In the disputed case of succession to the Sutherland peerage, Lord Hailes, as one of the guardians of Lady Elizabeth, the infant daughter of the last earl (and subsequently Duchess of Sutherland), in their name pre-

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[1] Of all the singular opinions maintained by Lord Kames, there is perhaps none more singular than the following: "Lord Stair, our capital writer on law, was an eminent philosopher; but as he was not educated to the profession of law, his Institutes chiefly consist of decisions of the court of session; which with him are all of equal authority, though not always concordant." (Elucidations of the Common and Statute Law of Scotland, pref. Edinb. 1777, 8vo.)

[2] He was the eldest son of sixteen children. Alexander Dalrymple, the eminent hydrographer, who died in 1808, was his younger brother.

[3] From a letter addressed to Mr John Pinkerton by Mr Malcolm Laing, the historian, July 9, 1800, we learn that the greater part of Lord Hailes' correspondence was unfortunately destroyed. "I am desired (he says) to ask you by Mr Thomson, an advocate, whether you have any letters of the late Lord Hailes, that could contribute to furnish an account of his life and writings. From some stupidity of his administrators, Lord Hailes' letters, &c. were destroyed, I believe, at his death; and, unless in the hands of his correspondents, there are no materials for his life, which Mr Thomson has some thoughts of undertaking, together with a new edition of his works. He left the first volume of his Annals corrected and enlarged for a new edition; and if you can contribute any thing to an account of his life, it will be received as a great obligation." (Pinkerton's *Correspondence*, vol. ii. p. 177.)

[4] No minutes of the proceedings of the *Senatus Academicus* for that year are preserved, which prevents our being able to state at whose recommendation this degree was conferred upon Sir David Dalrymple.

[5] "The erudition of Lord Hailes (says his friend the late Lord Woodhouselee), was not of a dry and scholastic nature. He felt the beauties of the composition of the ancients; he entered with taste and discernment into the merits of the Latin poets, and that peculiar vein of delicate and ingenious thought which characterises the Greek epigrammatists; and a few specimens which he has left us of his own composition in that style, evince the head of a master."

Dalrymple. pared, in 1770, for the House of Lords, the very elaborate memorial entitled "The Additional Case of Elizabeth, claiming the title and dignity of Countess of Sutherland." In this volume, to which is affixed the names of two of her ladyship's counsel (Alexander Wedderburn, afterwards the Lord Chancellor, Earl of Rosslyn, and Sir Adam Fergusson), Lord Hailes has displayed the greatest accuracy of research in regard to the family history of the Scottish nobility, and the rules of descent in this country; while he managed the question at issue with such dexterity of argument, as not only clearly to establish the right of his pupil, but also to form a precedent at the same time for the decision of all such questions of succession in future. About the same time Lord Hailes published, anonymously, selections from George Bannatyne's manuscript collection of early Scottish poetry; a volume which displays great judgment and good taste on the part of the editor, and which is accompanied with illustrative notes not less valuable than interesting. He is somewhat severe upon Allan Ramsay, who, in 1724, had published several of the same poems, for liberties taken with the text. Ramsay's mode of publication was not such as accords with our ideas of editing early remains, as he felt no scruple in omitting or altering what he disliked or did not understand, in improving, as he thought, what required improvement. Still we do not see why, as one of the first persons to call public attention to the works of the older and neglected Scottish poets, his attempts at emendation should be visited with more severe censure than the similar or still greater liberties taken by Dr Percy in publishing his Reliques of Ancient English Poetry.

Three years later, in 1773, appeared Lord Hailes' "Remarks on the History of Scotland," consisting of nineteen chapters, each of them treating of subjects calculated (in the words of Lord Elibank in his "Letter" to the author) "to revive that spirit of inquiry into the antiquities of this country, which, to our shame, was almost totally extinguished; and which, if it was possible to abolish, would at once destroy the most powerful incitement to private virtue and public spirit." The "Remarks" might be considered as gleanings of the historical research which he was making at that time, and discovered his lordship's turn for minute and accurate inquiry "into knotty points" of history. This publication, whilst it displayed the candour and liberality of his judgment, prepared the public for the favourable reception of the "Annals of Scotland," the first volume of which appeared in 1776. This is a work so well known, and its value is so justly appreciated, that it would be unnecessary to enlarge upon its merits. The chronological plan adopted was somewhat novel in English history, but was not calculated for a popular work. It was, however, quite suited to the author's peculiar turn of mind; his great object being that of clearing away the fables, unsupported theories, and partial statements, of former historians. Several general histories of the country had recently been published, such as Maitland and Grainger's, and Guthrie's, whilst public attention had been in a more especial manner directed towards the subject by the writings of Robertson and Hume. The period which Lord Hailes intended to treat of began with the accession of Malcolm Canmore, in 1057, "because the History of Scotland, previous to that period, is involved in obscurity and fable;" and because he was enabled to ascertain and establish its subsequent details by the authority either of contemporary writers, or by references to public records and other original documents which had been preserved. Although the "Annals" presented no attractions of style, being devoid of all the graces and amenities of writing, yet the author's patient elaboration of minute facts and dates, his acuteness in detecting error, his strict impartiality, and his scrupulous attachment to truth, excited the Dalrymple. admiration of the great English moralist, to whom he had sent the sheets for revisal, and whose opinion of the work is worthy of quotation. "It is in our language, I think," says Dr Johnson, "a new mode of history which tells all that is wanted, and, I suppose, all that is known, without laboured splendour of language or affected subtilty of conjecture. *The exactness of his* [Lord Hailes'] *dates raises my wonder.* He seems to have the closeness of Henault without his restraint." This opinion he takes a pleasure in repeating in a subsequent letter to Mr Boswell. "Be so kind," he says, "as to return Lord Hailes my most respectful thanks for his first volume; his accuracy strikes me with wonder; his narrative is far superior to that of Henault, as I have formerly mentioned." Again, he says, "Lord Hailes' Annals of Scotland have not that painted form which is the taste of this age; but it is a book which will always sell, it has such a stability of dates, such a certainty of facts, and such a punctuality of citation. *I never before read Scotch history with certainty.*" On the appearance of the second volume in 1779, he says, it "lies by my bed-side; *a book surely of great labour, and, to every just thinker, of great delight.*" Johnson, however, was not blind to its cardinal defect, namely, the dispassionate and dry statement of facts; but this he hints with a delicacy, arising no doubt from the high regard he entertained for the author's private character. "Lord Hailes' Annals of Scotland," he says, in a subsequent letter to Mr Boswell, "are very exact; *but they contain mere dry particulars.* They are to be considered as a dictionary. You know such things are there, and may be looked at when you please. Robertson paints; but the misfortune is, you are sure he does not know the people whom he paints; so you cannot suppose a likeness. Characters should never be given by a historian, unless he knew the people whom he describes, or copies from those who knew them."

Lord Hailes' Annals terminate with the accession of the house of Stuart, in the person of Robert III. in 1370. He intended to have carried them on to the restoration of James I. in 1424; but for "various and invincible reasons," which are not stated, he left this portion to be resumed by some future historian. We have seen it mentioned, that when urged by Dr Carlyle to write the history of the house of Stuart, by continuing the Annals to the period of the union between Scotland and England, he declined such a project, alleging "he had not temper to write the annals of such men." At a later period of life he turned his thoughts to the literary history of his country, and published several sketches of lives as specimens of a *Biographia Scotica;* a work, he thought, which, if executed "on a large and liberal plan, would deserve approbation:" and he engaged, if others would co-operate, "to assist in the general design." The only person, we believe, who came forward on the occasion was the Earl of Buchan, but, with all his zeal and patriotism, his lordship's habit of mind presented a striking contrast when compared with the extent and accuracy of Lord Hailes' literary and biographical knowledge, in which he probably excelled all his contemporaries: the scheme accordingly was abandoned.

We may now turn to the other class of Lord Hailes' publications, which consists of those relating to the history and antiquities of the Christian church. His attention must have been led to this subject previously to the appearance of the obnoxious chapters in Gibbon's History of the Roman Empire; for no allusion to that work is contained in the notes to his account of the Martyrs of Smyrna, published in the same year, 1776. He may therefore have been the more deeply impressed with a sense of the mistakes and partialities of that splendid writer; and he certainly, in no subsequent work, loses an oppor-

Dalrymple. tunity to expose his unfair statements in tracing the progress and establishment of Christianity during the earlier persecutions of the church. In all these publications Lord Hailes was evidently actuated by a fervent and enlightened zeal; and, by the light which he throws upon difficult passages of ancient writers, he vindicates such sentiments and conduct as are conformable to the word of God, against the insinuations of the historian of the Roman empire in its decline, and directly supports the cause of our most holy faith. His continued investigations of the subject at length, in 1786, led to the publication, in a substantive form, of his most elaborate work, entitled "An Inquiry into the secondary Causes which Mr Gibbon has assigned for the rapid Progress of Christianity." This work has too much the character of a collection of detached critical remarks; but, besides the extent of learning which it displays in common with his minor publications, it is both solid and acute in argument, and most satisfactorily establishes "that the things which Mr Gibbon considered as secondary or human causes, efficaciously promoting the Christian religion, *either tended to retard its progress, or were the manifest operations of the wisdom and power of God.*"

His lordship's constitution had been long in an enfeebled state, and being predisposed to corpulence, his habits of studious application, and the want of regular exercise, were unfavourable for the prolongation of life; yet he attended his duty on the bench till within three days of his death, when he was attacked with symptoms of apoplexy on his way from the Court of Session, and was carried off by a second attack on the 29th of November 1792, in the sixty-sixth year of his age. Lord Hailes was twice married. By his first wife, Anne, daughter of the Honourable George Brown, Lord Coalston, he left one daughter, who still inherits the family estate. By his marriage with Helen, daughter of the Honourable Sir James Fergusson, Baronet, Lord Kilkerran, who survived him, he had another daughter, afterwards married to her cousin, the grandson of Lord Kilkerran. As Lord Hailes left no male issue, the title of baronet descended to his nephew John, eldest son of his brother John Dalrymple, formerly Lord Provost of Edinburgh.

A list of the several works of Lord Hailes, as nearly as possible in the order of publication, is here subjoined. Many of them are anonymous, and those marked † were printed merely for private distribution.

1. Sacred Poems, or a collection of translations and paraphrases from the Holy Scriptures. Edin. 1751, 12mo.

2. † Proposals for carrying on a certain Public Work in the City of Edinburgh, 8vo. No date. [1752.] This *jeu-d'esprit*, dedicated to "the Patron and Pattern of all Castle-builders," was a parody on the "Proposals for carrying certain Public Works," &c. written by Sir Gilbert Elliot of Minto, and circulated under the patronage of the Convention of the Royal Burghs in August 1752, which contained the first proposals for extending and improving the city of Edinburgh, which was still confined within its ancient and narrow limits.

3. The Wisdom of Solomon, Wisdom of Jesus the son of Sirach, or Ecclesiasticus. Edin. 1755, 18vo.

4. Three papers in The World; No. 140, Sept. 4, 1755; No. 147, Oct. 23, 1755; No. 204, Nov. 25, 1756.

5. A Discourse of the unnatural and vile Conspiracye attempted by John Earl of Gowrye, and his brother, against his Majestie's Person, at Saint Johnstoun, upon the 5th of August 1600. No date [1755], 12mo. This tract is the narrative published in 1600 as King James's account of the Earl of Gowrye's Conspiracy, reprinted with explanatory notes, intended to serve as a specimen of historical collections illustrative of that still mysterious point of Scottish history. This reprint has no date, and is usually assigned to the year 1757; but it is mentioned in the list of new books, in the Scots Magazine for December 1755. There is another edition of the tract reprinted about the same time, but without notes. Sir David Dalrymple afterwards communicated such papers as he had collected, and explained his sentiments regarding the "Conspiracy" to Dr Robertson, which enabled him, in his History of Scotland, "to place that transaction in a light which dispels much of the darkness and confusion in which it has been hitherto involved." Dalrymple.

6. † British Songs, sacred to Love and Virtue. Edin. 1756, 12mo.

7. Select Discourses by John Smith, late fellow of Queen's College, Cambridge. Edin. 1756, 12mo.

8. † A Sermon which might have been preached in East Lothian, on the 25th of October 1761. Edin. 1761, 12mo. Occasioned by the country people pillaging the wreck of two vessels cast away on the coast of East Lothian, between Dunbar and North Berwick. This "Sermon" is mentioned in the Scots Magazine, Nov. 1761, p. 614, where the author is styled "a gentleman distinguished no less for humanity and religion, than for politeness and learning." His object in composing this discourse was the restitution of the stolen goods. It was "printed on his own charges, and caused be distributed in that country, not permitting a single copy to be sold;" and we are told it produced the designed effect. It was reprinted, Edin. 1794, 8vo.

9. Memorials and Letters relating to the History of Britain in the reign of James the First, published from the originals. Glasgow, 1762, 12mo. There is an enlarged edition of this volume, Glasgow, 1766, 8vo.

10. The Works of the ever memorable Mr John Hales of Eaton, now first collected together. Glasgow, 1765, 3 vols. 12mo. Lord Hailes, in this edition, modernised the language, which Dr Johnson blamed, and blamed justly; for, says he, "An author's language is a characteristical part of his composition, and is also characteristical of the age in which he writes. Besides, sir, when the language is changed, we are not sure that the sense is the same."

11. A specimen of a book intituled Ane compendious Booke of Godly and Spiritual Sangs, &c. Edinburgh, printed by Andrew Hart [1621]. Edin. 1765, 8vo.

12. Memorials and Letters relating to the History of Britain in the Reign of Charles I. published from the originals. Glasgow, 1766, 8vo.

13. An Account of the Preservation of Charles II. after the Battle of Worcester; drawn up by himself: to which are added, his Letters to several Persons. Glasgow, 1766, 8vo. Some copies of the volume have a reprinted title-page, dated Edinburgh, 1801.

14. The Secret Correspondence between Sir Robert Cecil and James VI. Edin. 1766, 12mo.

15. A Catalogue of the Lords of Session from the Institution of the College of Justice in the Year 1532, with Historical Notes. Edin. 1767, 4to. Reprinted with additional notes by an anonymous editor. Edin. 1794, 4to. More recently it has served as the basis of a work entitled "An Historical Account of the Senators of the College of Justice, by George Brunton and David Haig." Edin. 1832, 8vo. The 1794 edition of the Catalogue of the Lords of Session is occasionally to be met with in a volume, along with Nos. 18, 19, 20, and 21 of this list, having a separate title-page: "Tracts relating to the History and Antiquities of Scotland." Edin. 1800.

16. † A Specimen of Notes on the Statute Law of Scotland. Lord Hailes, in the Scots Magazine, May 1768, announced that "for some time past he had been engaged

Dalrymple. in drawing up Notes on the Statute Law of Scotland, from the First Parliament of James I. to the Accession of James VI." requesting "the aid of the learned, and of the lovers of antiquity," and inserted a specimen of the notes. This request being complied with by only *one* gentleman, he reprinted the "Specimen of Notes" in an enlarged form, without date, but probably in 1768, 8vo, pp. 37, and circulated copies, addressed to such persons as were likely to afford the information and assistance which he wished.

17. † A Specimen of similar Notes on the Statute Law of Scotland during the Reign of Mary Queen of Scots. No date, 8vo, pp. 69, probably not printed till some time after No. 16. Lord Hailes appears to have contemplated some publication of the kind, even at a late period of his life. In a letter to Pinkerton, dated Sept. 28, 1790, after observing that he had no view of beginning where he had left off in the History of Scotland, he says, "Any thing that I have [collected] as to the five James's and Queen Mary, will come in properly among my notes on their acts of parliament; a work which has been long under my hands, and which I am unwilling to lose sight of."

18. The Private Correspondence of Dr Francis Atterbury, Bishop of Rochester, and his Friends, in 1725, never before published. [Edin.] 1768, 4to.

19. An Examination of some of the Arguments for the high Antiquity of *Regiam Majestatem;* and an Inquiry into the Authenticity of the *Leges Malcolmi.* Edin. 1769, 4to.

20. Canons of the Church of Scotland, drawn up in the Provincial Councils held at Perth A. D 1242 and A. D. 1269. Edin. 1769, 4to.

21. Historical Memoirs concerning the Provincial Councils of the Scottish Clergy, from the earliest accounts to the era of the Reformation. Edin. 1769, 4to.

22. Ancient Scottish Poems, published from the MS. of George Bannatyne, 1568. Edin. 1770, 12mo.

23. † Specimen of a "Glossary" of the Scottish Language. No date, 8vo.

24. The Additional Case of Elizabeth, claiming the title and dignity of Countess of Sutherland. By her Guardians. No date [Nov. 1770], 4to.

25. Remarks on the History of Scotland. Edin. 1773, 12mo. The same year there appeared a "Letter to Lord Hailes on his Remarks on the History of Scotland," Edin. 1773, 12mo. In reply to this tract, which was written by Patrick Lord Elibank, the author communicated in MS. to his lordship, some observations, which were first printed in the third edition of his Annals, vol. iii. p. 155, Edin. 1819.

26. Huberti Langueti Epistolæ ad Philippum Sydneium Equitem Anglum. Edin. 1776, 8vo.

27. Annals of Scotland, from the Accession of Malcolm III. sirnamed Canmore, to the Accession of Robert I. Edin. 1776, 4to. This volume, along with an appendix containing eight dissertations, has tables shewing the succession of the kings of Scotland during the period embraced in the Annals.

28. Account of the Martyrs of Smyrna and Lyons in the Second Century. Edin. 1776, 12mo. This forms the first volume of the Remains of Christian Antiquity.

29. L. C. F. Lactantii Divinarum Institutionum liber quintus, sive de Justitia. Edin. 1777, 12mo.

30. Remains of Christian Antiquity [Vol. II.], containing the Trials of Justin Martyr, Cyprian, &c. Edin. 1778, 12mo.

31. Eight Papers in the "Mirror," communicated between April 1779 and April 1780, being Nos. 21, 46, 56, 62, 75, 86, 97, and 98.

32. Sermons of that eminent divine Jacobus a Voragine, Archbishop of Genoa, translated from the originals. Edin. 1779, 12mo.

33. Annals of Scotland [Vol. II.], from the Accession of Robert I. surnamed Bruce, to the Accession of the House of Stuart. Edin. 1779, 4to. The appendix to this volume has nine dissertations. An edition of the Annals, with tracts relating to the history and antiquities of Scotland, was printed Edin. 1797, 3 vols. 8vo. A still more complete edition, comprising Lord Hailes' historical and biographical tracts, was published Edin. 1819, 3 vols. 8vo. It includes Nos. 5, 19, 20, 21, 25, and 40 to 44, of the present list. Dalrymple

34. Remains of Christian Antiquity [Vol. III.], containing the History of the Martyrs of Palestine in the third century, translated from Eusebius. Edin. 1780, 12mo.

35. Octavius, a Dialogue by Marcus Minucius Felix. Edin. 1781, 12mo.

36. Of the Manner in which the Persecutors died, a treatise by L. C. F. Lactantius. Edin. 1782, 12mo.

37. Disquisitions concerning the Antiquities of the Christian Church. Glasgow, 1783, 12mo.

38. Miscellaneous Remarks on The Enquiry into the Evidence against Mary Queen of Scots. Lond. 1784, 8vo. This "Enquiry" is Mr W. Tytler of Woodhouselee's well-known Vindication of Queen Mary. Lord Hailes' tract is anonymous, and was sent to Dr Kippis at London for publication, as the author was evidently not anxious to have it ascribed to him.

39. An Inquiry into the Secondary Causes which Mr Gibbon has assigned for the rapid growth of Christianity. Edin. 1786, 4to. A translation of this work into Dutch was published at Utrecht, 1793, 8vo. The original work was reprinted at Edinburgh, 1808, 12mo, and again in 1810, accompanied with a "Brief Memoir of the Life and Writings of the Author;" by the late Dr Charles Stuart of Dunearn, but whose name is not prefixed to either of these editions.

40. Sketch of the Life of John Barclay, author of Argenis. No date [1786], 4to.

41. Sketch of the Life of John Hamilton, a secular priest. No date [1787], 4to.

42. Sketch of the Life of Sir James Ramsay, a general officer in the armies of Gustavus Adolphus, King of Sweden. No date [1787], 4to.

43. Life of George Lesley [of Monymusk, a Capuchin friar.] No date [1787], 4to.

44. Sketch of the Life of Mark Alexander Boyd. No date [1787], 4to.

45. † Davidis Humei, Scoti, summi apud suos philosophi, de vita sua acta, liber singularis; nunc primum Latinè redditus. [Edin.] 1787, 4to.

46. † Adami Smithi, LL.D. ad Gulielmum Strahanum armigerum, de rebus novissimis Davidis Humei, Epistola, nunc primum Latinè reddita. [Edin.] 1788, 4to. This is a translation into Latin verse of Dr Adam Smith's letter to Strachan, giving an account of the behaviour of David Hume during his last illness, which letter is also reprinted in this tract.

47. The Opinions of Sarah Duchess Dowager of Marlborough, published from her original MSS. Edin. 1788, 12mo.

48. The Address of Q. Sept. Tertullian to Scapula Tertullus, proconsul of Africa, translated. Edin. 1790, 12mo.

49. Miscellaneous Communications to Magazines. These being anonymous, cannot be well ascertained; but there are papers by Lord Hailes in the Scots Magazine, the Edinburgh Magazine and Review, the Edinburgh Magazine and Literary Miscellany, the Gentleman's Magazine, and in various other periodical works. In the Gentleman's Magazine, vol. lx. 1790, are a series of remarks on the late edition of the Tatler, with notes, in six volumes; also,

Dalton. in vol. lxi. two letters on the famous miniature, said to be of Milton, in the possession of Sir Joshua Reynolds. The Edinburgh Magazine and Review for February 1774 contains some remarks on the Latin Poems of Dr Pitcairne, by Lord Hailes. (*Life of Kames*, vol. i. p. 6, note.) He was also a contributor to Kippis's edition of the Biographia Britannica.

In addition to these, Lord Hailes printed several minor tracts without titles, some of them being specimen sheets of his published works. "The Little Freeholder," a dramatic entertainment, London, 1790, 12mo, has been usually attributed to him, but, we have heard it asserted, on insufficient grounds.

Some of his letters have been printed in Pinkerton's Literary Correspondence, in Nichols' Illustrations, and in other works.

After this copious list of the publications by Lord Hailes, it is unnecessary to add any thing to what has been already stated in regard to his literary character, which united acuteness of mind and soundness of judgment with extensive learning and assiduous research. Every true lover of his country must rejoice that such a man should have devoted himself so zealously to literary pursuits, while they must revere his memory for his successful attempts to subject to the ordeal of rational criticism so many disputed points of historical research, and more particularly for having illustrated three centuries of our national history with a degree of accuracy and information which it is much easier to admire than to emulate. But as in his writings his attention was uniformly directed to promote the interests of religion and virtue, so in his conduct he was actuated by the purest principles of benevolence and fervent piety; and in the private relations of life he was all that was praiseworthy and honourable. "In a word," says the late Lord Woodhouselee, "he was an honour to the station which he filled, and to the age in which he lived." "That such a man," to use the words of an intelligent writer, "should not yet have found a biographer worthy of his merits, cannot be ascribed either to the obscurity of his character and station, or to the incapacity of his contemporaries. But Lord Hailes was a man of piety of the old stamp, and a strenuous advocate for revealed religion, and therefore did not share, as he would not have been ambitious to share, the celebrity that has been conferred on some of his countrymen of a very opposite character."[1] (D. I.)

DALTON, JOHN, LL.D., the illustrious author of the Atomic Theory of Chemistry and of the Constitution of Mixed Gases, was born September 5, 1766, at Eaglefield, in the vicinity of Cockermouth in Cumberland. Like his parents, he was a member of the religious sect of the Society of Friends, and for a long period supported himself by the humble office of usher to a school at Kendal until 1793; when, through the recommendation of Mr Gough the blind philosopher of that town, he obtained the appointment of professor of mathematics and natural philosophy in a college or seminary established at Manchester, which was removed to York in 1799. From the commencement of the present century, Dalton fixed his residence in Manchester, although he sometimes publicly explained the doctrine of chemical philosophy in a few other places. Some have confounded this great philosopher with another Dalton, an ingenious self-taught individual, who for many years was well known in England as an itinerant lecturer on experimental science. It is painful to reflect that John Dalton, one of the most acute and original philosophers that have adorned our age, should have been for many years compelled to earn his subsistence by the irksome task of conveying the elements of instruction to the minds of both sexes. But Dalton was of too independent a spirit to be beholden to others for what he could obtain by his own exertions; was of a contented disposition, and lived amid a select society of tried friends, who admired his talents, and esteemed him as a man; continuing to employ his leisure hours in those interesting philosophical investigations which have given him a lasting reputation. He was successively the secretary, vice-president, and president of the Philosophical Manchester Society; and among its highly interesting memoirs, the papers of Dalton, both for their number and their value, occupy a most important place. Dalton.

His earliest papers consisted of contributions to that remarkable and able periodical termed *The Lady's Diary*. In after years he enriched the *Memoirs of the Manchester Society*, *Nicholson's Journal*, the *Philosophical Magazine*, and the *Transactions of the Royal Society*, with numerous contributions.

In 1793 appeared his earliest separate publication, *Meteorological Essays*, a favourite subject, on which he continued to collect and record observations to the period of his death. In the following year he gave an account of a singular defect in his own vision which rendered him incapable of distinguishing certain colours, as green and scarlet. In conversation with the writer of this notice, he stated how he first became aware of this peculiarity of his vision. When a boy he had gone to see a review of troops, and being surprised to hear those around expatiating on the gorgeous effect of the military costume, he asked, "In what a soldier's coat differed from the colour of the grass on which he trod?" The derisive laugh and exclamations of his companions now first led him to suspect that he did not see like other people. (See COLOUR BLINDNESS.)

His daily employment as a teacher of youth no doubt drew his attention to the want then subsisting of a suitable English grammar, and led to his publication in 1801 of *Elements of English Grammar*—a subject very foreign to those on which his powerful mind was usually exerted; yet it shows marks of that precision and comprehensive grasp with which he could handle everything which he investigated.

In the *Manchester Memoirs* for 1802, we find six dissertations by Dalton; and in these he unfolded his beautiful theory of the constitution of mixed gases; of which the characteristic feature is the proof that gases which do not form new chemical compounds act on each other as a vacuum, diffusing themselves among each other by their own elasticity. This philosophical view, for some time strenuously opposed by different chemists, is now universally received. Another subject discussed by him was very important—"On the force of Vapour of Water and other Fluids at different Temperatures in the Torricellian Vacuum, and under Atmospheric Pressure," which included the "Theory of Evaporation and the Expansion of Gases by Heat." The simple experiments by which Dalton illustrated those subjects, and the profound reasoning by which his views were supported, established the philosophical reputation of our author, and have been of infinite service to the progress of pneumatic chemistry, especially in the refined modern investigations on the specific gravity of gases.

But the high reputation of Dalton mainly reposes on the *Atomic Chemical Theory*, which he began to develop in 1803, and illustrated by numerous observations in succeeding years. Yet from the inherent difficulties of the subject,

[1] Chalmers' Biographical Dictionary, art. Dalrymple, vol. xi., p. 229. See also Life of Lord Hailes, in the Edinburgh Magazine and Literary Miscellany, March 1793; the brief memoir by Dr Charles Stuart, prefixed to the second and third editions of the Reply to Gibbon; and the "Sermon on the Death of Lord Hailes," preached at Inveresk, by Alexander Carlyle, D.D., Edin. 1792, 8vo.

Dam ‖ Damagram.

and, perhaps, from some want of perspicuity in his explanations, it was not at once adopted by philosophers; and we are in this country chiefly indebted for luminous views of this grand theory to the labours of the late Professor Thomson of Glasgow, of the late Dr Henry of Manchester, and its early adoption by Dr Wollaston; while the masterly analysis of Berzelius placed the doctrine of Dalton on a stable foundation. The atomic theory is a consequence of the investigations of Ritter which that laborious experimentalist did not perceive, and was obscurely indicated in a paper of Dr Higgins; but it is now acknowledged that we owe to Dalton the first development of its general principles, and the important consequences of its application to the explanation of chemical and natural phenomena. It is not too much to assert that we are indebted to the atomic theory for much of the recent progress in many branches of physical science.

This theory was fully propounded by Dalton in his *New System of Chemistry*, of which the first volume appeared in 1807, the second in 1810, and these were followed by a third in 1827. These important volumes contained the elements of the mathematical principles of the science.

In his other papers on subjects connected with meteorology, he has left us valuable remarks on evaporation, rain, the aurora borealis, winds, and dew. His observations on the latter contain the principles of Dr Wells's beautiful *Theory of Dew*, and of Daniell's *Hygrometer*.

In 1822 he visited France, where he was received with that distinction which was due to so eminent a philosopher. He was afterwards elected a corresponding member, and finally a foreign associate of the French Institute. He was also a foreign member of the Royal Academies of Berlin and Munich, and of the Natural History Society of Moscow. In 1834 the university of Edinburgh did itself honour by conferring on him the degree of LL.D. In the reign of William IV. he received from the government a pension of L.150, which was subsquently increased to L.200 a-year.

In person Dr Dalton was of middle stature, and vigorous, though not robustly formed. His powerful intellect was disciplined by patient observation and composure; and he had a happy facility in seizing the relations of physical subjects. His early habits as a member of the Society of Friends had given him a quiet, grave demeanour, but without austerity; and he possessed a manly independence of character, without superciliousness. His high moral worth will live in the remembrance of all who had the pleasure of knowing him, as well as the kindness with which he always accommodated his conversation to the comprehension of those who sought his acquaintance.

This eminent man had long enjoyed excellent health; but he had two attacks of paralysis in 1837, and a third attack carried him off on the 27th July 1844.

His principal contributions to physical science will be noticed under Atmosphere, vol. iv.; Aurora Borealis, vol. iv.; Atomic Theory and chemical researches, under Chemistry. See also articles *Evaporation*, *Heat*, *Mercurial Chronometers*, *Repulsive Power of the Particles of Air*, *Magnetism*, and *Elasticity and Density of Steam*. For further details of Dalton's life, see the excellent biography by Dr Charles Henry. (T. S. T.)

DAM (Fr. *dame*; Lat. *domina*), a female parent; used particularly of beasts.

Dam (Germ. *dämmen, to stop*), a construction of earth, wood, stone, or other material, to confine or shut in water; more particularly to obstruct the current of a stream and to raise it, for the purpose of driving mill-wheels, &c.

DAMAGRAM, a province of Central Africa, forming the north-western frontier of Bornu, and extending from about 13. 20. to 14. N. Lat., and from 4. 30. to 10. 50. E. Long. It has belonged alternately to Houssa and Bornu, and is at present subject to the latter. Damagram is a country of great fertility, but "not a 10,000th part of the soil is cultivated," the inhabitants deriving their chief subsistence from rapine and the proceeds of man-stealing. Most of the productions of Sudan seem to be found in Damagram. Mr Richardson, on his route through the province, saw the ghussub cultivated to some extent; and in some localities wheat, cotton, indigo, tobacco, onions, pepper, date-trees (bearing twice a-year), castor-oil tree, henna, potatoes (dankali), a species of palm bearing a large fruit (gonda) like the mealy melon, gourds, nogs, and gwarya, which last are two species of potatoes. The domesticated cattle are horses, asses, oxen, sheep, and goats, and a few camels. The wild animals are chiefly lions, wild boars and oxen, hyænas, jackals, and vultures and lizards in great numbers. Iron is found in the rocks of Sudan. The former capital was a town of the same name, but Zinder, which sometimes gives name to the province, is now the chief town. (See Petermann's *Account of the Expedition to Central Africa*, 1854.)

Damar ‖ Damascus.

DAMAR, an extensive open town of Arabia, in the country of Yemen, and the capital of a district, 56 miles north of Sana. It has a large castle, an extensive university, and about 5000 houses.

Damar, the name given to a kind of indurated pitch or turpentine which exudes spontaneously from various trees indigenous to most of the Indian islands. It is greatly used in Bengal and China for paying the bottom of ships, and for other purposes.

DAMASCENUS, Joannes, a voluminous ecclesiastical writer who flourished in the first half of the eighth century A.D. He derived the surname of Damascenus from the place of his birth, but was also styled Chrysorrhoas from his eloquence. His father, Sergius, was a councillor at the court of the khaliph, and transmitted both his office and fortune to his son. While on an embassy to Jerusalem, however, Damascenus entered the service of the church, and retired to the monastery of St Saba, where he passed the remainder of his days. He died sometime about the middle of the eighth century, and has been canonized both by the Greek and Latin Churches. In his works he has treated a great variety of speculative questions, relating to the Manichæan, Nestorian, and Eutychian heresies. His *Accurate Exposition of the Orthodox Faith* still maintains its reputation in the Greek Church; but his keen defence of image-worship, against the iconoclasm of Leo the Isaurian, shows him to have been deeply tinctured with the superstition of the age. The best edition of his works is that of Le Quien, Paris, 1712.

Damascenus, *Nicolaus*, a Greek historian and philosopher, who flourished in the Augustan age, and was the intimate friend of Herod, tetrarch of Judea. Some fragments only of his works remain.

DAMASCIUS, a celebrated Neo-platonic philosopher, who was born at Damascus about the middle of the fifth century, A.D. He studied at Alexandria, and thence removed to Athens, where he taught philosophy till the close of the heathen schools during the reign of Justinian. Of his works, which consisted chiefly of commentaries on Plato and Aristotle, some fragments exist in the writings of Photius, who combats his indirect attacks on Christianity. His work entitled *Difficulties and Solutions of the First Principles* has been published by J. Kopp., Francof. 1828.

DAMASCUS (called by the natives Es Sham), the capital of Syria, as well as of a pashalic of the same name, is a large and opulent city, situated in a plain at the eastern foot of the Anti-Libanus, about 180 miles S. by W. of Aleppo. N. Lat. 33. 27.; E. Long. 36. 25. It lies on the Barrada, by which and its branches it is abundantly watered. Nothing can exceed the beauty of its position, whether approached from the side of Mount Lebanon, from the desert to the east, or by the high road from the north. For many miles the city is girdled by fertile fields (or gardens, as they

Damascus.

are called); which, being abundantly watered by rivers and sparkling streams, give to the vegetation, consisting principally of olive trees, a remarkable freshness and beauty.

The view of Damascus, when the traveller emerges from Anti-Libanus, is of the most enchanting kind. "One of the most magnificent prospects in the world," says Addison (*Damascus and Palmyra*, vol. ii., p. 92), "burst upon my sight: like the first view of Constantinople, it is unique. We were looking down from an elevation of a thousand feet upon a vast plain, bordered in the distance by blue mountains, and occupied by a rich luxuriant forest of the walnut, the fig, the pomegranate, the plum, the apricot, the citron, the locust, the pear, and the apple, forming a waving grove of more than fifty miles in circuit; possessing a vast variety of tint, a peculiar density and luxuriance of foliage, and a wildly-picturesque form, from the branches of the loftier trees throwing themselves up above a rich underwood of pomegranates, citrons, and oranges, with their yellow, green, and brown leaves; and then conceive our sensations, to see grandly rising in the distance, above this vast superficies of rich luxuriant foliage, the swelling leaden domes, the gilded crescents, and the marble minarets of Damascus; while in the centre of all, winding towards the city, ran the main stream of the river Barrada. As we descended, here and there the openings in the trees displayed little patches of green verdure, or a glimpse of richly-cultivated gardens: the whole of the rich tract was surrounded by a mud-wall, beyond which all was arid and desert."

The interior of the city, however, does not correspond with the exquisite beauty of its environs. It was formerly surrounded by walls defended by towers, which have now fallen into a ruinous state; and the buildings also have so increased that the number of houses without the walls is double that of those within. The streets are in general narrow compared with those in European cities; but the narrowest streets of Damascus are wider than most of the streets of Cairo, and conveniently admit two foot passengers to move with safety on each side of a loaded camel. The greater number of the streets would allow two loaded camels to pass without incommoding those on foot, and many of them are so wide as to allow six or eight camels or horses to move abreast. They are all well paved, and have elevated foot-paths on each side. The houses in the suburbs are surmounted with cupolas; and these, viewed from a distance, present an appearance of an encampment of conical tents ten or twelve feet high. The houses in this quarter of the town are built of bricks baked in the sun, which, were they not protected by the cupolas, would be wasted away by the rains. The buildings in the interior are generally about two stories high, with flat roofs; whilst the principal edifices are painted in the gayest colours, and the aspect is light and airy in the extreme. The town, however, in the interior has a dull and monotonous appearance. The houses present a great superficies of dead wall; yet Damascus is one of the most splendid cities in the East, and contains about 500 houses, which are entitled to the name of palaces: all their splendour is, however, confined to the interior, which contains a number of spacious and gorgeous apartments, courts, terraces, and galleries, adorned with marble pavements of various colours ingeniously and fancifully arranged, mosaic work of the same materials, friezes painted and gilded, while the ceilings are so many broad canopies of gold and brilliant colours, with rich additions of sculpture and enamel. These houses are sumptuously furnished with sofas richly embroidered, Persian carpets, mirrors, and other valuable articles. Into many of the apartments beautiful fountains are introduced. One of the finest streets in the city is formed by the palaces of the agas of Damascus, who are the nobility of the land. The fronts of these palaces, however, towards the street, are like long prison or hospital walls—mere gray mud walls, with few or no windows, whilst at intervals is a great gate opening on a court. But the interior is magnificent. The ornaments alone of many of their saloons cost upwards of L.1000 sterling. Damascus.

The mosques and chapels throughout the city are exceeding numerous. Of these, the Great Mosque is the most remarkable. The architecture is of the Corinthian order throughout every part of the edifice. Its form is an oblong composed of three aisles running parallel to each other, and divided by rows of fine Corinthian columns. It has two minarets at each end, and is crowned by a large stone cupola, supported by four enormous pillars. The interior produces a most imposing effect from its dimensions; and the square court in front is also magnificent from its extent. It has on three of its sides a colonnade of Syrian granite pillars, mostly of a fine grain and reddish colour; and on the outside is a superb fountain. Another, with a grove of trees on each side, stands in a spacious court within. The galleries are supported by numerous columns; and on the walls are still seen the remains of the mosaic work with which they were once adorned. A hospital for the indigent sick is attached to this edifice. This mosque is said to have been originally built by the emperor Heraclius, and to have been dedicated to Zachariah; by others it has been considered to have been the work of the bishops of this see, and by them dedicated to St John of Damascus; whilst the Turks call it the Mosque of St John the Baptist, and think it was built by the khalif Valid in the 86th year of the Hegira (A.D. 692). The mosque of the dervishes (where these fanatics dance until they are excited almost to frenzy) is a large, regular, and handsome edifice, and has two of the loftiest and finest minarets to be seen in Damascus. Besides the principal dome, which is very large, a line of smaller ones is carried round three sides of the open court in front of the building, after the same manner as those in the great mosque of Mecca, of which it appears to be a close imitation. In the court adjoining this mosque is a hospital or charitable institution, constructed by the sultan Selim, for the manufacture of silk. There are other mosques, distinguished for their beautiful and ancient architecture. One is adorned with all kinds of fine marble like mosaic pavement; and another is remarkable for its minaret, which is entirely cased with pantiles.

The bazaars are very striking. The great bazaar is about half a league long. They are long streets covered in with high wood-work, and lined with shops, stalls, magazines, and cafés. The shops are narrow, and go only a short way back. The merchant himself sits in front, with his legs doubled up below him, and his pipe in his mouth. The magazines are stored with merchandise of all sorts, and particularly with Indian manufactures, which are brought in great quantities by the caravans from Baghdad.

The castle is situated towards the S.W. part of the city, and is about three quarters of a mile in circuit. It is a large and fine edifice, with three square towers in front and five on each side, and is surrounded with a broad and deep ditch lined with undressed stone. Within it resembles a small town. It is supposed to have been built in the middle ages, either by the Greeks, or by the first Mohammedan conquerors of Syria. It appears to be a work of great antiquity, and to have undergone many additions, alterations, and repairs at different periods. In the oldest parts of it, near the foundation, the stones are of an extraordinary size, and indicate extreme antiquity. It is said by Buckingham to present in the interior a confused heap, in which are mingled together strong works of defence, ruined palaces retaining marks of ancient splendour, and rich ornaments of the most florid arabesque, with remains of fountains, aqueducts, and gardens attached, besides dark passages, gloomy dungeons, secret stairs, and a labyrinth of other objects which could not be penetrated without a guide acquainted with the localities. Some of the finest buildings in Damascus are the khans or caravanserais

Damascus. appropriated to the reception of goods brought in caravans from various quarters by wholesale merchants. The great khan is said to be the finest in the east. It consists of a spacious court, with a superb gateway in the form of a pointed arch, vaulted and highly ornamented with sculpture. The court is finely paved, and in the centre a large fountain sends forth cooling and agreeable streams; the whole being crowned with a cluster of lofty domes. The masonry is in the ancient Saracenic and Turkish style, with alternate layers of black and white marble; and the ornaments are profusely rich. The coffee-houses in Damascus are exceedingly spacious: they have benches on each side of the street, extending fifty yards in length, and contain rooms of the same extent, in which passengers smoke and drink coffee. There are many houses also at which sherbet and other sweet drinks are prepared, cooled with the ice and snow brought down to the city from a snowy mountain to the S.W. of the town. Skins of iced water, sweetened and perfumed, are retailed through the streets.

The suburb of Salheyah, which lies at the foot of the mountains that bound the city on the W. and N.W., is a great resort on the last day of every week, and to it all the inhabitants of Damascus of every age and condition repair in their holiday dress to enjoy the free air and pleasures of the country. Here are to be seen parties by the way-side, some smoking, others engaged in loud and merry conversation, and others amusing themselves and their children; the women enveloped in snow-white muslin robes, with veils of a dark gauze, their usual dress; the men of the city mounted on horses richly caparisoned, or on fine mules and asses; others sauntering on foot, or reposing on the banks that skirt the road, either smoking, playing at chess, or touching the Arnaout guitar to their songs.

Damascus is the seat of an extensive trade both with India and with Europe. The productions of India, consisting chiefly of spices, cotton manufactures, coarse and fine muslins, and gold stuffs, are in great demand, and bring high prices. They are brought from India by the Persian Gulf, Bussora, Baghdad, and Aleppo. The manufactures of England are much sought after, and held in very high esteem, particularly light woollen cloths of gay colours, printed cottons and chintzes, and silk and cotton shawls made in imitation of those of Cashmere; also needles, pins, knives, scissors, and fine hardware, as well as china and earthenware, whether English or Indian. These goods being generally imported through Saida, Beirût, and Tripoli, are sold at very high prices. Iron, lead, tin, cochineal, sugar, and other European articles, are also imported through the same channel. Wearing apparel for fashionable persons of both sexes at Damascus, and clothes that have been worn, are brought from Constantinople; and being distributed all over the country, are frequently the means of spreading the contagion of the plague. Amongst the various manufactures to be found in the bazaars are superb caparisons for horses, of which the Turks, as well as all the other Eastern nations, are extremely fond. These are made in European Turkey; and a number of fine bridles, martingales, and silver and embossed breastpieces, come also from Persia. The firearms are chiefly of French and German manufacture, being prepared in an ornamented style expressly for this market. The sabre blades are almost all of the old Persian or Damascus manufacture. The art of making them, however, is no longer known or practised in this city; so that they grow daily more valuable, as no modern sword can compare with them in temper and in quality. The silk seen in the bazaars of Damascus is principally of Chinese and Indian manufacture; the furs come from Russia, Georgia, Circassia, and Armenia; the velvet from Italy; copper from Asia Minor; the manufactures of Britain through Smyrna; and various other articles of an inferior kind from Germany and France. There are few manufactures in Damascus; and these consist chiefly of silk stuffs, plain, coloured, and embroidered with gold; fabrics of plain cotton, and cotton and silk mixed, all for home consumption, and mostly of broad striped or wavy patterns for the caftans of the Turkish dress. Damascus.

Commerce, as in all other places in the East, is carried on by means of caravans, of which the principal is that which goes with the annual pilgrimage to Mecca. It is conducted by the pasha, who receives the standard of the prophet from the governor of the castle, and gives a solemn pledge for its restoration. This expedition unites commercial with religious objects. A caravan accompanied by a numerous train of armed men goes thrice a-year to Baghdad, the journey occupying thirty days; that to Aleppo travels twice or thrice a-month. Besides these, many other caravans go to different ports of Syria, Damascus being a great rendezvous and emporium of trade. Provisions and fruit of all kinds are abundant; also ice and snow, which may always be obtained from the neighbouring mountains. Damascus is generally regarded as the oldest city in the world, its history remounting beyond the time of Abraham, whose steward Eliezer was a native of this place. L. Müller (*Ad Orig. Reg. Damas.*) has undertaken to show that it was even then governed by its own rulers. How long it may have retained its independence cannot be determined; but it appears (2 Sam. viii. 5, 6; 1 Chron. xix. 4) that its monarch having unadvisedly attacked the victorious David, the Hebrew sovereign defeated the Syrians, making a great slaughter of them, and subdued Damascus, and exacted tribute from its inhabitants. This subjection was not of long duration, for under his successor one Rezon, a servant of Hadadezer, king of Zobah, made himself master of Damascus, and, ruling over Syria, "was an adversary to Israel all the days of Solomon." After Rezon, Hezion occupied the throne. He was succeeded by his son Tabrimon, who was in alliance with Asa, king of Judah. Preserving the same direct line, the crown then fell to Benhadad, under whose son Damascus was the head of a very powerful empire, since it appears (1 Kings xx. 1) that "thirty and two kings" (doubtless petty princes or pashas, governors of provinces) accompanied him in a campaign which he undertook against Samaria. After a series of contests with the kings of Israel, Damascus fell into the hands of Jeroboam II.; and an expedition undertaken by the united powers of Damascus and Syria against Ahaz, king of Judah, was avenged by the Assyrian Tiglath-Pileser, who added the Damascene territory to his own kingdom. Damascus after this fell under the power of the Babylonians and Persians, from whom it was taken by Alexander the Great. Then it made a part of the kingdom of the Seleucidæ, from whom it passed into the hands of the Romans. In the time of the apostle Paul it belonged to the dependent kingdom of the Arabian prince Aretas. At a later period it was reckoned among the cities of Decapolis; then it was added to the province of Phœnice; and at last made a part of the province of Phœnicia Libanesia. From the time of Hadrian it bore the honorary title of Metropolis, without enjoying the rights of a metropolis. Under the Greek emperors of Constantinople Damascus was the most celebrated city of the East, remarkable for its wealth, luxury, magnificence, and its numerous Christian population. A great era in its history is its conquest by the Saracens, of which an account may be found in the Arabic historian Alwakidi (Ockley's *Hist. of the Saracens*). The war was begun about A.D. 633, by the celebrated Abubeker, the successor of Mohammed; and ended in the capture of the city, and the substitution of Islamism for Christianity. It then became the capital of the whole Mussulman world, till the khaliphate was removed to Baghdad. The city continued under the sway of the khaliphs of Baghdad till it came into the hands of the Turks, and was held and rendered famous by Noureddin and Saladir. In 1401 Timour the Tartar captured the city and barba-

Damask ‖ Damergu.

rously treated its inhabitants. It afterwards fell into the hands of the Mamelukes, who retained possession of it till 1516, when it was taken by the Turks under Sultan Selim I. In 1832 it was taken by the Egyptian army under Ibrahim Pasha, but was restored to the Turks in 1840. The population of Damascus is estimated at 150,000.

DAMASK (from *Damascus*, whence first brought), a variegated textile fabric of silk, richly ornamented with raised patterns representing flowers, fruits, &c., woven in the loom. It is also fabricated in woollen stuffs.

DAMASK likewise denotes a kind of wrought linen, used chiefly for table-cloths and napkins, and so called because its patterns resemble those of real damask. It was first made in Flanders, but it is now wrought extensively in Britain, particularly at Dunfermline in Scotland, and also at Lisburn and Ardoyne in Ireland. An inferior description has latterly been made of cotton.

DAMASK is also applied to a very fine steel, prepared in some parts of the Levant, but particularly in former times at Damascus, whence its name. It is used for sword and cutlass blades, and is very finely tempered.

DAMASKEENING, or DAMASKING, the art of ornamenting iron or steel, by making incisions on its surface, and filling them up with some other metal, generally gold or silver. It is chiefly used for enriching sword-blades, guards, locks of pistols, &c.

There are two ways of damasking; the one, which is the finest, is when the metal is cut deep with proper instruments, and inlaid with gold and silver wire; the other is superficial only. This art is of great antiquity, and its invention is attributed by Herodotus (i. 25) to Glaucus of Chios, who lived B.C. 490. It would appear to have flourished at some period in Damascus, whence the name is generally derived.

DAMAUN, a seaport of Hindustan, situate on the western coast, and within the limits of the presidency of Bombay. It is a considerable place, though its commerce has now greatly fallen off; and it makes a conspicuous figure from the sea, the churches and houses being all white. The Parsees have a temple here, in which they maintain that the sacred fire brought with them from Persia nearly twelve hundred years ago is still burning. Ship-building to a considerable extent is here carried on, the teak forests being at no great distance. The harbour is convenient for small vessels, there being nearly seventeen feet of water at the bar. Damaun was taken by the Portuguese in 1531, and still remains in their possession. The Portuguese district, of which the town is the principal place, is about ten miles in length and five in breadth. Distance of town from city of Bombay, 101 miles north. Lat. 20. 24.; Long. 72. 53. (E. T.)

DAMAUN, or the Border, a strip of territory in Hindustan, so called because it stretches between the Suliman Mountains and the river Indus. The tract formerly constituted a portion of Runjeet Singh's kingdom of Lahore, and is now annexed to the British province of the Punjaub. Among the principal towns are those of Dera Ismael Khan, Dera Fati Khan, and Dera Ghazee Khan. The Damaun is 300 miles in length from the Salt Range on the north to the borders of Scinde on the south, and its average breadth is about sixty miles. Lat. 28. 40. to 33. 20.; Long. 69. 30. to 71. 20. (E. T.)

DAME (French, from Lat. *domina*, a *mistress*), was formerly a title of honour, and is still used in law to denote the wife of a knight or baronet.

DAMELOPRE, a kind of bilander or hoy, used in Holland for conveying merchandise from one canal to another.

DAMERGU, a frontier country of Bornu, in Africa; under the sway of the Tuaricks, greatly intermixed with people of Bornu and Houssa. It is the granary of Air, and is, in fact, chiefly peopled by slaves of the Kelowis. Ola-

Damianus ‖ Dammoodah.

loal, the capital, lies in about N. Lat. 14. 30. Besides this city there are said to be 200 or 300 towns and villages in the country. (See Petermann's *Account of the Expedition to Central Africa*, 1854.)

DAMIANUS, a saint and martyr of the early Christian church. See COSMAS.

DAMIENS, ROBERT FRANÇOIS, an assassin, who wounded Louis XV. of France in 1757. He was born in a village of Artois in 1715, and early enlisted in the army. After his discharge from service he became a menial in the College of the Jesuits in Paris, and was dismissed from this as well as from other employments for misconduct. During the disputes of Clement XI. with the parliament of Paris, the mind of Damiens seems to have been excited by the ecclesiastical disorganization which followed the refusal of the clergy to grant the sacraments to the Jansenists and Convulsionaires; and he seems to have thought that peace would be restored by the death of the king. It is probable, however, that he designed no more than the infliction of a slight wound. Having been condemned as a regicide, he was torn in pieces by horses in the Place de Grêve, March 28, 1757. Before being put to death, he was barbarously tortured for an hour and a half with red hot pincers, molten wax, lead, and boiling oil—all which he endured with unflinching fortitude.

DAMIETTA, a town of Lower Egypt, on the great eastern branch of the Nile, about 6 miles from its mouth (the ancient Phatniticum ostium), and nearly 100 miles from Cairo. After the metropolis and Alexandria, Damietta is the largest town in Egypt, and contains a population of about 27,000, consisting for the most part of Egyptians, with a few Greeks and Syrians. The town, as a whole, is ill-built and straggling, and is only redeemed from being a congregation of miserable mud-hovels by the presence of some handsome mosques, bazaars, and public baths. The houses of the better classes are brick edifices situated on the water-edge, and furnished with terraces, on which the inmates enjoy the cool river-breezes of the evening. The general trade of Damietta was at one time considerable, but has of late been absorbed in great part by Alexandria. It has still, however, a considerable coasting trade with Syria and the Levant. The country surrounding Damietta is extremely well watered and fertile, and the rice grown there is the best in Egypt. Mehemet Ali established a military school in the town with accommodation for 400 pupils; as also a cotton factory and an extensive rice-mill. The lake Menzaleh yields large supplies of fish, which are dried and salted, and furnish an important article of export trade. Coffee, dates, and flax are the other articles most largely exported.

Damietta is a corruption of the word *Thamiatis*. The original town was 4 miles nearer the sea than the modern city, and first rose into importance on the decay of Pelusium. When it passed into the hands of the Saracens it became a place of great wealth and commerce, and was therefore frequently attacked by the old crusaders. The most remarkable of these sieges was conducted in person by Louis IX. of France, who, however, was soon after taken prisoner and compelled to purchase his freedom by restoring the city to its Saracen owners. The Egyptian sultans, to obviate these attacks, blocked up the Phatnitic mouth of the Nile, razed old Damietta to the ground, and transferred the inhabitants to the site of the modern town. From this circumstance large ships cannot now sail up the Nile, and are obliged to discharge their cargoes outside the bar.

DAMM, CHRISTIAN TOBIAS (1699-1778), a distinguished German scholar, was a native of Gesthayn, near Leipzig. He rendered very important services to Greek literature by his admirable *Lexicon* of Homer and Pindar,—a work which is hardly yet antiquated.

DAMMOODAH, a river of Hindustan, rising in the

Damnii || Dampier.

British district of Ramgurh, presidency of Bengal, and taking a south-easterly direction through the districts of Pachete, Bancoora, Burdwan, and Hooghly. It falls into the river Hooghly in Lat. 22. 13., Long. 88. 7., after a total course of 350 miles. The valley of the Dammoodah abounds in mineral wealth; but as the river is navigable only during the periodical rains of autumn, when, moreover, it is subject to sudden rises and inundations, considerable difficulty is experienced in providing means of transport for the coal and iron of Bancoora and its vicinities. The defect is about to be remedied by the construction of a branch railway quitting the Calcutta Trunk line, near Burdwan, and running in a westerly direction to the rich collieries of Raneegunge. The most severe inundation experienced on the Dammoodah occurred in 1823, when the destruction of life and of property was incalculable. A similar visitation took place in 1834; and in 1840 the rise of the river was so great as to overtop the embankments, which sustained considerable damage from the flood. (E. T.)

DAMNII, or DAMNONII, in *Ancient Geography*, a tribe in the south of Scotland, whose exact *locale* it is extremely difficult to fix. They seem to have inhabited the country now represented (as nearly as can be determined) by the shires of Renfrew, Dumbarton, Lanark, Linlithgow, Stirling, and Edinburgh.

DAMNONII, in *Ancient Geography*, a tribe in the extreme south of England, who inhabited a tract of country corresponding as nearly as possible with the modern county of Cornwall.

DAMOCLES, a noted parasite at the court of Dionysius, the tyrant of Sicily. To enable him to realize the true nature of royal happiness, Dionysius is said to have placed him at a sumptuous banquet, with a drawn sword suspended over his head by a single hair. Seeing his danger, Damocles begged to be relieved from the perilous situation.

DAMON, a Pythagorean philosopher, celebrated for his disinterested affection for Pythias, a member o the same philosophic fraternity. Having been condemned to death by Dionysius I. of Syracuse, Pythias requested permission to depart for the purpose of arranging his domestic affairs, and Damon pledged his life for the return of his friend. The punctual arrival of Pythias before the appointed day of execution so astonished the tyrant that he released both, and begged to be admitted into their friendship.

DAMPER, an iron plate made to slide across a flue or chimney, so as to contract or enlarge the passage at will, in order to regulate the draught of the fire.

DAMPIER, WILLIAM, an English navigator, was born at East Coker, Somersetshire, about 1652. Having early become an orphan, he was removed from the Latin school, and placed with the master of a ship at Weymouth. In this ship he made a voyage to Newfoundland; but, disgusted at the cold of that northern climate, on his return he engaged himself as a common sailor in a voyage to the East Indies. He next served in the Dutch war under Sir Edward Sprague, and was present at two engagements; but the declining state of his health induced him to come on shore, and remove to the country, where he remained some time. In the year following he became an under-manager of a Jamaica estate; but only continued a short time in this situation. He afterwards engaged in the coasting trade, and thus acquired an accurate knowledge of all the ports and bays of that island. Having entered on board a vessel bound for the bay of Campeachy, and returning a second time to the same coast, he remained with the logwood-cutters, and engaged himself as a common workman. During his stay in that country he collected the materials for the minute and interesting account which he has given of the laborious life of these people, as well as of the geographical description and the natural history of the country.

Satisfied with the knowledge which he had obtained of the nature of the trade and country, he returned to Jamaica, and thence proceeded to England, where he arrived in 1678. About the beginning of the year following he went out to Jamaica as a passenger, with the intention of revisiting the bay of Campeachy; but he was persuaded to associate himself with a promiscuous band of English, Dutch, and French privateers, who carried on a predatory warfare on the commerce and settlements of the Spaniards. In this expedition Dampier crossed the isthmus of Darien with his associates, spent the year 1680 on the Peruvian coast, and was occasionally successful in plundering the towns. In consequence of a dissension which arose among them, Dampier, and the minority which he had joined, recrossed the isthmus, and engaged with another fleet of privateers, which was then stationed on the Spanish Main; and having spent another year amongst the West India islands, he, with some others, proceeded to Virginia in a single ship, in order to dispose of their prize goods. Here he remained for a year; and afterwards engaged with a captain named Cook, who with about seventy men undertook an expedition against the Spaniards in the South Seas. They sailed in the month of August 1683, touched at the coast of Guinea, and then proceeded round Cape Horn into the Pacific Ocean. Having fallen in with a ship from London, which had sailed on a similar expedition, they joined company; and, touching at the island of Juan Fernandez, they made the coast of South America, cruising along Chili and Peru. They took some prizes; and with these they proceeded to the Mexican coast, which they fell in with near Cape Blanco. While they lay here Captain Cook died, and the command devolved on Captain Davis. Having separated from the London ship, they were joined by another commanded by Captain Swan. An attempt to plunder the town of Guayaquil was unsuccessful, but at the mouth of the river they took some vessels which had about 1000 slaves on board. With these negroes Dampier proposed to work the gold mines in the neighbourhood of Santa Maria, on the isthmus of Darien, from which the Spaniards had been driven away by some privateers. But this plan was not attempted. The next object of plunder was the Spanish fleet which was laden with the treasure of the Peruvian mines; but the English being ill supported by some French ships which had joined them, the fleet, after a running fight, got safe into Panama. Dampier.

The English ships, afterwards cruising along the coast of Mexico, landed, took the town of Puebla Nova, and burnt two others. Dampier, leaving Davis, went on board of Swan's ship, and proceeded with him along the northern parts of Mexico, as far as the southern part of California. During this expedition they frequently landed for the purpose of plunder; but the loss of 50 of the party during one of these incursions so discouraged them that they relinquished all further attempts on these coasts. Swan then proposed to run across the Pacific Ocean, and return by the East Indies; and, in hopes of a successful cruise off the Manillas, the crew were persuaded, with a very slender stock of provisions, to risk this long passage. On the last day of March 1686, they took their departure from Cape Corrientes, and on the fifty-second day reached Guam, one of the Ladrone Islands. About this time the crew talked of killing and eating Swan and the other officers, in case their stock of provisions should be exhausted before it could be supplied. From Guam they proceeded to Mindanao, where a mutiny arose among the crew, and the majority carried off the ship, leaving Swan and some of his people on the island. Among the number of those that sailed away was Dampier, although it is said that he had no concern in the mutiny. After cruising some time off Manilla, and having careened their vessel at Pulo Condore, in 1687, they were driven to the Chinese coast, made the circuit of Luzonia and Mindanao, passed through the group of Spice Islands

Dampier. and reached the coast of New Holland in the beginning of 1688. In March they cruised along the west coast of Sumatra, and touched at the Nicobar Islands, where Dampier, at his own request, and two other Englishmen, a Portuguese, and some Malays, were set on shore. Dampier's object was to establish a trade in ambergris. Attempting to navigate a canoe to Acheen in Sumatra, they were overtaken by a severe storm, in which they experienced great hardships. They at last reached Sumatra; but the fatigues and distress of the voyage proved fatal to several of them, who were carried off by a fever; while Dampier himself had scarcely recovered at the end of a twelvemonth. After making several voyages to different places of the East Indies, he acted for some time as gunner to the English fort of Bencoolen. In 1691, wishing to revisit his native country, he embarked on board a ship bound for England, where he arrived in September. At this time he brought with him a native of Meangis, one of the Spice Islands, who was supposed to be the son of a chief, and who, after being exhibited as a curiosity, died of the smallpox at Oxford.

It appears that afterwards Dampier was engaged in the king's service. He had the command of the Roebuck, a sloop of 12 guns and 50 men. This vessel was believed to have been fitted out for some voyage of discovery, for she had 20 months' provisions on board. He sailed from Britain in 1699, touched at the coast of Brazil, and then ran across to the coast of New Holland, and arrived there on 1st Aug., somewhere about Lat. 26. Proceeding northwards along the coast, he explored the country in different places where he landed. To procure refreshments he found it necessary to direct his course towards Timor; and from thence he sailed to the coast of New Guinea, where he arrived Dec. 3. By sailing along to its easternmost extremity he discovered that it was terminated by an island, which he circumnavigated, and named New Britain.

Here it would appear from his own journal that he encountered considerable difficulties from the small number of his men, and their eager desire to hasten home. On account of these difficulties he was prevented from prosecuting his discoveries. In May he returned to Timor, and thence proceeded homeward by Batavia and the Cape of Good Hope. In February 1701 he arrived off the island of Ascension, when the vessel sprung a leak and foundered; and it was with much difficulty that the crew reached the island. They remained at Ascension till they were taken away by an East Indiaman and conveyed to England. This closes the account of Dampier's life and adventures as it is detailed by himself. It appears, however, from the preface to the third volume, that he was preparing in 1703 for another voyage. It is mentioned also in Woodes Rogers' *Voyage round the World*, that Dampier had the command of a ship in the South Seas about the year 1705, along with Captain Stradling, whose vessel foundered at sea. Dampier accompanied Woodes Rogers in his voyage round the world in the years 1708, 1709, 1710, and 1711, but only in the capacity of pilot, which is supposed to be a circumstance due to some remissness in his conduct. During this expedition Guayaquil was taken, and Dampier had the command of the artillery. Nothing further is known of the life of Dampier; and we are equally ignorant of the place and time of his death.

The works of Dampier are well known, and have been often reprinted. They consist of, *A Voyage round the World*, 3 vols. 8vo; *A Supplement to it, describing the countries of Tonquin, Malacca, &c.; Two Voyages to Campeachy; A Discourse of Trade-winds, Seasons, Tides, &c. in the Torrid Zone;* and *A Voyage to New Holland.* His observations are curious and important, and conveyed in a plain manly style. His nautical remarks discover a great deal of professional knowledge. His knowledge of natural history is not scientific; but it appears to be accurate and reliable. Damps.

DAMPS, in *Mining*, certain noxious exhalations or gases issuing from some parts of the earth, and which prove almost instantly fatal to those who breathe them.

These damps occur chiefly in mines and coal-pits, though vapours of the same kind often issue from old lavas of burning mountains; and, in those countries where volcanoes are common, it is said that they fill the houses, and destroy people suddenly without the least warning of their approach. In mines and coal-pits they are chiefly of two kinds, called by miners and colliers the *choke-damp* and *fire-damp*. The *choke-damp*, known in modern chemistry by the name of fixed air, or carbonic acid gas, usually infests those places which have been formerly worked, but long neglected, and are known among miners as *wastes*. No place, however, can be reckoned safe from this kind of damp, except where there is a due circulation of air; and the procuring of this is the only proper means of preventing accidents from damps of all kinds. The choke-damp being heavy descends towards the lowest parts of the workings, and thus is dangerous to the miners, who can scarcely avoid breathing it.

The *fire-damp*, which is carburetted hydrogen, rises to the roof of the workings, as it is specifically lighter than common atmospheric air; and hence, though it will suffocate like the other, it seldoms proves so dangerous in this way as by its inflammable property; for when exposed to the flame of the miners' candle it explodes with extreme violence.

In the *Philosophical Transactions* (No. 119), there is an account of some explosions by damps of this kind, on which the following observations have been made:—1*st*, Those who are in the place where the vapour is fired find themselves suddenly surrounded with flames, but hear little or no noise; while those who are in places adjacent, or above ground, hear a very great one. 2*d*, Those who are surrounded by the inflamed vapour feel themselves scorched or burnt, but are not moved out of their places; though such as unhappily stand in the way of it are commonly killed by the violence of the shock, and are sometimes ejected from the mouth of the pit. Nor are the heaviest machines able to resist the impetuosity of the blast. 3*d*, No smell is perceived before the fire, but a very strong one of brimstone is afterwards perceptible. 4*th*, The vapour lies towards the roof, and is not perceived when the candles are held low; but when held higher, the damp descends like a black mist, and catches hold of the flame, increasing it to two or three handlengths; and this appearance ceases when the candles are held nearer the ground. 5*th*, The flame continues in the vault for several minutes after the report. 6*th*, Its colour is blue, something inclining to green, and very bright. 7*th*, On the explosion of the vapour, a dark smoke like that proceeding from fired gunpowder is perceived. 8*th*, Damps are generally observed to come about the latter end of May, and to continue during the heat of summer. They return several times during the summer season, but observe no certain rule.[1]

Besides these damps other kinds are described in the *Philosophical Transactions* by Mr Jessop, who derived his information from the miners in Derbyshire. After describing the common damp, he says, "They call the second sort the *peas-bloom damp*, because, as they say, it smells like peas-bloom. They tell me it always comes in the summer time; and those grooves are not free which are never troubled with any other sort of damps. I never heard that it was mortal—the scent, perhaps, freeing them from the danger

[1] The nature of the fire-damp was first accurately examined by Dr Henry of Manchester, in a paper published in *Nicholson's Journal*, xix., in the year 1806.

Damsel || Danaides.

of a surprise; but by reason of it many good grooves lie idle at the best and most profitable time of the year, when the subterraneous waters are the lowest. They fancy it proceeds from the multitude of red-trefoil flowers, by them called *honey-suckles*, with which the limestone meadows in the Peake do much abound. The third is the strangest and most pestilential of any, if all be true which is said concerning it. Those who pretend to have seen it, for it is visible, describe it thus: In the highest part of the roof of those passages which branch out from the main groove, they often see a round thing hanging, about the bigness of a foot-ball, covered with a skin of the thickness and colour of a cobweb. This, they say, if it be broke by any accident, as the splinter of a stone, or the like, disperses itself immediately, and suffocates all the company. Therefore, to prevent casualties, as soon as they have espied it, they have a way, by the help of a stick and long rope, of breaking it at a distance; which done, they purify the place well with fire before they dare enter it again. I dare not avouch the truth of this story in all its circumstances, because the proof of it seems impossible, since they say it kills all that are likely to bear witness to the particulars; neither do I deny but such a thing may have been seen hanging on the roof, since I have heard many affirm it." See LAMP, *Safety*.

DAMSEL (Fr. *damoiselle*; Norm. *demicelle*; Ital. *damigella, donzella*), according to Skinner, denotes a woman of noble rank, but without a title, a gentlewoman, *q.d. dominicella* or *parva domina*. In more recent times it was applied to any young unmarried woman, especially to such as were in the intermediate condition between that of ladies and the lower class. In ancient times this appellation was bestowed on all young persons of either sex who were of noble or gentle blood, as the sons and daughters of princes, knights, and barons. Thus we read of Damsel Pepin, Damsel Louis le Gros, Damsel Richard Prince of Wales. From the sons of kings this appellation first passed to those of great lords and barons, and at length was conferred on young gentlemen following the profession of arms but not yet knighted. *Damoiseau* in French, and *damigello* and *donzello* in Italian, are the masculine correlatives respectively of *damoiselle, damigella*, and *donzella*.

DAN, in *Ancient Geography*, a town of Judæa, originally under the protection of the Sidonians, and by them named Laish. It became the chief seat of Jeroboam's idolatry; and after the conquests of the Syrians, it became proverbial as the southern boundary of the Promised Land. Its site, a little to the north of Paneas, is supposed by Burckhardt to be marked by the ruins of a few habitations.

DANACE, an ancient Persian coin, in value rather more than an obolus. The same name was also applied by the Greeks to the obolus or small coin which used to be put into the mouth of the dead as Charon's fee. See CHARON.

DANAE, the fabled daughter of Acrisius, king of Argos, and Eurydice. To frustrate the declaration of the oracle that he would be put to death by his daughter's son, Acrisius is said to have confined her in a brazen tower; but Jupiter, descending in a shower of gold, gained access to her prison, and she gave birth to Perseus. (See PERSEUS.) Along with her child she was exposed in a chest on the sea, and carried to Seriphus, where she became the slave, or, according to some, the wife of Polydectes the king of the island. According to another account, the chest was stranded on the coast of Italy, and Danae was then married to Pilumnus the founder of Ardea.

DANAIDES, the fifty daughters of Danaus, king of Argos. They were betrothed to the fifty sons of Aegyptus, and promised to their father to kill their husbands on the bridal night. All are said to have fulfilled their promise with the exception of Hypermnestra, who spared the life of her husband, Lynceus. Having been purified from their crime, they were afterwards married to the victors in games instituted for the purpose. According to another account, the crime was avenged by Lynceus, who put them to death; and in the popular mythology they were doomed in Hades to the endless task of filling with water a vessel full of holes.

Danaus || Dance.

DANAUS, the son of Belus and Anchinoe, who reigned over Libya, while his brother Aegyptus filled the throne of Arabia. Having been driven from his kingdom by the plots of Aegyptus, he set sail with his fifty daughters in quest of a settlement. After touching at Rhodes, where he set up a statue to Minerva, he landed in Argos; and availing himself of the disaffection of the people towards their lawful sovereign, he succeeded in establishing himself on the throne. The sons of Aegyptus, following the track of their uncle, arrived in Argos, and met their death at the hands of their cousins. (See DANAIDES.) Danaus died at Argos, or more properly was killed by Lynceus; and his tomb in the *Agora* was pointed out in the time of Pausanias. He is said also to have built the Acropolis of that city.

DANCE, or DANCING (Fr. *danser*; Teut. *dantzen*), as at present practised, may be defined to be a graceful movement of the body, adjusted by art to the measures or tones of instruments, or of the voice. But according to what some reckon more agreeable to the true genius of the art, dancing is the art of expressing the sentiments of the mind, or the passions, by measured steps or bounds made in cadence, by regulated motions of the figure and by graceful gestures; all performed to the sound of musical instruments or of the voice.

There is no account of the origin of the practice of dancing amongst mankind. It is found to exist amongst all nations whatever, even the most rude and barbarous; and, indeed, however much the assistance of art may be necessary to make any one perfect in the practice, the foundation must certainly lie in the human constitution itself.

As barbarous people are observed to have the strongest passions, so they are also observed to be the most easily affected by sounds, and the most habitually addicted to dancing. Sounds to us the most disagreeable, the drumming of sticks upon an empty cask, or the noise made by blowing into reeds incapable of yielding one musical note tolerable to us, is agreeable music to them. Much more are they affected by the sound of instruments which have anything agreeable in them. M. Gallini informs us that "the spirit of dancing prevails almost beyond imagination among both men and women in most parts of Africa. It is even more than instinct, it is a rage, in some countries of that part of the globe. Upon the Gold Coast especially, the inhabitants are so passionately fond of it, that in the midst of their hardest labour, if they hear a person sing, or any musical instrument played, they cannot refrain from dancing. There are even well attested stories of some negroes flinging themselves at the feet of an European playing on a fiddle, entreating him to desist, unless he had a mind to tire them to death; it being impossible for them to cease dancing while he continued playing."

The same thing is found to take place in America; though, as the inhabitants of that continent are found to be of a more fierce and barbarous nature than the African nations, their dances are still more uncouth and barbarous than those of the negroes. "In Mexico," says Gallini, "they have also their dances and music, but in the most uncouth and barbarous style. For their symphony they have wooden drums, something in form of a kettledrum, with a kind of pipe or flageolet made of a hollow cane or reed, but very grating to an European ear. It is observed they love everything that makes a noise, how disagreeable soever the sound is. They will also hum over something like a tune when they dance thirty or forty in a circle, stretching out their hands, and laying them on each other's shoulders,

Dance. They stamp and jump, and use the most antic gestures for several hours, till they are heartily weary. And one or two of the company sometimes step out of the rings to make sport for the rest, by showing feats of activity, throwing their lances up into the air, catching them again, bending backwards and springing forwards with great agility."

The origin of dancing amongst the Greeks was most certainly the same as amongst all other nations; but as they proceeded a certain length in civilization, their dances were by consequence more regular and agreeable than those of the more barbarous nations. They reduced dancing into a kind of regular system; and had dances proper for exciting, by means of the sympathy above mentioned, any passion whatsoever in the minds of the beholders. In this way they are said to have produced effects to us absolutely incredible. At Athens it is stated that the dance of the Eumenides or Furies in the theatre had so expressive a character as to strike the spectators with irresistible terror. Men grown old in the profession of arms trembled; the multitude ran out; women with child miscarried; people imagined they saw in earnest those terrible deities commissioned with the vengeance of heaven to pursue and punish crimes upon earth.

The Greeks had martial dances, which they reckoned useful for keeping up and cherishing the warlike spirit of their youth; but the Romans, though equally warlike with the Greeks, never had anything of the kind. This may probably be owing to the want of that romantic spirit for which the Greeks were so remarkable. Hence there was less excitement, and much more cool deliberate valour, displayed by the Romans. The passions of pride, resentment, obstinacy, and the like, were excited in them, not by the mechanical means of music and dancing, but by the idea early instilled, that their greatest glory was to fight for the republic. It does not, however, appear that the Romans were at all less capable of being affected in this mechanical manner than the Greeks. When dancing was once introduced, it produced the very same effects at Rome as at Athens.

Amongst the Jews, dancing seems to have formed a part of the religious worship on some occasions, as we learn from some passages in the Psalms, though we do not find either saltation or singing positively enjoined by a divine precept. In the Christian churches mentioned in the New Testament, there is no account of dancing being introduced as an act of worship, though it is certain that it was used as such in after-ages. Gallini tells us, that "at Limoges, not long ago, the people used to dance the round in the choir of the church which is under the invocation of their patron saint; and at the end of each psalm, instead of the *Gloria Patri*, they sung *St Marcel, pray for us, and we shall dance in honour of you.*" Though dancing would now be looked upon as the highest degree of profanation in a religious assembly, yet it is certain that dancing, considered as an expression of joy, is no more a profanation than singing, or than simple speaking; nor can it be thought in the least degree more absurd that a Christian should dance for joy that Jesus Christ is risen from the dead, than that David danced before the ark when it was restored to him after a long absence.

Plato reduces the dances of the ancients to three classes: first, the military dances, which tended to make the body robust, active, and well disposed for all the exercises of war; secondly, the domestic dances, which had for their object an agreeable and innocent relaxation and amusement; thirdly, the mediatorial dances, which were in use in expiations and sacrifices. Of military dances there were two sorts; the *gymnopedic* dance, or the dance of children; and the *enoplian*, or armed dance. The Spartans had invented the first as an early excitation of the courage of their children, and in order to lead them on insensibly to the exercise of the armed dance. This children's dance used to be executed in the public place. It was composed of two choirs, the one of grown men, the other of children; whence, being chiefly designed for the latter, it took its name. Both classes of performers were in a state of nudity. The choir of the children regulated their motions by those of the men, and all danced at the same time, singing the poems of Thales, Alcmæon, and Dionysodotus. The *enoplian* or *Pyrrhic* was danced by young men armed *cap-à-pie*, who executed to the sound of the flute all the proper movements either for attack or for defence. It was composed of four parts. The first, called the *podism* or footing, consisted in a quick shifting motion of the feet, such as was necessary for overtaking a flying enemy, or for getting away from him when an overmatch; the second, the *xiphism*, a kind of mock fight, in which the dancers imitated all the motions of combatants, aiming a stroke, darting a javelin, or dexterously parrying or avoiding a blow or thrust; the third part, called the *komos*, consisted in very high leaps or vaultings, which the dancers frequently repeated for the better accustoming themselves occasionally to leap over a ditch, or spring over a wall; the *tetracomos*, or the fourth and last part, was a square figure, executed by slow and majestic movements, but it is uncertain whether this was everywhere executed in the same manner. Dance.

Of the Greeks, the Spartans were those who most cultivated the Pyrrhic dance. Athenæus relates, that they had a law by which they were obliged to exercise their children in it from the age of five years. This warlike people constantly retained the custom of accompanying their dances with hymns and songs. The following was sung for the dance called *trichoria*, said to be instituted by Lycurgus, and which had its name from its being composed of three choirs, one of children, another of young men, and the third of old. The old men opened the dance, saying, "In time past we were valiant." The young men answered, "We are so at present." "We shall be still more so when our time comes," replied the chorus of children. The Spartans never danced except with real arms. In process of time, however, other nations came to use only weapons of wood on such occasions. Nay, it was only so late as the days of Athenæus, who lived in the second century, that the dancers of the Pyrrhic, instead of arms, carried only flasks, and ivy-bound wands (thyrsi) or reeds. But even in Aristotle's days they used thyrsi instead of pikes, and lighted torches instead of javelins and swords. With these torches they executed a dance called the *conflagration of the world.*

Of the dances for amusement and recreation, some were simply gambols, or sportive exercises, which had no character of imitation, and of which the greater part exist to this day. The others were more complex, agreeable, figured, and were always accompanied with singing. Amongst the first or simples ones was the *ascoliasmus*, which consisted in jumping with one foot only, on bladders filled with air or wine, and rubbed on the outside with oil. The *dypodium* was jumped with both feet close. The *kybeslesis* was what is called in this country the *somerset*. Of the second kind were that called the *wine-press*, of which there is a description in Longinus, and the Ionian dances. These last expressed originally nothing but what was decent and modest; but in time their movements came to be so depraved, as to be employed in expressing voluptuousness and obscenity.

Amongst the ancients there were no festivals nor religious assemblies which were not accompanied with songs and dances. It was not held possible to celebrate any mystery, or to be initiated, without the intervention of these two arts. In short, they were looked upon as so essential in these kind of ceremonies, that to express the crime of such as were guilty of revealing the sacred mysteries, they em-

Dancing Girls ‖ Danet.

ployed the word *kheistæ*, signifying to be out of the dance. The most ancient of these religious dances is the *Bacchic*, which was not only consecrated to Bacchus, but to all the deities whose festival was celebrated with a kind of enthusiasm. The most grave and majestic was the *hyporchematic*, which was executed to the lyre, and accompanied with the voice. On his return from Crete, Theseus instituted a dance, at which he himself assisted at the head of a numerous and splendid band of youths, round the altar of Apollo. The dance was composed of three parts; the *strophe*, *antistrophe*, and the *stationary*. In the strophe, the movements were from the right to the left; in the antistrophe, from the left to the right; and in the stationary, they danced before the altar; so that the stationary did not mean an absolute pause or rest, but only a more slow or grave movement. Plutarch is persuaded that in this dance there is a profound mystery. He thinks, that by the strophe is indicated the motion of the world from east to west; by the antistrophe, the motion of the planets from the west to the east; and by the stationary, the stability of the earth. To this dance Theseus gave the name of *geranos*, or the crane, because the figures which characterized it bore a resemblance to those described by cranes in their flight.

Stage-Dances are treated of under the head Ballet.

Country-Dance, commonly so written, and hence seeming to imply a rustic way of dancing borrowed from country people or peasants, is, however, merely a corruption of the French *Contre-danse*, where a number of persons placed opposite each other begin a figure.

Rope-Dancer (*schœnobates*). See Acrobates.

Dancing-Girls are commonly met with all over the East. Such are the Almé of Egypt, and the Bayaderes of India. See Alme.

DANCETTE, a term applied to the indented or zigzag moulding peculiar to Norman architecture.

DANDELION, *Leontodon Taraxacum*. See Botany, vol. v., p. 197.

DANDINI, the name of a family of Florentine painters: Cesare (1595–1658); Vincenzio (1607–1675); and Pietro (1646–1712). Of these the last was a successful imitator of Titian, Tintoretto, and Paul Veronese. His principal works are at Florence.

DANDOLO, Enrico, a celebrated doge of Venice, elected to that office in 1192, in his old age; yet in 1201, though nearly blind, Dandolo joined in the crusade undertaken to restore Alexius to the imperial throne. With his own hands the aged hero planted the standard of St Mark on the ramparts in the first assault of Constantinople in 1203; and was present at the storming of the city in the following year. He had the glory of refusing the imperial crown, which was offered to him by the Latins, although he afterwards accepted the sovereignty of Roumelia. He died at Constantinople in 1205, and was buried in the church of St Sophia.

DANEGELT (*Dane* and *gelt, money*), an annual tax (originally of one shilling, and afterwards of two) imposed on the Anglo-Saxons for every hide of land throughout the English realm, church-lands excepted, to maintain forces to oppose the Danes, or to furnish tribute to procure peace.

Danegelt was first imposed as a standing yearly tax under King Ethelred, A.D. 991. Edward the Confessor remitted this tax, but William I. and II. resumed it occasionally. In the reign of Henry I. it was accounted among the king's standing revenues; but Stephen, on his coronation-day, abrogated it for ever. Church-lands were exempted from the *danegelt* because, as is set forth in an ancient Saxon law, the people of England placed more confidence in the prayers of the church than in any military defence.

DANET, Peter, editor of the Delphin Phædrus, was abbot of St Nicholas, Verdun, in 1674, and died at Paris in 1709. He published also a Latin and French dictionary.

Daniel.

DANIEL (*i. e. judge of God*), a celebrated prophet in the Chaldæan and Persian period. He was descended from one of the highest families in Judah, if not even of royal blood, and Jerusalem was probably his birth-place.

We find him at the age of twelve or sixteen years already in Babylon, whither he had been carried together with three other Hebrew youths of rank, Ananiah, Mishael, and Azariah, at the first deportation of the people of Judah in the fourth year of Jehoiakim. Along with his companions he was obliged to enter the service of the Babylonian court, on which occasion he received the Chaldean name of *Belteshazzar*. In his new career, Daniel, besides his education in oriental etiquette, was especially instructed "in the writing and speaking Chaldæan" (Dan. i. 4); and at an early period acquired renown for high wisdom, piety, and strict observance of the Mosaic law. More especially his refusal to partake of unclean food, and to participate in the idolatrous ceremonies attendant on the heathen banquets, was crowned with the Divine blessing, and had the most splendid results.

After the lapse of three years, Daniel was attached to the court of Nebuchadnezzar, where, by the Divine aid having interpreted a dream of that prince, he rose into high favour with the king, and was entrusted with two important offices—the governorship of the province of Babylon, and the head-inspectorship of the sacerdotal caste.

Considerably later in the reign of Nebuchadnezzar we find Daniel interpreting another dream of the king's, to the effect that, in punishment of his pride, he was to lose, for a time, his throne, but to be again restored to it after his humiliation had been completed (Dan. iv.) Here he displays not only the most touching anxiety, love, loyalty, and concern for his princely benefactor, but also the energy and solemnity becoming his position, pointing out with vigour and power the only course left for the monarch to pursue for his peace and welfare.

Under the successors of Nebuchadnezzar, Daniel was removed from his high posts, and speedily forgotten in some insignificant situation.

We thus lose sight of him until the first and third year of king Belshazzar, generally understood to have been Nebonnedus the last king of Babylon, but who was, more probably, the son and successor of Nebuchadnezzar, usually called Evil-Merodach, though passing in Daniel by his Chaldæan title and rank. After a reign of two years, this monarch was assassinated by his brother-in-law Neriglissar. Shortly before this event Daniel was again restored to the royal favour, in consequence of being able to read and solve the meaning of a sentence miraculously written on the walls of his banquet-room. During his reign, Daniel was comforted by two remarkable visions, which disclosed to him the ultimate fate of the most powerful empires of the world, with their relations to the kingdom of God, and its great consummation.

After the conquest of Babylon by the united powers of Media and Persia, Daniel busied himself under the short reign (two years) of Darius the Mede or Cyaxares II., with the affairs of his people and their possible return from exile, the term of which was fast approaching, according to the prophecies of Jeremiah. Occupying, as he did, one of the highest posts of honour in the state, the strictness with which he fulfilled his official duties roused the envy and jealousy of his colleagues, who induced the king to issue a decree abolishing for a time the usual hours of prayer. For his disobedience the prophet was thrown into a den of lions, but was miraculously delivered, and raised to the highest posts of honour under Darius and Cyrus (Dan. vi.)

He had at last the happiness to behold his people restored to their own land; but his advanced age would not allow him to be among those who returned to Palestine.

In the third year of Cyrus, he had a series of visions de-

Daniel ‖ Dannecker.

tailing the future history and sufferings of his nation, to the crucifixion of Christ. Of the manner of his death we have no reliable accounts.

DANIEL, *Gabriel*, a learned French historian, born at Rouen in 1649. He early entered the order of the Jesuits, and at his death in 1728 he was superior of the house of that order in Paris. He is best known by his *Histoire de France depuis l'Etablissement de la Monarchie Françoise*; and his *Entretiens de Cléanthe et d'Eudoxe sur les Lettres Provinciales*, in which he attempted an elaborate reply to the brilliant sallies of Pascal. His *Histoire de la Milice Françoise* contains an account of the French military establishment till the time of Louis XIV.

DANIEL, *John Frederick*, was born in London in 1790, and was bred to be a sugar-refiner. But having become a pupil of Mr Brande very early in life, he imbibed a strong relish for scientific investigations; and in 1814 became a member of the Royal Society. In 1817 he married the daughter of Sir William Rule, surveyor of the navy; and he now dedicated himself to science. In 1820 he published the description of his very elegant hygrometer, founded on the principle of ascertaining the dew-point by a delicate thermometer, in a very portable apparatus. Three years after this he gave to the world his valuable *Meteorological Essays*, a work that has gone through three large editions. In 1824 appeared his *Essay on Artificial Climate*, especially as it affects vegetation, a work rewarded by the Horticultural Society. In 1821 he became professor of chemistry in King's College, London, and now devoted himself assiduously to the study of voltaic electricity, its connection with chemical phenomena, and the improvement of voltaic apparatus. His *Introduction to Chemical Philosophy* appeared in 1839, and a second edition in 1841; in which year the University of Oxford conferred on him the honorary degree of D.C.L. In this work the doctrine of molecular forces is very ably treated. He was for several years foreign secretary to the Royal Society. This ingenious philosopher died in his lecture-room, March 13, 1845. (T.S.T.)

DANIEL, *Samuel*, an English poet and historian, was born near Taunton, Somersetshire, in 1562, and educated at Oxford; but leaving that university without a degree, he applied himself to literary pursuits. He resided for some time with the family of the Earl of Pembroke, and was afterwards tutor to Lady Anne Clifford. On the death of Spenser, he was created poet-laureate to Queen Elizabeth. During the reign of James he was appointed gentleman extraordinary, and afterwards one of the grooms of the privy chamber to the queen consort, who took great delight in his conversation and writings. Daniel died in October 1619. His works, which are numerous, consist mostly of dramatic pieces and poems. Of these the principal is a series of poems from the wars of the Roses. Though soft and pleasing in details, they are generally verbose and languid. His language is pure, and his reflections are just; but the thoughts are too abstract, and lack power to move the imagination or the heart.

DANKALI, certain tribes of Abyssinia. See ADAL.

DANNECKER, JOHANN HEINRICH, a celebrated modern sculptor, was born at Stuttgart, October 15, 1758, of parents in humble circumstances. While still an infant, he exhibited a love for imitative art in delineations of men and flowers, traced on a scrap of paper, or on a smooth stone. In 1771, he was by the duke entered as a pupil in the school at Ludwigsburg, for the children of the retainers of the court of Wurtemburg, where his talents were speedily developed; and he gained the prize for a model of *Milo destroyed by the Lion*, which led the way to his appointment as sculptor to the duke, with a salary of 800 florins. In 1781 he was sent to Paris, and studied in the school of Pajone for four years. He then accompanied Scheffæuer to Rome, where he enjoyed the friendship of Canova, Herder, and Göthe. He remained at Rome until the troubles of Italy in 1790, and there executed his first works in marble. These chiefly consist of busts, in which he has been excelled by none of his contemporaries: but his Bacchus and Ceres, now at Stuttgart, his Ariadne reclining on a leopard, and several of his other groups and statues, proclaim him a master in the highest walks of sculpture. His colossal bust of Schiller, the busts of Lavater and of Glück, as well as of several princes of the family of Würtemburg, are considered among his finest works. He was appointed, soon after his return home, professor of sculpture in the academy of Würtemburg; where he died December 8, 1841. (T. S. T.)

Dante.

DANTE ALIGHIERI, the most illustrious of the Italian poets, was born at Florence in May 1265, and was descended of an ancient and honourable family. The name he received at his birth was Durante, which was abbreviated into Dante, in which form it has descended to posterity. Boccacio, who lived at the same period, has left a very curious and entertaining treatise on the life, studies, and manners of this extraordinary poet, whom he regarded as his master, and for whose memory he cherished the highest veneration. This biographer relates, that Dante, before he was nine years old, conceived a passion for the lady whom he has immortalized in his singular poem. Her age was nearly the same as his own, and her name was Beatrice, the daughter of Folco Portinari, a noble citizen of Florence. The passion of Dante, however, like that of his successor Petrarch, seems to have been of the Platonic kind, if we may judge from the account he has given of it in one of his early productions in prose, entitled *Vita Nuova*, in which he mentions both the origin of his affection and the death of his mistress, who, according to Boccacio, died at the age of twenty-four. The same author asserts that Dante, in consequence of this event, fell into a deep melancholy, from which his friends endeavoured to rouse him, by persuading him to marry. After some time he followed their advice, and repented it; for he unfortunately made choice of a lady named Gemma, of the house of Donati, who bore a considerable resemblance to Xantippe; and the poet, not possessing the patience of Socrates, separated himself from her with such vehement expressions of dislike, that he never afterwards admitted her to his presence, though she had borne him several children. In the early part of his life he acquired some credit in a military character, having distinguished himself by his bravery in an action where the Florentines obtained a signal victory over the citizens of Arezzo. But he became still more eminent by the acquisition of civil honours; and at the age of twenty-five he rose to be one of the chief magistrates of Florence, when that dignity was conferred by the suffrages of the people. From this exaltation, however, the poet himself dated his principal misfortunes, as appears by the fragment of a letter quoted by Leonardo Bruni, one of his early biographers, in which Dante speaks of his political failure with that liberal frankness which integrity inspires. Italy was at that time distracted by the contending factions of the Gibelines and the Guelfs; and the latter, with whom Dante took an active part, were again divided into the Blacks and the Whites. Dante, as Gravina informs us, exerted all his influence to unite these inferior parties; but his efforts proved ineffectual, and he had the misfortune to be unjustly persecuted by those of his own faction. A powerful citizen of Florence, named Corso Donati, had taken measures to terminate these intestine broils, by introducing Charles of Valois, brother of Philip the Fair, king of France. But Dante, with great vehemence, opposed this disgraceful project, and obtained the banishment of Donati and his partizans. The exiles, however, applied to the pope, Boniface VIII. and by his assistance succeeded in their design. Charles of Valois entered Florence in

Dante. triumph, and those who had opposed his admission were banished in their turn. Dante had been dispatched to Rome as the ambassador of his party, and was upon his return when he received intelligence of the revolution in his native city. His enemies, availing themselves of his absence, had procured an iniquitous sentence against him, by which he was condemned to banishment, and his possessions were confiscated. His two enthusiastic biographers, Boccacio and Manetti, express the warmest indignation against the injustice of his country. Dante, on receiving this intelligence, took refuge in Sienna, and afterwards in Arezzo, where many of his party had assembled. An attempt was then made to surprise the city of Florence by a small army which Dante is supposed to have attended; but the design miscarried, and the poet is conjectured to have wandered throughout various parts of Italy, until he found a patron in Candella Scala, prince of Verona, whom he has celebrated in his poem. The high spirit of Dante was ill suited to courtly dependence, and he is said to have lost the favour of his Veronese patron by the rough frankness of his manner and bearing. From Verona, according to Manetti, he retired to France; and Boccacio affirms that he disputed in the theological schools of Paris with great reputation. Bayle questions his visiting Paris at this period of his life, and thinks it improbable, that a man who had been one of the chief magistrates of Florence should have condescended to engage in the public disputations of the Parisian theologists. But the spirit both of Dante and the times in which he lived sufficiently accounts for this exercise of his talents; and his residence in France at the period in question is confirmed by Boccacio, in his life of the poet, which Bayle seems to have had no opportunity of consulting.

The election of Henry count of Luxemburg to the empire in November 1308, afforded Dante a prospect of being restored to his native city, as he had attached himself to the interest of the new emperor, in whose service he is supposed to have written his Latin treatise *De Monarchia*, in which he asserted the rights of the empire against the encroachments of the papacy. In the year 1311 he instigated Henry to lay siege to Florence, an enterprise in which he did not appear in person, from motives of respect towards his native city. But the emperor was repulsed by the Florentines; and his death, which happened in the following year, deprived Dante of all hopes of ever being re-established in Florence. After this disappointment, he is supposed to have passed some years in roving about Italy in a state of poverty and distress, until he found an honourable establishment at Ravenna, under the protection of Guido Novello da Polenta, lord of that city, who received the illustrious exile with the most endearing liberality, continued to protect him during the few remaining years of his life, and extended his munificence even to the ashes of the poet.

Eloquence was one of the many talents which Dante possessed in an eminent degree. On this account he is said to have been employed, in the course of his life, on fourteen different embassies, and to have succeeded in most of them. His patron Guido having occasion to try his abilities in a service of this nature, dispatched him as his ambassador to negociate a peace with the Venetians, who were preparing for hostilities against Ravenna. But Manetti asserts that he was unable to procure a public audience at Venice, and returned to Ravenna by land, from apprehension of the Venetian fleet; when the fatigue of his journey, and the mortification of having failed in his attempt to preserve his generous patron from the impending danger, threw him into a fever, which terminated in death on the 14th of September 1321. He died, however, in the palace of his friend; and the generous Guido paid the most tender regard to his memory. This munificent patron commanded the body to be adorned with poetical ornaments, and, after being carried on a bier through the streets of Ravenna by the most illustrious citizens, to be deposited in a marble sarcophagus. He himself pronounced the funeral oration, and expressed his design of erecting a splendid monument in honour of the deceased; a design which his subsequent misfortunes rendered him unable to accomplish. At his request many epitaphs were written on the poet, the best of which were by Giovanni del Virgilio of Bologna, a celebrated author of that time, and the intimate friend of Dante. Boccacio then cites a few Latin verses, not worth transcribing, six of which are quoted by Bayle, on the authority of Paul Jovius, as the composition of Dante himself. In 1483 Bernardo Bembo, the father of the celebrated cardinal, raised a handsome monument over the neglected ashes of the bard. Dante.

Before this period the Florentines had vainly endeavoured to obtain from the city of Ravenna the bones of their great poet. In the age of Leo X. they made a second attempt, by a solemn application to the pope for that purpose; and Michel Angelo, an enthusiastic admirer of Dante, very liberally offered to execute a magnificent monument to the poet. But the hopes of the Florentines were again disappointed. The particulars of their singular petition may be found in the notes of Codivi's Life of Michel Angelo.

At what time, and in what place, he executed the great and singular work which has rendered him immortal, his numerous commentators have been unable to determine. Boccacio asserts that he began it in his thirty-fifth year, and had finished seven cantos of his *Inferno* before his exile; and that in the plunder of his house on that occasion the beginning of his poem was fortunately preserved, but remained for some time neglected, till its merit being accidentally discovered by an intelligent poet named Dino, it was sent to the Marquis Marcello Malespina, an Italian nobleman, by whom Dante was then protected. The marquis restored these papers to the poet, and entreated him to proceed with a work which opened in so promising a manner. To this incident we are probably indebted for the poem of Dante, which he must have continued under all the disadvantages of an unfortunate and agitated life. It does not appear at what time he completed it; perhaps before he quitted Verona, as he dedicated the *Paradise* to his Veronese patron. The critics have variously accounted for his having called his poem *Commedia*. He gave it the title, said one of his sons, because it opens with distress and closes with felicity. The very high estimation in which this production was held by his country appears from a singular institution. The republic of Florence, in the year 1373, assigned a public salary to a person appointed to read lectures on the poem of Dante, and Boccacio was the first person engaged in this office; but his death happening about two years after his appointment, his comments extended only to the seventeen first cantos of the *Inferno*. The critical dissertations which have been written on Dante are almost as numerous as those to which Homer himself has given birth; the Italian, like the Grecian bard, having been the subject of the highest panegyric and of the grossest invective.

The most ancient Italian commentary extant on the *Divina Commedia* is that of Boccacio, which, however, was not printed until 1724, at Naples. Specimens of other commentaries will be found in the first volume of Muratori's *Antiquitates Italicæ*. The first edition of the text without commentaries is that of 1472, in folio, without the name of any place, but printed at Foligno under the title of *La Commedia di Dante Alighieri, delle pene e punizioni de' Vizj, e premj delle Virtù.* The same year

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another appeared at Mantua, in folio, bearing the Latin title of *Dantis Capitula, Italice;* but the most valuable of all these editions is that of Naples, 1477, in folio, which is now very scarce and high priced. The first of the old editions with commentaries is that of Milan, 1478, in folio, entitled *Dantis Comœdia cum Commentariis*, by Martin Paul Nidobeato de Navarre, printed, the text in beautiful characters, and the commentaries in Gothic. This edition is highly esteemed on account of the purity of the text, and the excellent lessons which it affords. The principal editions accompanied with commentaries are those of Florence, 1481, folio; Venice, 1491, folio; Venice, 1554, in 4to; Lyons, 1547, in 16to; Venice, 1568, in 4to; Padua, 1727, in 3 vols. 8vo; Venice, 1739, in 3 vols. 8vo; Verona, 1749; and Venice, 1757, 1758, 3 vols. large 4to. The most esteemed editions of the text alone since the fifteenth century, are those of Venice, Aldus, 1502, in 8vo; Aldus and Andrea d'Assola, 1515, in 8vo; Florence, Juntes, 1506, in 8vo; Florence, 1595, in 8vo, being the Della-Cruscan edition, which was reprinted at Naples in 1716, in 12mo; Paris, Prault, 1768, in 2 vols. 12mo; Parma, Bodoni, 1796, in 3 vols. 4to; Pisa, 1804, in 3 vols. folio; Milan, Mussi, 1809, in 3 vols. large atlas folio. The best French translation of Dante's works is that of Artaud, published at Paris in 1811, 1812, 1813. In English there are two translations, both excellent, the one by Carey and the other by Wright. The *Inferno* has given rise to a good deal of speculation, of which some account will be found in the *Edinburgh Review*, vol. lv. The lyric productions or *Rime* of Dante, though inferior to his great poem, are not unworthy of him. They are to be found in the Venetian editions of his works, published by Pasquali in 1741 and by Zatta in 1758. These two editions also contain the prose works of Dante, the most interesting of which is his *Vita Nuova*. The *Convivio di Dante* is a commentary in prose on three of his Canzoni. The treatise *De Monarchia*, written in Latin, had for its object to support the rights of the Emperor Henry VII. by whose means Dante hoped to be restored to his country in spite of the pope, who had been the cause of his disgrace and exile; and though the style is devoid of elegance, it nevertheless displays considerable vigour. In the treatise *De Vulgari Eloquentia*, also written in Latin, Dante proposed to examine the state of the Italian language about a century after its origin, to indicate the idioms formed nearly at the same time in different parts of Italy, which ought to prevail, and to point out the different species of composition in which the language had been employed with success, as well as the authors who had most distinguished themselves by their writings in that language. The edition of Zatta above mentioned also contains paraphrases of the seven penitential psalms, of the *Credo*, the *Pater Noster*, and the *Ave Maria*, pieces which have nothing in common with his great poem, except the form of the verses and the interlacement of the rhymes.

DANTON, George-Jacques, born at Arcis-sur-Aube on the 28th October 1759, was, at the epoch of the revolution, advocate to the council of the king, and one of the most terrible enemies of the authority to which a little before he appeared to have attached his fortune. Nature seems to have fitted this man for the part which he chose for himself. In appearance, in figure, and in voice, he might well have passed for an incarnate impersonation of a malignant but mighty fiend. Of colossal stature and extraordinary strength, with a countenance deeply marked by the small-pox, a flat and wry nose, protruding lips, and little sparkling eyes, he had an ardent and audacious look; whilst his rude and powerful voice made the public halls resound with its harsh thunder, and his diction, full of gigantesque figures and violent apostrophes, terrified those whom it failed to overpower. Mirabeau, who wanted persons of this description, in order to frighten the court and produce the first shocks of the revolution, employed Danton, as a sort of forge-blast, to inflame the popular passions. Ever since the year 1789, he had been the principal chief of the Parisian populace, in fact a true fish-market king. When the capital had been divided into districts, he was chosen to preside over that of the Cordeliers; and this portion of Paris immediately became the rendezvous of the most furious revolutionists;—in its assemblies all authorities were attacked, and all principles perverted. But this local anarchy did by no means satisfy the wishes of Danton. For, as the tribune of the district was accessible to all the citizens, there occasionally appeared in it reasonable men, who forcibly combated his extravagances; and hence, in order to ensure the development of his system, he required auxiliaries disposed rather to go beyond than to fall short of his intentions. With this view he established the club of the Cordeliers, compared to which, that of the Jacobins was a collection of moderate and rational persons. Hitherto the district had only attacked monarchical institutions; but the new club had for its object to subvert, even to its foundations, the whole fabric of society. About the same time Danton took under his protection the infamous Marat, whose journal corrupted the populace, and stimulated them to the commission of every kind of excess; he withdrew that diseased miscreant from the agents of the police, afforded him an asylum, and employed him as often as he had occasion for any seditious movement, or for spreading some denunciation necessary to his designs. But it was not only in district assemblies nor in the clubs that Danton domineered; he was to be seen in the streets and in the public places, in the midst of tumultuous assemblages, haranguing the multitude, often with vehemence, and sometimes with gaiety. He had not, like many others, declared for the revolution on speculative grounds. His views were far less elevated. Devoted to sensual indulgences, he belonged to that class of intriguers who seek to bring on great civil commotions in order thereby to arrive at fortune; and sometimes he made no mystery of his intentions in this respect.

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But it was not till the flight and return of Louis XVI. from Varennes that he began to make himself generally feared. On that occasion he put himself at the head of the assemblage in the Champ-de-Mars, which demanded the trial and punishment of the king. This first essay, however, proved unsuccessful; Danton was ordered to be arrested; and being at the same time pursued for debt, he durst not appear openly at the elections. But he had nevertheless the audacity to go to canvass for votes; and when an officer named Damien attempted to seize him, the poor man was himself arrested for having violated the national sovereignty. The populace, who watched over the safety of their chiefs, wished to massacre the officer; and Danton was named deputy attorney-general of the commune of Paris, in the face of the laws, and even of the constituent assembly itself, to which this nomination was a manifest outrage. At length the constitutional advisers of Louis XVI. seeing that they could not overpower Danton, or rather that they durst not attempt it, resolved to purchase him; but the persons charged with the negociation having estimated his services at too low a price, were consequently treated with disdain; he haughtily rejected their propositions, and had the incredible audacity, in one of his discourses to the commune, to signify, that if the terms proposed had not been accepted, it was only because they were below his pretensions. In order, however, to silence some rumours which were circulated against him, he now showed himself fiercer than ever against royalty, and contributed more than any other individual to the revolution

Danton. of the tenth of August. The real republicans still confined themselves to mere declamations; they were undecided what course they should follow, and they dared not push matters to extremities. It was Danton who struck the decisive blow, after having prepared all the means necessary to render it effectual. Some days before the catastrophe, Pétion, major of Paris, had caused to be lodged in the house of the Cordeliers, and recommended to its benevolence, that horde of ruffians who, under the name of the Marseillais, had traversed France, to the number of six hundred, declaring openly, wherever they went, that they were going to Paris to murder the king. Danton received them, entertained them, gave them the necessary instructions, provided them with suitable auxiliaries, and arranged with them the attack of the Tuilleries; and it was, in fact, by means of these vagabonds that the oldest and most powerful monarchy of Europe was, at a moment of weakness and terror, overthrown.

After this event, Danton was appointed minister of justice by the legislative assembly, which had now lost all authority, and decreed whatever he required of it. Even Robespierre, afterwards so powerful, durst not as yet venture to show himself; and Danton stood alone on the field of battle, surrounded only by a small number of friends. He began by causing the barriers to be shut, and decreeing domiciliary visits in order to discover those who were known to be attached to the party of the court. These searches were made in the middle of the night, and a crowd of persons, chiefly belonging to the most distinguished classes, were hurried to prison, where a dreadful fate awaited them. An extraordinary tribunal was instituted, and the first victims were sent to the scaffold; but, formidable as were the men who composed it, this tribunal still proceeded too slowly for the taste of the popular leaders, who required numerous executions, and proceedings more rapid and terrible. On the morning of the 2d September 1792, intelligence arrived that the Prussians, commanded by the Duke of Brunswick, and having with them two brothers of the king, and a great number of emigrants, had entered the territory of France and taken possession of Longwy and Verdun. This news threw the capital into the most violent agitation. Danton immediately repaired to the committee of the commune, and, having convoked the committee of public safety, whose members all belonged to the club of the Cordeliers, had a long conference with them. The prisoners were then deprived of all instruments and moveables which might have been used by them in their own defence; whilst those detained for debt, and some other persons who were fortunate enough to interest the popular leaders, were released. This being done, the terrible minister of justice proceeded to the bar of the national assembly, gave an account of the progress of the enemy, and required that a general arming should be instantly decreed, that the tocsin should be sounded, and that all citizens able to bear arms should be summoned to the Champ-de-Mars, to be there enrolled and formed into military cohorts, to march against the tyrants and their satellites. The deputy Vergniaud, in a vehement harangue, enumerated the menaces of the Duke of Brunswick, and converted the demand of the minister into a motion, which was unanimously agreed to.

But scarcely had this decree passed, when alarm and terror spread all over the capital. At the lugubrious sound of the tocsin, and the hollow roll of the générale, the furious multitude shouted "to arms," insulting and menacing all who did not participate in their frenzy; whilst the emissaries of the clubs and of the committee of the commune declared loudly, that before marching against the enemy, it was necessary to exterminate the "scélérats" of the interior, and particularly the prisoners seized in the course of the domiciliary visits. These unhappy men, foreseeing their fate, supplicated the individual charged with the superintendence of the prisons to save their lives; and, to his eternal honour, that person courageously undertook to do his utmost in order to provide for their safety. He repaired to the hotel where the ministers were assembled, and first addressed himself to Danton, giving an account of the movements which were observed around the prisons, with the alarm of the prisoners, and representing to the colossal terrorist that it particularly belonged to him, as minister of justice, to afford them protection. Danton, however, repulsed the application in language worthy of a revolutionary Moloch. With a bellowing tone of voice, and a gesture appropriated to the expression, he exclaimed, in words which we shall not translate, "Je me f... bien des prisonniers; qu'ils deviennent ce qui pouront;" and went away grinning a diabolical smile at his own sanguinary brutality. It was equally by his orders or with his approbation that the persons who had been sent to the high court of Orleans were brought back to Versailles, and there massacred. It was under his countersign that the odious circular issued by the committee of the commune of Paris was sent into the departments to invite the "patriots" to repeat in the provinces the executions of September in the capital. These dreadful massacres produced the effect which their authors had expected from them. Terror froze every heart. In the greater number of the departments, as well as in Paris, the enemies of the royal authority alone obtained suffrages at the elections; and all public functions were performed by the most furious of this class. Danton.

Danton quitted the ministry of justice in order to discharge the duties of a deputy to the convention, to which he had been called by the electors of Paris, hoping to exercise there the same ascendency as he had done over the clubs and the people of the capital; but he carried along with him a double source of discord and enmity, namely, his crimes and his success. Although he was in fact the real founder of the republic, yet the true republicans were necessarily his adversaries. This class of revolutionists, amongst whom were several who to fine talents united elevated sentiments, did not choose that the republic, which was the object of their wishes, should from its very birth be attainted by crimes so horrible and so monstrous as the executions of September; and they warmly demanded the punishment of those who had committed them, or had been accessary to their commisslon. On the other hand, the dark jealousy of Robespierre observed with uneasiness that Danton divided with him the favour of the populace, and possessed at least equal influence in the convention; and from this time accordingly he meditated Danton's destruction.

Although at this time much more criminal than his rival, Danton was nevertheless of a disposition less exclusively wicked. He was one of those proud beings who, conceiving themselves called to regulate the destinies of states, think that all crimes become lawful actions, provided they tend to ensure the success of grand designs; but he would not have committed useless crimes, and it may be said of him that he ceased to be criminal from the moment when he had no longer any pretension to figure as a statesman. Even at the first sitting of the convention, he wished to re-establish order and to inspire confidence, by demanding that all property should be guaranteed by a solemn decree. More tolerant than other persons who had not to reproach themselves with the same excesses, he said he was afraid of rendering liberty hateful by too rigorous an application of what he was pleased to call "philosophical principles." On several occasions he even took upon himself the defence of religious worship; and it is not

Danton. altogether improbable that this terrible man would have become prudent and moderate, had he not been forced to repel the attacks directed against his party. Roland, his colleague in the ministry, hoping to render himself agreeable to the people by proving that he had not shared in the peculations which had recently taken place, gave an account of his conduct in office, and caused placards containing his official exposition to be affixed to the corners of the streets. Danton, on the other hand, being unable to parade so much honesty, pretended that the ministers were only responsible as a whole, and could not render an account except collectively. This doctrine prevailed, and Roland soon after put an end to his life.

Danton voted for the death of Louis XVI.; but it was not apparently a judgment which he wished to pronounce. In answer to one of the familiars who, in conversation, represented to him that the convention had done wrong in putting the king on his trial, "You are right," said Danton; "therefore we will not judge him, we'll kill him." The new republic was already tormented with the most violent discords, which, notwithstanding all his audacity, occasioned Danton great uneasiness. He foresaw inevitable catastrophes, and dreaded that he and his associates would not be able much longer to command events. "The metal boils," said he; "but the statue of liberty is not yet cast. If you do not watch the furnace, you will be all burned."

On his return from Belgium, whither he had been sent with Lacroix to superintend the armies and revolutionize the country, he was warmly accused of peculation, particularly by Marat. He treated Marat with contempt, and silenced his accusers; but he could never efface the impression which this denunciation had made. After the check which the armies experienced at Aix-la-Chapelle, Danton returned to Paris to give an account of the state of things, and to prepare the necessary means of defence. These were terror and levies *en masse*. In the clubs and in the sectional assemblies, the cry to arms was continually resounded; and to supply the place of the massacres of September, which being too complete could not be renewed, Danton caused Chaumette, then one of his partisans, to demand the formation of a revolutionary tribunal. Towards the close of the struggle which terminated in the events of the 31st May 1793, Danton hesitated what part to take. The popularity of Robespierre disturbed him; but the declared determination of the moderate republicans to bring the authors of the massacres of September to punishment did not occasion him less alarm. At the moment of the crisis, M. de Meilhan, who belonged to the latter party, endeavoured to draw him over by flattering his pride. Danton listened to him with attention, looked for an instant undecided, then, reflecting on the danger to which he would expose himself, and the influence which he would lose by a change of system, he merely replied, with reference to the republicans, "They have not confidence;" and entered the hall of the convention, where, mingling with those who were rushing blindly into a new revolution, he invoked without success the vengeance of the laws against Henriot, who had outraged the convention, and appeared to desire its dissolution. After the 31st of May, Danton demanded that the committee of public safety should be erected into a provisional government; and, in order to prevent all suspicion, he refused to become a member of that body.

Less verbose than Robespierre in his popular cajoleries, Danton nevertheless sought to attach the multitude by means which must have appeared to him much more effectual. He attacked all the laws of the maximum, and especially the tax on grain; and as the sectional assemblies of Paris had been deserted, terror having kept away some, and the necessity of labour others, he caused a decree to be passed, ordaining that each citizen who attended these assemblies should receive an indemnity of forty sous. From this time they were inundated by crowds of the lowest populace, prepared to believe whatever was told them, and to do whatever they were desired. One of their first acts was to demand that Danton should be added to the committee of public safety; and although he affected to refuse, he ended by consenting to form one of that body. In the month of November 1793, he attacked the extravagant festivals of Reason, which the schismatic Cordeliers dared to celebrate, even in the very bosom of the convention. "When shall we cause these mummeries to cease?" said he. "We have not wished to destroy superstition in order to establish atheism." Robespierre joined him in overthrowing a faction which threatened both alike; and soon afterwards the principal founders of the worship of reason parted with their heads on the scaffold. Danton.

But this understanding could not be of long duration. Robespierre was not one of those men who hate in vain. Camille Desmoulins, the friend of Danton, had ventured to compare the measures then pursued with those which had been employed by Tiberius, and to exhibit proofs in a pamphlet entitled *Le Vieux Cordelier*, wherein he published various passages from Tacitus, which certainly went to show that a perfect similitude existed between the decrees of the convention and those of the Roman emperor. Robespierre rebuked him sharply, and abandoned him to the vengeance of the chiefs of his party, whom he had turned into ridicule. Danton took the part of Desmoulins, and counselled him not to be alarmed at the severity of the reproof administered by Robespierre, who could no longer tolerate any opposition to his will. He also wished to defend Fabre d'Eglantine, his intimate adviser, who had been accused of malversation; but he was unable to save his brother peculator, and ought to have learned by this check that he himself would soon be attacked. In fact the struggle now commenced between these redoubted rivals; and those who dreaded the consequences attempted to bring them together. They met at dinner, but parted in greater alienation than ever. "It is right," said Danton, addressing Robespierre, "that the royalists should be put down; but the innocent ought not to be confounded with the guilty, and we should only strike when the blow will be useful to the republic." "Eh! who has told you," replied Robespierre, knitting his eye-brows fiercely, "that any innocent man has perished?" "I must show myself," said Danton, in retiring; "there is not a moment to be lost." Nevertheless, instead of acting he hesitated. Westermann, his principal agent, pressed him to strike, and promised assistance. Danton merely answered, "He dares not." But before braving him, Robespierre had taken his measures, and the giant who had overturned the throne was arrested in bed on the night of the 31st March 1794, without offering the least resistance. Lacroix, his friend, was arrested the same night, and both were conducted to the Luxembourg. Danton, on entering, politely saluted the numerous *detenus* who had crowded around in order to see him. "Gentlemen," said he, "I had hopes of soon bringing about your liberation; but here I am myself among you; and I no longer know how all this will end." Some deputies wished to remonstrate against this arrest; but Robespierre appeared in the tribune, and having indignantly asked who they were that dared to take the part of the conspirator, and the immoral man with whose crimes the people were about to be made acquainted, they all remained silent. Danton and Lacroix were confined in separate cells, but sufficiently near to be able to converse, and to be overheard by the other *detenus*. Lacroix threw out some reproaches against Danton, accusing him of indolence and carelessness. "It is this," said he, "which has ruined

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us." They then conversed gaily on the fate which awaited them, and which they appeared to deride. When brought before the revolutionary tribunal, four days after their arrest, they scarcely deigned to answer the interrogatories put to them by the president, and during the discussion they amused themselves with rolling pellets of bread, and darting them at the noses of the judges and the jury. Danton, whilst occupied in forming these missiles, merely observed, "*Mon individu sera bientôt dans le néant; mais mon nom est déjà dans la postérité.*" The tribunal, terrified at their audacity, consulted the committees of government on the subject, and the latter gave orders to put the prisoners *hors des debats*, that is, to condemn them at once, without further hearing. This decision threw Danton into an inexpressible rage, and he launched out into imprecations against those by whom he had been proscribed. "It was I," cried he on entering the chamber of the condemned, "it was I who caused this infamous tribunal to be instituted; I ask pardon of God and man for having done so. I leave every thing," added he, "in a frightful hodge-podge; no one understands any thing of government: besides, they are all brothers of Cain; Brissot would have caused me to be guillotined as well as Robespierre." The sight of the apparatus of punishment did not in the slightest degree discompose him; he mounted the fatal cart with unshaken firmness; his head was high, and his looks full of pride; and he seemed still to command the populace. Nevertheless, before submitting himself to the executioner, he seemed for an instant to be softened, if not overcome. "Oh, my well-beloved! oh, my wife," cried he, "I shall never see you more." Then rousing him abruptly, he shouted, "Be thyself, Danton; no weakness;" after which he rapidly ascended the scaffold, and said to the executioner, "You will show my head to the people; it is worth the trouble." He died on the 5th April 1794, at the age of thirty-five. (*Biographie Universelle.*) (J. B—E.)

DANTZIC (in German, DANZIG), the principal port and commercial city of Prussia, province of Prussia Proper, and capital of a cognominal government, lies on the left bank of the Vistula, about four miles from its mouth. N. Lat. 54. 20.; E. Long. 18. 38. Population in 1849, including military, 63,917; of whom 2369 were Jews, 13,339 Catholics, and 47,723 Protestants. Ramparts, bastions, and wet ditches, which have been vastly strengthened since the war, and gigantic works for laying the country under water, have done what fortifications can to make Dantzic impregnable.

Its modern name, according to Malte-Brun, is derived from Dansk Vik, which means Danish port or gulf, a Danish colony having at one time established itself in this advantageous position. In consequence of a war against Waldemar I., king of Denmark, Dantzic, as well as the province in which it is situated, was subjected by turns to the Danes, the Swedes, the Pomeranians and to the Teutonic Knights; but its name (in Polish *Gdansk*, and in Latin *Gedanum*) scarcely appears in history before the tenth century. It was held for a considerable period by the knights of the Teutonic Order, under whom the present cathedral was founded. Upon shaking off their yoke in 1454 it became a free city, and was a principal member of the Hanseatic League. More than one attempt was afterwards made by the Poles to take possession of the city. In repelling these attacks such important aid was rendered by a number of Scotch residents, whose ancestors had settled in the place as weavers, that they were invested with the privileges of freemen, and the district where they resided still bears the name of Schottland.

In 1792 Dantzic, feeling itself pressed on all sides by Prussia, which was continually encroaching, attempted to resist; but being abandoned by Poland it could not sustain the struggle, and in virtue of a convention, signed 8th March 1793, the Prussians took military possession of the town.

Again, during the war between France and Prussia it was besieged and taken by the French under Marshal Lefèbvre in 1807. Danube.

At the peace of Tilsit, Dantzic was placed under the triple protection of France, Russia, and Saxony, and declared a free town with a territory of two leagues beyond. But being in reality completely under the power of France, its independence was a mere name, and its prosperity declined. After the retreat of the French from Moscow, in February 1814, Dantzic again fell under the power of Prussia, and is now incorporated with that kingdom.

The city is traversed by the small river Motlau. On approaching it by land, lines of horse-chestnuts on each side of the road give a pleasing appearance to the suburbs in summer, and numerous country houses suggest ideas of citizen comfort and opulence, which, however, are not justified by the appearance of the interior. The town consists of narrow streets, and quaint melancholy-looking dwellings, with few remarkable public buildings except the cathedral church of St Mary, which was finished in 1503, and in which is a celebrated picture of the *Last Judgment*, attributed to Van Eyck. The town-house, arsenal, and exchange, also deserve notice.

There are 29 places of public worship, with several monasteries and convents. Dantzic likewise has a gymnasium and 31 public schools, with a variety of literary, scientific, and charitable institutions.

Dantzic is the seat of the courts of government, a council of admiralty, and a tribunal of commerce. It contains a vast number of distilleries and breweries, and flour-mills, dye-works, sugar refineries, &c. Next to St Petersburg, Dantzic is the most important commercial city in the north of Europe, and is, after Odessa, at the head of all the corn shipping ports of the world. The Vistula, with its important tributaries the Bug, the Narew, &c., give it the command of an extensive internal navigation, rendering it the entrepot for the products of West Prussia, Poland, and part of Lithuania. The quality of the Dantzic wheat is for the most part excellent; the rye is also very superior; but the exports of barley and oats are comparatively inconsiderable. Next to grain, timber is the most important article of export, but the supply is said to be diminishing, and the quality inferior to what it was formerly. The other exports are salt pork, black beer, ashes, linseed, &c. The principal imports are cotton, coffee, coals, herrings, iron and steel ware, lead, sugar, salt, &c. The exports in 1851 amounted to L.1,145,924, and the imports to L.611,486.

The usual depth of water at the river's mouth is from 13 to 14 feet, but in the roads there is good anchorage for ships of any burden. The greater part of the trade is in the hands of foreigners, particularly the English.

(G. Loschin, *Geschichte Danzigs;* Dantzic, 1822. M'Culloch's *Commercial Dictionary*, 1854. Milner, *The Baltic, its Gates, Shores, and Cities*, 1854, &c.)

DANUBE (Ger. *Donau;* Hung. *Duna;* Lat. *Danubius*, and in the lower part of its course, *Ister*), the largest river of Europe next to the Volga, traversing the southern part of Germany, Hungary, and Turkey, and falling into the Black Sea after a course of about 1750 miles. This large river drains a territory of nearly 250,000 square miles. Its basin is formed by the Black Forest, some of the minor Alpine ranges, the Bohemian Forest, and the Carpathian mountains on the north, and by the Alps and the range of the Balkan on the south. The Danube is generally considered to take its rise from the union, at Donaueschingen, of the Brigach and the Brege, two mountain streams which have their sources in the Black Forest. A third stream, originating in a spring in the palace garden of Donaueschingen, and joining the infant river, is, however, by some held to be the true source of the Danube. It flows first N.E. through the kingdom of Würtemburg and part of Bavaria to Ratisbon, where it turns to the S.E., in which direc-

Danube.

tion it flows till it approaches Lintz in Austria. From this town its course is mostly easterly to Hungary, which it enters a little above Presburg. From Presburg it flows S.E. through the lesser Hungarian plain to its confluence with the Raab, whence it runs E. to Waitzen. At Waitzen it turns S., and flows with a slow current and numerous windings through the greater plain of Hungary for nearly 2½ degrees of latitude. After its junction with the Drave it again takes a general S.E. direction to Orsova, where it leaves the Austrian territories. From Orsova, its course is generally S. by E. to Kalafat, thence mostly E. by S. to Sistova; it there takes an E. by N. direction to Rassova, then N. to Galatz, and finally eastward to the Black Sea. Among its numerous tributaries the principal are, on the right the Iller, Lech, Iser, Inn, Ens, Raab, Drave, Save, Morava, Timok, Isker, Vid, and Jantra; and on the left, the Altmühl, Nab, Regen, March, Waag, Gran, Theiss, Temes, Chyl, Aluta, Jalomnitza, Sereth, and Pruth. The Danube communicates with the Rhine by means of the Altmuhl, the Main, and the Ludwigs canal, and with the Elbe by means of the Moldau and other canals. Steam navigation was introduced on the Danube in 1830. The upper course of this river is frozen over all winter, and even in the plain of Hungary from December to March. The breaking up of the ice always causes great anxiety to the inhabitants. If the thaw begins in the upper part of the stream before the ice has given way below, the waters rush down with incredible fury, tossing about large masses of ice in all directions, and frequently doing incalculable damage. When a sudden thaw is apprehended, watchmen are stationed on eminences along the banks of the river, to give notice by firing alarm guns when the ice is broken.

At its source, the Danube is 2850 feet above the level of the sea. Its course lies through an Alpine country to Ulm, where its elevation is 1400 feet. At this town it receives the Iller, and becomes navigable for flat-bottomed boats of 100 tons. From Donauworth to Passau it traverses the Bavarian plain. Leaving this plain, it intersects a second mountainous region till it reaches Vienna. At Passau it is 800 feet above the level of the sea, and at Vienna 450. From Vienna to the mouth of the Drave it flows through an expanse of plain country, broken only in a few places, as at Presburg, Buda, and Waitzen. The following minute account of the lower parts of the Danube is from an excellent article in the *Times* of 29th December 1853.

The general valley of the Danube is naturally divided into four basins by chains of mountains, which successively become detached, extend away to the right and left, then meet and inclose the valley of the Danube in three different places, force the river to change its bed, and to pass over four vast slopes. The third of these great inclosures is formed by the junction of the Veliki-Balkan and the Eastern Carpathians, in the direction of Orsova, the point where the Danube issues from the Austrian dominions, and rolls away on its course to the Ottoman territory. It is at this point that its fourth basin commences, which only terminates in the Black Sea. To the north extend the chain of the Carpathians and the successive heights which rise between the Pruth and the Dneister, and to the south the Veliki and the vast chain of the Balkans. This fourth basin, through which the noble river rolls its huge volume of waters, swelled by many navigable streams, to the Euxine, comprises the whole of Bulgaria on the south, Wallachia and Moldavia on the north, and a portion of Bessarabia. While yet the Danube waters the Hungarian plains its bed is generally regular, deep, without torrents, and is intersected by many islets; its banks are mostly low, and its width in some places from two and a half to three English miles. But when it approaches Orsova, where the Carpathians and the Balkans approach, it becomes completely changed; it struggles through that formidable barrier; flings itself with the fury of a vast torrent through the gigantic walls of granite which close in upon it; it returns on itself, coils and winds, as if in convulsive rage against the rocks and shallows which bar its passage; and where it cannot undermine these adamantine barriers, lifts its waters and dashes in fury over them. Some of these whirlpools and rapids are passed by the hardy natives of the mountains in small boats in certain spots; but the steamers which navigate the stream thus far from Vienna, there arrest their course, and the merchandise with which they are laden is transported on the backs of men and animals through a road cut in the rocks, from Orsova for some miles down to Kladova, while the tortured river passes away to the east. The spot where it is thus strangled, as it were, is known by the name of the Iron Gate, or the Gate of Trajan. New Orsova, in the Servian territory, is situate in an isle of the Danube. It forms nearly a rectangle, and is defended on the right bank by Fort St Elizabeth. It was taken by the Austrians in 1789. Kladova, a little to the south, is also a Servian town, and, like most of the small towns near the Danube, is encased by an earthen rampart, with a ditch, and pallisades of oak sufficiently strong to resist all but cannon shot. Kladova was taken by the Russians in 1829. To the north, and not far from Tchernetz, are the remains of Trajan's bridge, originally of twenty arches, but of which five only remain, and which was flung across the river when it measured more than 3000 feet in width

Danube.

To the south of Kladova, the river, escaping from its more formidable girdle, rolls more freely between the rocky steeps, and forms the boundary between Servia and Wallachia; it has on its right Berza-Palanka, a fortified town, and there receives the waters of the Timok, which comes up from the south, and separates Servia from Bulgaria The Danube then rolls through a vast plain, but still bears the impress of its previous struggle, for it rolls rapidly, but not tumultuously, along. It grows wider and wider, and its waters are interspersed with isles, which are covered with brushwood. It next reaches Widdin, a considerable town, with a population of about 26,000, and a garrison of 8000 or 10,000 men. Widdin is one of the important fortified places of the military line of the Danube. It covers the approaches of Servia, commands Little Wallachia, the defiles of Transylvania, and, above all, the opening of the road which leads through Nissa and Sophia on to Adrianople. Its form is an irregular pentagon; it is strongly bastioned, possesses a fortified castle, with two redoubts in the islands, and its defences are completed by an extensive marsh. It was before the walls of Widdin that the Turks were defeated by the Imperialists in 1689; and it was under cover of its guns that the Ottoman army effected its passage to Kalafat, which is on the left bank, and established itself in Little Wallachia. Below Widdin the river makes a bend, and then flows on to the east, and waters on its right bank Argul-Grad, Lom, Zibroul-Palanka, and Orsova, all situate at the confluence of the streams which come up from Veliki-Balkan on the south, and at the points where the right bank becomes lower and ceases to command the left. These towns present no serious means of defence, but are sufficient to annoy an enemy crossing the stream. The Danube flows on to the east with some windings till it reaches the town of Nicopolis, which was founded by Trajan Nicopolis is an important place, owing to its position at the point where the Oswa enters the Danube, and to its being almost right opposite to the Aluta, which also enters it on the Wallachian side Its population is 10,000, and its garrison between 2000 and 3000 men. It has been strongly fortified by Omar Pasha Opposite, on the Wallachian bank of the river, is the town of Turna, which served formerly as its *tête-du-pont*, until it was dismantled by the Russians in 1828. It was by that *tête-du-pont* that the Turks used to penetrate into the valley of the Aluta, while Nicopolis covered the route to the Balkans, and which leads by the defile of Gabrova. It was taken by the Russians in 1810, and again in 1829. The ground near it has been the scene of many battles.

After Nicopolis the Danube reaches Sistova, where it is large and deep enough to bear vessels of 500 tons burden. Its population is estimated at about 12,000. Sistova has a wall flanked with towers, and a castle; but it is of secondary importance. It was taken and dismantled by the Russians in 1810. From Widdin to Sistova the Danube flows from west to east without many or considerable windings; but at Sistova it begins to take a northern direction. In its gradual course upwards it reaches Rustchuk, one of the three most important places of the line of the Danube. It is situate at the confluence of the Kara-hom, at the extreme point of the great route from Russia to Constantinople by Vassy, and Bucharest in Lower Wallachia, and of the two principal routes of the Balkans, those of Gabrova and Shumla. Rustchuk has a fortified castle, which commands the town and the river, and has been recently fortified. Its population is 30,000, and its present garrison about 7000. In front of Rustchuk, and on the left bank, is Giurgevo, a Wallachian town, which was formerly its *tête-du-pont*, and which played a great part in most of the wars between the Russians and Turks. It was dismantled by the latter in 1828.

From the Danube, which up to Rustchuk had flowed regularly in one bed, issue at this point several streams, which inundate the country for 8 or 10 miles distant. The last slopes of the Bulgarian mountains dip down towards one bank, while the other is bounded by patches of low marshy soil, cut up by other vagrant streams, or by pools of stagnant water, interspersed with islets covered with brushwood or with thick reed-grass. The river, however, soon again

Danube.

gathers itself into one undivided stream, and rolls on to Turtukai, situate opposite the point where the Argisch, flowing down from Wallachia, enters the Danube. Turtukai—which, owing to its important position, has been regularly fortified—connects the two important towns of Rustchuk and Silistria; and it is, moreover, between these two towns that both banks of the Danube are equally low, and present the points where its passage is without difficulty. Opposite to Turtukai, and about a mile and a half from the left bank, is the Wallachian village of Oltenitza. It was there that in 1810, and again in 1829, the Russians passed the Danube. At the commencement of the war they were also in force there, when the Turks boldly crossed the river and beat them.

Silistria is the next place of importance which the Danube waters in its gradually northward course. It is situate at the extremity of the principal route of the Balkans, by Shumla; has a population of 20,000, considerable fortifications, a castle, capacious barracks, and carries on in ordinary times an extensive trade on the river. Its present garrison is in proportion to its importance. It was unsuccessfully attacked by the Russians in 1773 and 1809, and, after a long siege, was taken in 1829. Rustchuk, Silistria, and Shumla are at the angles of a triangle which forms as it were the citadel of that part of the Turkish territory which lies between the Danube and the Balkans.

Leaving Silistria, the river advances, but still gradually, towards the north, while it again throws out branches, the most considerable of which is Borchicha, which flows along the parent stream for more than 50 miles, but at a distance of from 15 to 20; after which it unites with it by various channels, forming marshy islets, — so much so that the whole of the left bank of the Danube up to Hirsova is impracticable. The river then passes to Rassova, a small fortified town, defended in front by impassable marshes. At this spot, it is said that the Danube, in times now remote, continued unvarying its western course to Kostendjé, in the Black Sea, from which it is only separated about 50 or 60 miles, but that it became blocked up by long accumulating sandbanks, and was forced to seek a new outlet. At Rassova it now at all events turns sharply to the north, and traverses a space of 80 leagues before it empties itself into the Euxine. In the time of the Romans, a wall and ditch, which extended for 50 miles, from Rassova to the sea, repelled the invasions of the Dacians; and of that barrier, the Vallum Trajani, traces may still be seen. A canal which would unite the Danube with the Black Sea at that spot was once projected, and recently plans have been furnished of a railroad, which would make Rassova the station for vessels descending the Danube.

The mighty stream after leaving Rassova once more quits its bed, and scatters its waters, which flow along a low soil cut up into a maze of marshes. In this state it reaches Hirsova, which is defended by a fortified castle, and has a garrison of about 2000 men. This place was taken by the Russians in 1809 and 1828. Though small, it is of considerable importance from its position on the very spot where the Borchicha returns to the Danube, and the river itself resumes its course. It covers the points where a passage might be effected in the Dobrouscha. The Dobrouscha is the rectangular peninsula comprised between the Danube, from Rassova to the mouth of the Kilia, Trajan's Vallum, and the Black Sea. It is in many parts inundated, but has good pasturage for the excellent horses which constitute the sole wealth of the Tartars who inhabit it. If the Danube be then passed, the routes by Varna and Shumla to Constantinople are open to an enemy.

Dobrouscha.

After Hirsova the Danube again loses itself in many streams, and thus scattered reaches Mathiné, a town protected by two fortified castles and a wall, and which has now a garrison of about 4000 men. Its importance in 1809 and 1828 was considerable, as its *tête-du-pont* was the Wallachian Brailow, though separated from it by four or five acres of the river about four or five miles in breadth. In the latter year it was dismantled by the Russians. By means of it Wallachia was turned, and the entry into Moldavia secured; and it covered the Lower Danube and the Dobrouscha. It was many times besieged, as the Russians could not venture beyond the Danube with such a place in their rear.

Below Brailow the Danube again recovers its single bed, and flows on to Galatz, which is on the left bank and near the confluence of the Sereth: it is the only port Moldavia possesses on the river. Once more the waters are divided; but the Danube reaches its highest northern point at Reni, where it resumes its original direction from W. to E. It passes through a district almost entirely inundated, and it hurries on its way through vast lakes. It is again confined nearly to one bed before it reaches Isaktchi, where hostilities were commenced in the present war by the attack made on the place by the Russians. With a fortified castle, and a garrison of about 1500 men, Isaktchi is but a post of observation on the *embouchures* of the river. The same may be said of Toultcha, which is the last fortified place held by the Turks on the Danube, and which has a garrison of 1200 men. Above Toultcha, the river is divided into a great many arms; the three most important of which form a vast delta, which belongs in great part to Russia. The first division of the delta begins at the island of Tchatal, where the Danube separates into two large branches—the first of which, called the Kilia, takes a northern direction, and reaches Ismail and Kilia, both taken by the Turks from the Russians, and which now command the whole of the delta of the Danube. In former times Ismail was for the Turks a position of the same importance as Brailow. Its capture by assault, under Suwarrow, in 1790, when 35,000 of the inhabitants were involved in a general massacre, has been celebrated in prose and poetry. The Kilia, divided and subdivided into several branches, is scarcely navigable; at its mouth the water is from four to seven feet deep. The second branch is the Sulina, which flows to the S E., and is divided into the two streams, St George and Dunavitz—the latter, more to the southward, flows into the maritime lake of Rassein. The Sulina is easy of navigation; it is from 400 to 600 feet in width, it ought to be 18 to 22 feet in depth, and flows in an undivided channel to the sea. The St George branch is about 30 feet deep, but its mouth is almost entirely blocked up with sand. The Dunavitz is not navigable. The mouths of the Danube extend over 70 miles of coast. The delta is formed of isles Tchatal and Leti, between the Kilia and the Sulina; of the Isle of St George, between the Sulina and the St George; and of the isle Portitza, between St George and the Dunavitz. This last only is possessed by the Turks; all the rest belong to the Russians, who, intentionally or through negligence, have, since the recent quarrel with the Porte, allowed the sand to accumulate at the mouth of the Sulina so as to do incalculable injury to the navigation of the most important river of Europe. The whole of the delta, with the exception of the Island of Portitza, which is a mass of sand, is neither thinly peopled nor poorly cultivated.

Daphne.

DAPHNE, in *Mythology*, daughter of the river-god Ladon in Arcadia, or of the river-god Peneus in Thessaly, by the goddess Terra, was a nymph of surpassing beauty, of whom Apollo became deeply enamoured. This passion had been incited by Cupid, with whom Apollo, elated at his recent conquest of the serpent Python, had disputed the power of his darts. Daphne, filled with terror at the importunities of the god, endeavoured to elude his embraces by flight; and when on the point of being overtaken by her pursuer, she invoked the assistance of the gods, and was metamorphosed into a laurel—in Greek called δάφνη—which tree was thenceforward sacred to Apollo. According to another legend, Daphne was beloved by Leucippus, son of Œnomaus, king of Pisa in Elis, who disguised his sex, and attended her in the woods in the habit of a huntress; but his sex having been discovered by his rival Apollo, Leucippus was killed by the companions of Daphne. (Ovid, *Met.* i. 452, &c.)

Daphne was also the name of a daughter of the soothsayer Tiresias, a priestess in the temple of Delphi. She is more generally called Manto.

DAPHNE, a grove, temple, and oracle of Apollo, about five miles from Antioch in Syria, and one of the most renowned and sumptuous places of devotion in the whole Pagan world. In the words of Gibbon,—"The perpetual resort of pilgrims and spectators insensibly formed in the neighbourhood of the temple the stately and populous village of Daphne, which emulated the splendour without acquiring the title of a provincial city. The temple and village were deeply bosomed in a thick grove of laurels and cypresses, which reached as far as a circumference of ten miles, and formed in the most sultry summers a cool and impenetrable shade. A thousand streams of the purest waters issuing from every hill preserved the verdure of the earth and the temperature of the air; the senses were gratified with harmonious sounds and aromatic odours, and the peaceful grove was consecrated to health and joy, to luxury and love." Daphne first became famous in the reign of Seleucus Nicator, who designed it. Under the Romans its reputation was not suffered to decline till the days of the Apostate Julian. When that emperor visited the place, he complained that, instead of hecatombs of fat oxen sacrificed by the tribes of a wealthy city to their tutelary deity, he found only a single goose provided at the expense of a priest, the pale and solitary inhabitant of this decayed tem-

Daphnephoria ‖ Darabjird.

ple. In the reign of Zeno, Daphne became a third-rate provincial town. For a very detailed history of Daphne, see Gibbon's *History of the Decline and Fall*, chap. xxiii. No remains that can with certainty be pronounced those of the ancient village and grove have been discovered.

DAPHNEPHORIA, in *Antiquity*, a festival celebrated every ninth year by the Bœotians, in honour of Apollo, surnamed Ismenius or Galaxius. It was so called from the laurel branches borne by those who took part in its celebration, which was conducted as follows:—An olive-bough was adorned with garlands of laurel and various kinds of flowers, and on the top of it was fixed a brazen globe, from which smaller globes were suspended. About its middle were arranged purple garlands, and a globe of size inferior to that at the top, while the lowest part of the bough was enveloped with a saffron-coloured covering. The uppermost globe represented Apollo or the sun; that in the middle was an emblem of the moon; while the others were symbols of the stars. The garlands, in number 365, indicated the course of the year. The bough, thus adorned, was carried in solemn procession to the temple of Apollo, where supplicatory hymns were sung to the god. At the head of this procession walked the Δαφνηφόρος, or chosen priest of Apollo for that year, who was a youth selected for his strength and beauty from one of the most distinguished families of Thebes, and whose parents were both living. He was arrayed in a magnificent robe which reached to his feet, his hair hung loose and dishevelled, on his head was a golden crown, in his hand he bore a branch of laurel, and on his feet were a kind of shoes called *iphicratidæ*, from the Athenian Iphicrates, who first introduced them. Immediately before him walked his nearest kinsman, bearing the olive bough above mentioned; and after him followed a choir of virgins with branches in their hands and singing hymns. This festival was of great antiquity; and similar festivals appear to have been celebrated in other parts of Greece. The Daphnephoria was instituted on the following occasion:—When an oracle advised the Æolians, who inhabited Arne and the adjacent country, to abandon their ancient possessions and go in quest of a settlement, they laid siege to Thebes, which was at the same time attacked by the Pelasgians, and ravaged the adjoining country. As the celebration of Apollo's festival was near, both nations, who religiously observed it, laid aside their hostilities, and, according to custom, cut down laurel boughs from Mount Helicon and in the neighbourhood of the river Melas, and walked in procession in honour of Apollo. The day on which this solemnity was observed, there appeared in a dream to Polematas, the general of the Bœotian forces, a youth who presented him with a complete suit of armour, and commanded the Bœotians to offer solemn prayers to Apollo, with laurel boughs in their hands, every ninth year. Three days after this vision Polematas made a sally upon the besiegers, and with such success that they were compelled to relinquish their enterprise. He accordingly instituted a novennial festival to the god who had favoured the Bœotians.

DAPHNIS, a Sicilian shepherd, to whom the invention of bucolic poetry is ascribed. He was struck blind by a Naiad for having broken his vow of constancy to her, but was afterwards translated to heaven by his reputed father Hermes. According to one account, Daphnis was not himself a poet, but gained that reputation merely from having been the theme of the bucolic strains of Stesichorus.

DAPIFER (Lat. *dapes, feast*, and *fero, to bear*), literally, one who brings meat to table, was formerly the title or office of the grand-master of a king's household. This title was given by the Emperor of Constantinople to the Czar of Russia as a testimony of favour. In France an analogous office was instituted by Charlemagne. The dignity of dapifer still subsists at some of the German courts.

DARABJIRD, or DARAB-GUIERD, a town of Persia, in the province of Fars, situated on the banks of a river which runs through an extensive plain interspersed with villages and cultivated lands, 150 miles N.E. from Schiraz. It is surrounded with groves of orange and lemon trees, which yield fruit in such abundance that the juice is exported to all parts of Persia. Although a great part of the town is in ruins, it still contains from 15,000 to 20,000 inhabitants.

Darapti ‖ Darfur.

DARAPTI, in *Logic*, one of the modes of syllogisms of the third figure, the premises of which are universal affirmatives, while the conclusion is a particular affirmative: thus,—

> Every body is divisible;
> Every body is a substance;
> Therefore some substance is divisible.

D'ARBLAY, MADAME. See BURNEY, *Fanny*.

DARDANELLES, STRAITS of the, form the communication between the Sea of Marmora and the Archipelago. This channel, through which there flows a constant current out of the Sea of Marmora into the Archipelago, is upwards of 50 miles long, and varies in breadth from 1 mile towards its western to 10 miles at its eastern extremity. It derives its name from two ancient fortresses on either side of the river, of which one is built on the site of the ancient Sestos, and the other on the site of the ancient Abydos. About 20 miles to the west of these are two modern fortresses called the New Castles, and between the old and the new forts are military works of various descriptions. The total number of guns mounted on these fortresses is 689, some of which discharge stone shot, and require a charge of more than 3 cwts. of powder. It derived its ancient name of the Hellespont from the tradition of Phryxus and Helle, and is celebrated in ancient times for the bridge of boats built over it by Xerxes. It is memorable also as the scene of the death of Leander.

DARDANUS, the mythical ancestor of the Trojans, was the son of Jupiter and Electra. According to the Greek legend, he came from Arcadia to Samothrace, and thence removed to Phrygia, where he established the famous palladium, originally the dowry of his wife Chryse, which was afterwards enshrined at Troy. Dardanus afterwards married Bateia, the daughter of Teucrus, and by her became the father of Ericthonius and Idæa. According to a later tradition he was the son of Corythus an Etruscan prince, and emigrated from Etruria to Phrygia.

DARDANUS, *Dardanum*, or *Dardania*, in *Ancient Geography*, a city of the Troad in Mysia, taking its name from Dardanus the founder of the dynasty of Troy. It was a small and unimportant town even during the authentic period of ancient history, and is chiefly memorable as the spot where Sulla and Mithridates met in B.C. 84, to arrange the terms of peace.

DARES, a Phrygian, who lived during the Trojan war, and wrote the history of it in Greek. This history was extant in the age of Ælian. A Latin translation, which has come down to us, is generally allowed to be spurious, and is attributed by some to Cornelius Nepos. It was first published at Cologne in 1470.

DARFUR, or DARFOOR, a considerable kingdom of Central Africa, occupying a large tract of the country lying between Abyssinia and Bornu. The boundaries of this kingdom are not well defined. According to the best authorities, it has on the east Kordofan and the country of the Shilluks, which separate it from Sennaar and Abyssinia; on the west Bergu, which divides it from Begherme and Bornu; whilst the regions to the south are occupied by barbarous nations, extending to and inhabiting the Mountains of the Moon, and the early course of the Bahr-el-Abiad.

Darfur is destitute of any great river or lake; and accordingly during the dry season the aspect of the country is parched and sterile. The rainy season commences in June and continues till September. Then the fields are clothed with luxuriant verdure, and the empty ravines

Darfur.

filled with water. This is the season for sowing, at the commencement of which, the king, with his attendants, goes out into the fields, and with his own hand makes several holes in the ground for the reception of the seed. The vegetable productions of Darfur are found chiefly to the south, where water is most abundant. The ground is extensively covered with trees, amongst which the tamarind, plane, and sycamore are found, but not in great abundance. The *heglig* and the *nebbek* are two species peculiar to Darfur; their wood is hard, and they are very thorny. There are also two small trees or shrubs called the *enneb* and *shair*. The other plants copiously produced are the *mimosa nilotica*, the gum of which is carried into Egypt; the watermelon, the gourd, hemp, capsicum, and tobacco. The date tree is here small, and of inferior quality. Camels of all forms and sizes are exceedingly abundant. The wild animals are principally the lion, leopard, hyena, wolf, jackal (*Canis aureus*), and wild buffalo. These, however, are chiefly confined to the uncultivated parts of the country, except the jackal and hyena, herds of which enter the villages at night and commit great ravages. Here also are found the elephant, rhinoceros, cameleopard, hippopotamus, and crocodile. Darfur has no good horses except those obtained from Dongola, and no good asses except those from Egypt. The sheep are inferior to the Egyptian, and their wool is very coarse. Goats and horned cattle are numerous, and their flesh is good. Very fine copper is brought from the south; and gold is plentiful in the east and west, but it is conveyed to Northern Africa by other channels. The rocks of Darfur consist chiefly of gray granite. Various kinds of marble, alabaster, fossil salt, and sulphur are also found. Thermal springs are said to exist in a mountain called Gebel Maria.

The national industry is directed chiefly to agriculture. Wheat is raised only in small quantities: the principal grains are the *dokn*, which seems to be a species of millet, and another of larger size called *kassob*. The harvest is conducted by the women and slaves, who break off the ears with their hands and carry them away in baskets; whilst the straw is left standing to be employed in building, &c. The grain, after being thrashed, is buried in the earth, and is thus tolerably well preserved. The houses are built of clay, sometimes embellished with a coating of plaster; the roofs are flat, and formed of light beams of wood, with a covering of clay. An apartment of about 20 feet by 12, and secured by a rude door with a padlock, is used as the repository of all property belonging to the family; another, called *kournac*, somewhat larger than the above, but without a door, serves for sitting and sleeping in; and a third, somewhat similar to the latter, is appropriated to the women.

The population is supposed by the most recent travellers not to exceed 200,000. Cobbe, the capital, has not more than 6000 inhabitants. There are only eight other considerable places, the remaining collective residences being only small villages. The population of the towns, and especially of the capital, consists in a great measure of foreign traders, from Egypt, and from the eastern countries of Dongola, Sennaar, and Kordofan. Many of the various tribes of Arabs which wander in the surrounding deserts have also settled in the interior of Darfur.

The government, like that of other Mohammedan countries, is despotic. Beyond the Koran, which is inviolable, the will of the king is unlimited. The Fukhara or ecclesiastics alone are entitled to remonstrate; but if their warning be rejected, they have no means of enforcing it. A very formidable power resides in the army, which consists of about 2000 men; and no sovereign can with impunity act in opposition to that body. On the death of the monarch, the crown constitutionally descends to the eldest son; but is liable to be seized by any stronger or more popular member of the royal family. The revenue of the sovereign is derived from various sources; from a duty on all merchandise imported, amounting in most instances to about a tenth; fines for misdemeanours; and to which is added, in case of murder, a certain proportion of the property of the village in which the murder has been perpetrated; presents received continually from the nobles and merchants, and the tribute of the bordering Arab tribes. Lastly, the king is an extensive merchant, with means of procuring a market which are not enjoyed by private individuals.

Daric ‖ Darien.

The Darfurians differ from the negroes on the coast of Guinea, though their complexion is black, and their hair generally short and woolly. In their dispositions they are cheerful; and the females are not immured, nor, unless among the great, are their faces concealed by a veil. Notwithstanding the law of the prophet, a fermented liquor is used by persons of both sexes, and sometimes to a great extent.

The only commerce of Darfur is inland; but this is extensive, and the merchants are the most important persons in the country. The chief intercourse is with Egypt, and it is carried on entirely by the African system of caravans. These are not only very uncertain in their journeys, but are exposed to great dangers from the attacks of wild Arabs. Among the articles sent into Egypt, the most important are slaves, camels, ivory, the horns, teeth, and hides of the rhinoceros and hippopotamus, ostrich feathers, gum, pimento, parroquets in abundance, and a small quantity of white copper. The imports are extremely various, comprising beads of all sorts, toys, glass, arms, light cloths of different kinds, &c. Commerce is carried on entirely by barter, which greatly increases the difficulty of conducting it. The intercourse with Mecca is considerable; and in this the objects of trade and religion are combined. (See Browne's *Travels*.)

DARIC (δαρεικός), a very pure gold piece, generally supposed to have been first coined by Darius the son of Hystaspes, probably during his stay at Babylon, out of the vast quantity of gold which had been accumulated in the treasury of that capital. The daric was widely circulated not only in the Persian empire, but also in Greece; so that the Persian daric, which was also called *stater*, was the gold coin best known in Athens in ancient times. According to Dr Bernard, it weighed fifteen grains more than our guinea. Hussey gives its value at about L.1, 1s. 10d. 1·76 farthings. There are specimen of this rare coin in the British Museum, of the respective weights of 128·4 grains and 128·6 grains. They are stamped on one side with the figure of a kneeling archer clothed in a long robe, with a spiked crown on his head, and holding a bow in his left hand and an arrow in his right; and on the other side with a sort of quadrata incusa or deep cleft. All the other pieces of gold of the same weight and value which were coined by the succeeding kings, both of the Persian and Macedonian race, were also called *darics*. Of these there were whole darics and half darics; and in those parts of Scripture written after the Babylonish captivity they are called *adarkonim*, and by the Talmudists *darkonoth*. There were also silver darics.

DARIEN GULF, a large gulf on the northern coast of New Granada. It measures 26 leagues from N. to S., and 9 from E. to W. Several rivers flow into it, the largest of which is the Atrato. The coast is full of sharp and inaccessible shoals, and possesses few places fit for disembarkation.

DARIEN, *Isthmus of*. See PANAMA.

DARIEN, *Scottish Colony of*. Of the rise, progress, and catastrophe of this ill-fated undertaking, Sir John Dalrymple, in the second volume of his Memoirs of Great Britain and Ireland, has given a very interesting account, authenticated in every particular by unquestionable documents. The projector and leader of the Darien expedition was a clergyman of the name of Paterson, who having a strong desire to see foreign countries, made his profession the means of indulging it, by going to the new western world on the pretence of converting the Indians to the

Darien. religion of the old. During his residence there he became acquainted with Captain Dampier and Mr Wafer, who afterwards published, the one his voyages, and the other his travels in the region where the separation is narrowest between the Atlantic and the Pacific Oceans; and both of whom appear to have been men of considerable observation. But he obtained much more knowledge from men who could neither read nor write, by cultivating the acquaintance of some of the old buccaneers, who, after surviving their glories and their crimes, still, in the extremity of age and misfortune, recounted with transport the ease with which they had passed and repassed from the one sea to the other, sometimes in hundreds together, and driving strings of mules before them loaded with the plunder of friends and of foes. Paterson having examined the places, satisfied himself that on the Isthmus of Darien there was a tract of country running across from the Atlantic to the Pacific, which the Spaniards had never possessed, and inhabited by a people continually at war with them; that along the coast, on the Atlantic side, there lay a string of islands called the Sambaloes, uninhabited, and full of natural strength and of forests, from which last circumstance one of them was called the *island of the pines;* that the seas there were filled with turtle and the manati or sea cow; that midway between Porto-Bello and Carthagena, but nearly fifty leagues distant from either, at a place called Acta, in the mouth of the Darien, there was a natural harbour, capable of receiving the greatest fleets, and defended from storms by other islands which covered the mouth of it, and from enemies by a promontory which commanded the passage, and by hidden rocks in the passage itself; that on the other side of the isthmus, and in the same tract of country, there were natural harbours, equally capacious and well defended; that the two oceans were connected by a ridge of hills, which by their height created a temperate climate in the midst of the most sultry latitudes, and were sheltered by forests, but not rendered damp, because the trees grew at a distance from each other, and had very little underwood; that, contrary to the usual barren nature of hilly countries, the soil was of a black mould two or three feet deep, and producing spontaneously the fine tropical fruits and plants, roots and herbs; that roads might be formed with ease along the ridge, by which mules, and even carriages, might pass from the one sea to the other in the space of a day, and consequently that this passage seemed to be pointed out by nature, as a common centre to connect together the trade and intercourse of the universe.

Paterson knew that ships which stretch in a straight line from one point to another, and with one wind, run less risks, and require fewer hands, than ships which pass through many latitudes, follow the windings of many coasts, and require many winds; that vessels of seven or eight hundred tons burden are often to be met in the South Sea, navigated by not more than eight or ten hands, because these hands have little else to do than set their sails when they begin their voyage, and to take them in when they end it; that as soon as ships from Britain should get so far south as to reach the trade-wind, which seldom varies, that wind would carry them to Darien, and the same wind would carry ships from the Bay of Panama, on the opposite side of the isthmus, to the East Indies; that as soon as ships coming from the East Indies to the Bay of Panama got so far north as the latitude of 40°, to reach the westerly winds, which about that latitude blow almost as regularly from the west as the trade-winds do from the east, these winds would carry them, in the track of the Spanish Acapulco ships, to the coast of Mexico, whence the land-wind, which blows for ever from the north to the south, would carry them along the coast of Mexico into the Bay of Panama. Thus, in going from Britain, ships would encounter no uncertain winds, except during their passage south into the latitude of the trade-wind; and in coming from India to the Bay of Panama they would meet no uncertain winds, except in their passage north to the latitude of the westerly winds, and in going from the other side of the isthmus to the east, with no uncertain wind whatsoever. Gold was seen by Paterson in some places of the isthmus; and hence an island on the Atlantic side was called the Gold island, and a river on the side running to the Pacific was called the Golden river; but these were objects which he regarded not at that time, because far greater were in his eye, namely, the shortening of distances, the drawing of nations nearer to each other, the preservation of the valuable lives of seamen, and the saving in freight, and in time, so important to merchants, and to an animal whose life is of so short duration as that of man.

Darien.

By this obscure Scotchman a project was formed to settle, on this neglected spot, a great and powerful colony; not as other colonies have for the most part been settled, by chance, and unprotected by the country whence they proceeded; but by system, upon foresight, and to receive the ample protection of those governments to whom he was to offer his project. And certainly no greater idea has been formed since the time of Columbus.

Paterson's original intention was to submit his project to England, as the country which had most interest in it, not only from the benefit common to all nations, of shortening the length of voyages to the East Indies, but by the effect which it would have had in connecting the interests of her European, West Indian, American, African, and East Indian trade. Paterson, however, having few acquaintances and no protection in London, thought of drawing the public eye upon him, and ingratiating himself with moneyed men and with great men, by assisting them to model a project, which was at that time in embryo, for erecting the Bank of England. But that happened to him which has happened to many projectors in his situation; the persons to whom he applied made use of his ideas, took the credit of them to themselves, were civil to him for a while, and neglected him afterwards. He therefore communicated his project of a colony only to a few persons in London, and these few discouraged him.

He next submitted his project to the Dutch, the Hamburgers, and the elector of Brandenburg; because, by means of the passage of the Rhine and Elbe through their states, he thought that the great additional quantities of East Indian and American goods which his colony would export to Europe would be distributed throughout Germany. The Dutch and Hamburg merchants, although they had most interest in the project, heard him with indifference; while the elector, who had very little interest in it, received him with honour and kindness; but court arts and false reports soon lost him even that prince's favour.

Paterson, on his return to London, formed a friendship with Mr Fletcher of Saltoun, whose mind was inflamed with the love of public good, and all whose ideas to procure it had a sublimity about them. Fletcher brought Paterson down to Scotland, presented him to the Marquis of Tweeddale, then minister for that country; and thereafter, with that power which a vehement spirit always possesses over a diffident one, persuaded the marquis, by arguments of public good, and the honour which would redound to his administration, to adopt the project. Lord Stair and Mr Johnston, the two secretaries of state, patronised those abilities in Paterson which they possessed in themselves; and the lord advocate, Sir James Stuart, the same person who had adjusted the Prince of Orange's

Darien. declaration at the Revolution, and whose son had married a niece of Lord Stair, went naturally along with his connections. These persons, in June 1695, procured a statute from parliament, and afterwards a charter from the crown in terms thereof, for creating a trading company to Africa and the new world, with power to plant colonies and build forts, by consent of the inhabitants, in places not possessed by other European nations.

Paterson now finding the ground firm under him, and that he was supported by almost all the power and talents of his country, the character of Fletcher, and the sanction of an act of parliament and royal charter, threw his project boldly before the public, and opened a subscription for a company. The frenzy of the Scotch nation to sign the solemn league and covenant never exceeded the rapidity with which they ran to subscribe to the Darien company. The nobility, the gentry, the merchants, the people, the royal burghs without the exception of one, and most of the other public bodies, subscribed. Young women threw their little fortunes into the stock; and widows sold their jointures to get the command of money for the same purpose. Almost immediately L. 400,000 were subscribed in Scotland, although there was not at that time above L.800,000 of cash in the kingdom. The famous Mr Law, then a youth, afterwards confessed that the facility with which he saw the passion of speculation communicate itself, satisfied him of the possibility of producing the same effect by means of the same cause, but upon a larger scale, when the Duke of Orleans engaged him against his will to turn his bank into a bubble. Paterson's project, which had been received by strangers with fears when opened to them in private, filled them with hopes when it came to them upon the wings of public fame; for Colonel Erskine, son of Lord Cardross, and Mr Haldane of Gleneagles, the one a generous branch of a generous stem, and the other a country gentleman of fortune and character, having been deputed to receive subscriptions in England and on the Continent, the English subscribed L. 300,000, and the Dutch and Hamburgers L.200,000 more.

In the mean time the jealousy of trade, which has done more mischief to the commerce of England than all other causes put together, created an alarm in England; and the Houses of Lords and Commons, without previous inquiry or reflection, on the 13th of December 1695, concurred in a joint address to the king against the establishment of the Darien company, as detrimental to the interest of the East India Company. Soon afterwards the Commons impeached some of their own countrymen for being instrumental in erecting the company, and also some of the Scotch nation, one of whom was Lord Belhaven; that is to say, they arraigned the subjects of another country for making use of their own laws. Among six hundred legislators, not one had the sense, not to say genius, to propose a committee of both parliaments to inquire into the principles and consequences of the establishment; and if these should, upon inquiry, be found sound and beneficial, that the advantage should be communicated, by a participation of rights, to both nations. The king's answer was, that he had been ill advised in Scotland. He soon afterwards changed his Scottish ministers, and sent orders to his resident at Hamburg to present a memorial to the senate, in which he disowned the company, and warned them against all connections with it. The senate transmitted the memorial to the assembly of merchants, who returned it with the following spirited answer: "We look upon it as a very strange thing, that the king of Britain should offer to hinder us, who are a free people, to trade with whom we please; but are amazed to think that he would hinder us from joining with his own subjects in Scotland, to whom he had lately given such large privileges, Darien. by so solemn an act of parliament." But the merchants, seeing the scheme discouraged by their governments, were soon intimidated; and the Dutch, Hamburg, and London merchants withdrew their subscriptions.

The Scotch, not discouraged, were rather animated by this oppression; for they converted it into a proof of the envy of the English, and of their consciousness of the great advantages which were to flow to Scotland from the colony. The company proceeded to build six ships in Holland, from thirty-six to sixty guns, and they engaged 1200 men for the colony; amongst whom were younger sons of many of the noble and ancient families of Scotland, and sixty officers who had been disbanded at the peace, who carried with them such of their private men, generally raised on their own or the estates of their relations, as they knew to be faithful and brave, most of them being Highlanders. The Scotch parliament, on the 5th August 1698, unanimously addressed the king to support the company. The lord president Sir Hugh Dalrymple, brother of Lord Stair, and head of the bench, and the lord advocate Sir James Stuart, head of the bar, jointly drew up memorials to the king, able in point of argument, information, and arrangement, in which they defended the rights of the company upon the principles of constitutional and of public law; and neighbouring nations, with a mixture of surprise and respect, saw the poorest kingdom of Europe sending forth the most gallant and the most numerous colony which had ever set out from the old to the new world.

On the 26th day of July 1698, the whole city of Edinburgh poured down to Leith to see the colony depart, amidst the tears, and prayers, and praises of relations, and friends, and countrymen. Many seamen and soldiers, whose services had been refused, because more had offered themselves than were needed, were found hid in the ships, and, when ordered ashore, clung to the ropes and timbers, imploring to go without reward along with their companions. Twelve hundred men sailed in five stout ships, and arrived at Darien in two months, with the loss of only fifteen of their people. At that time it was in their power, most of them being well born, and all of them hardily bred and inured to the fatigues and dangers of the late war, to have marched from the northmost part of Mexico to the southmost point of Chili, and to have overturned the whole empire of Spain in South America. But modest respecting their own and their country's character, and afraid of its being alleged that they had plunder, and not a settlement, in view, they began with purchasing lands from the natives, and sending messages of amity to the Spanish governors within their reach; and then fixed their station at Acta, calling it *New St Andrew*, from the name of the tutelar saint of Scotland, and the country itself *New Caledonia*. One of the sides of the harbour being formed by a long narrow neck of land which ran into the sea, they cut it across so as to join the ocean and the harbour. Within this defence they erected their fort, planting upon it fifty pieces of cannon. On the other side of the harbour there was a mountain about a mile in height, on which they placed a watch-house, which, in the rarefied air within the tropics, so favourable for vision, gave them an immense range of prospect, in order to prevent all surprise. To this place it was observed that the Highlanders often repaired to enjoy the cool air, and to talk of their friends whom they had left behind on their native hills. The first public act of the colony was to publish a declaration of freedom of trade and religion to all nations. This luminous idea originated with Paterson.

But the Dutch East India Company having pressed the king, in concurrence with his English subjects, to prevent

Darien. the settlement at Darien, orders had been sent from England to the governors of the West Indian and American colonies, to issue proclamations against giving assistance, or even holding correspondence with the colony; and these were more or less harshly expressed, according to the temper of the different governors. The Scotch, trusting to far different treatment, and to the supplies which they expected from these colonies, had not brought sufficient provisions along with them, and fell into diseases from bad or inadequate food; but the more generous savages, by hunting and fishing for them, afforded them that relief which fellow Britons had refused. They lingered eight months, waiting in vain for assistance from Scotland, and almost all of them either died out or quitted the settlement. Paterson, who had been the first to enter the ship at Leith, was the last to go on board at Darien.

During the space of two years, while the establishment of his colony had been in agitation, Spain had made no complaint to England or Scotland against it. The Darien council even averred in their papers, which are in the Advocates' Library, that the right of the company was debated before the king, in presence of the Spanish ambassador, ere the colony left Scotland. But now, on the 3d of May 1698, the Spanish ambassador at London presented a memorial to the king, in which he complained of the settlement at Darien as an encroachment on the rights of his master.

The Scotch, ignorant of the misfortunes of their colony, but provoked at this memorial, soon afterwards sent out another colony of 1300 men, to support an establishment which was now no more; but this last expedition having been more hastily prepared than the first, proved unlucky in its passage. One of the vessels was lost at sea, many men died on board, and the rest arrived at different times, broken in their health, and dispirited when they heard the fate of those who had gone before them. Added to the misfortunes of the first colony, the second had a misfortune peculiar to itself. The General Assembly of the Church of Scotland sent out four ministers, with orders to take charge of the souls of the colony, and to erect a presbytery, with a moderator, clerk, and record of proceedings; to appoint ruling elders, deacons, overseers of the manners of the people, and assistants in the exercise of church discipline and government, and to hold regular kirk-sessions. When they arrived, the officers and gentlemen were occupied in building houses for themselves with their own hands, because there was no assistance to be got from others; yet the four ministers complained grievously that the council did not order houses to be immediately built for their accommodation. They had not had the precaution to bring with them letters of recommendation from the directors at home to the council abroad; and on these accounts, not meeting with all the attention they expected from the higher, they paid court to the inferior ranks of the colonists, and by this means sowed divisions in the colony. They exhausted the spirits of the people, by requiring their attendance at sermon four or five hours at a time, relieving each other by preaching alternately, but allowing no relief whatever to their hearers. The employment of one of the days set aside for religious exercise, which was Wednesday, they divided into three parts; thanksgiving, humiliation, and supplication, in which three ministers followed one another. And as the service of the church of Scotland consists of a lecture with a comment, a sermon, two prayers, three psalms, and a blessing, the work of the day, upon an average of the length of the service in that age, could not occupy less than twelve hours, during which time the colony was collected, and kept crowded together in the guard-room, which was used as a church, in a tropical climate, and in a sickly season. The preachers presented a paper to the council, which they took care to make public, requiring them to set aside a day for solemn fasting and humiliation; and, under pretence of enumerating the sins of the people, they poured out abuse on their rulers. They damped the courage of the people by continually representing hell as the termination of life to most men, because most men are sinners. Carrying the presbyterian doctrine of predestination to an extreme, they put a stop to all exertions, by showing that the consequences of these depended not on the individuals by whom they were made, but on an all-controlling and irresistible power, by which, independently of human efforts and volitions, every thing was necessarily determined. They converted the numberless accidents to which soldiers and seamen are exposed into immediate judgments of God against their sins; and, having resolved to quit the settlement, they, in excuse for doing so, wrote bitter letters to the general assembly against the characters of the colonists, and the advantages of the colony itself. One of these men, in a kind of history of the colony which he published, exulted with a savage triumph over the misfortunes of his countrymen. "They were such a rude company," said he, "that I believe Sodom never declared such impudence in sinning as they. An observant eye might see that they were running the way they went; hell and judgment was to be seen upon them, and in them, before the time. Their cup was full; it could hold no more: they were ripe; they must be cut down with the sickle of the wrath of God." Darien.

The last party which joined the second colony at Darien, after it had been three months settled, was Captain Campbell of Finab, with a company of the people of his own estate, whom he had commanded in Flanders, and whom he carried to Darien in his own ship. On their arrival at New St Andrew, they found that intelligence had been received that a Spanish force of 1600 men, which had been brought from the coast of the South Sea, lay encamped at Tubucantee, waiting there till a Spanish squadron of eleven ships which was expected should arrive, when they were jointly to attack the fort. The military command was offered to Captain Campbell, in compliment to his reputation and to his birth as a descendant of the families of Breadalbane and Atholl. In order to prevent a joint attack, he resolved to attack first; and therefore on the second day after his arrival, he marched with two hundred men to Tubucantee, before his approach could be known to the enemy, stormed the camp in the night-time, dissipated the Spanish force with much slaughter, and returned to the fort the fifth day. But he found the Spanish ships off the harbour, their troops landed, and almost all hope of aid or of provisions cut off; yet he stood a siege of nearly six weeks, until almost all the officers had died, the enemy by their approaches had cut off his wells, and his ammunition had been so far expended that he was obliged to melt the pewter dishes of the garrison into balls. The garrison then capitulated, and obtained not only the common honours of war and security for the property of the company, but, as if they had been conquerors, even exacted hostages for the performance of the conditions. Captain Campbell alone desired to be excepted from the capitulation, saying, that he was sure the Spaniards would not forgive him the mischief which he so lately had done them. But the brave, by their courage, often escape that death which they seem to provoke. Captain Campbell made his escape in his vessel, and arrived safely at New York, whence he proceeded to Scotland, where the company presented him with a gold medal, in which his bravery was duly commemorated. The lord-lyon king-at-arms, whose office it is in Scotland to confer badges of distinction upon honourable actions ac-

Darii ‖ Darling.

cording to the rules of heraldry, also granted him a Highlander and an Indian as supporters to his coat of arms.

But a harder fate attended those whom Captain Campbell left at Darien. They were so weak in their health as not to be able to weigh up the anchors of the *Rising Sun*, one of their ships, which carried sixty guns; the generous Spaniards, however, assisted them. In going out of the harbour the vessel ran aground. The prey was tempting; and, to obtain it, the Spaniards had only to stand by and look on; but they showed that mercy to the Scotch in distress which one of their own countrymen, General Elliot, afterwards returned to the posterity of those Spaniards at the siege of Gibraltar. The Darien ships being leaky and weakly manned, were obliged in their voyage to take shelter in different ports belonging to Spain and England. But the Spaniards in the new world treated them with uniform kindness, while the English governments showed them none; and one of their ships was seized and detained. In fact, only Captain Campbell's ship and another small one were saved. The *Rising Sun* was lost on the bar of Charlestown; and of the colony, not more than thirty, saved from war, shipwreck, or disease, ever returned to their native country.

Paterson, who had withstood the blow, could not endure the reflection of misfortune. He was seized with a lunacy in his passage home, after the ruin of the first colony; but he recovered in his own country, where his spirit, still ardent and unbroken, presented a new plan to the company, founded on the idea of King William, that England should have the joint dominion of the settlement with Scotland. He survived many years in Scotland, pitied, respected, but neglected. After the union of the two kingdoms, he claimed reparation of his losses from the equivalent-money obtained by England to the Darien Company, but was paid nothing; because a grant to him from a public fund would have been only an act of humanity, and not a political job. Thus ended the colony of Darien; an adventure which, in its disastrous results, inflicted a severe blow upon Scotland, and excited feelings of deep hostility towards the English government and nation, which half a century was scarcely sufficient to extinguish.

DARII, in *Logic*, one of the modes of syllogism of the first figure, in which the major proposition is an universal affirmative, and the minor and conclusion are particular affirmatives: thus,

> Every thing that is moved, is moved by another;
> Some body is moved;
> Therefore some body is moved by another.

DARIUS, the name of several kings of Persia. See PERSIA.

DARJEELING, in Hindustan, a sanatory station founded by the British government for the reception of invalid European soldiers from one of the military divisions of the presidency of Bengal. It is situate on a strip of mountain territory ceded in 1836 by the Rajah of Sikkim in consideration of a pecuniary equivalent. The spot possesses great advantages for a sanatarium, in the salubrity of its climate and facility of access from the plains of Bengal. Its elevation is 7218 feet above the level of the sea, and as in India generally, the temperature is observed to fall one degree for every 300 feet of elevation. Its mean temperature is about twenty-four degrees below that of Calcutta, or only two above that of London. The grant of L.600 per annum, which was made to the Rajah of Sikkim as compensation for the cession of Darjeeling, was declared to be forfeited in 1850 in consequence of gross outrages committed by that prince against British subjects. Lat. 27. 2.; Long. 88. 19. (E. T.)

DARLING, one of the principal rivers of Central Australia, formed by numerous streams between S. Lat. 26. and 27., and E. Long. 151. and 152. Its general course is S.W. to about 142. E. Long., whence its direction is S. to the Murray river, which it joins about S. Lat. 34.; E. Long. 142. During the greater part of its course its waters are salt.

Darlington ‖ Dartford.

DARLINGTON, a municipal borough and market-town of England, county of Durham, and eighteen miles S. of the town of that name. It occupies a declivity on the right bank of the Skerne (an affluent of the Tees), here crossed by a bridge of three arches. The surrounding country is rich and fertile. The market-place is a large and well-built square, from which several of the streets diverge. On the eastern side of the square stands the church of St Cuthbert, a cruciform building in the early English style, and surmounted by a fine tower and spire 180 feet high. Darlington has a grammar-school founded by Queen Elizabeth, a blue-coat, national, and infant schools, mechanics' institute, dispensary, savings-banks, &c. The manufactures of Darlington are considerable, consisting of woollen and linen stuffs, yarns, worsted, optical glasses, and iron and brass wares. Market-day, Monday. Pop. (1851) 11,228.

DARMSTADT, the capital of the grand duchy of Hesse-Darmstadt, and of a cognominal circle in the province of Starkenburg, is situated on the banks of the small stream Darm, from which it takes its name, fifteen miles S. of Frankfort-on-the-Maine. It consists of an old and a new town, with three suburbs, and has a population of about 31,000. The Darm separates the old from the new town. The former, which is inclosed by old walls, has a gloomy uninteresting appearance: the latter is regularly built, and has many handsome edifices. Among the principal buildings are the new palace, the residence of the grand duke, the old palace containing a large picture gallery and a public library of nearly 200,000 volumes, a fine new Catholic church, the Lutheran city church, the arsenal, *exercier-haus* (drilling-house), theatre, and several barracks. It has also a gymnasium, a normal school, a school of arts and sciences, numerous literary and scientific institutions, and several museums and public gardens. Darmstadt is the seat of the government and the principal courts, but is a place of little trade. The chief manufactures are tobacco, wax candles, carpets, paper, jewellery, &c. In the fourteenth century Darmstadt was only a village, belonging to the Counts of Katzenellenbogen. In 1380 it was raised to the rank of a town. The male line of the house of Katzenellenbogen becoming extinct by the death of Philip in 1479, Darmstadt passed by marriage into the house of Hesse. In the war of Smalkalde the town was taken by the imperial army. After the death of Philip the Magnanimous in 1567 the town fell to his youngest son George, who there fixed his residence; and was the founder of the line of Hesse-Darmstadt.

DARNETAL, a town of France, department of Seine-Inferieure, arrondissement of Rouen, and two miles E. of that city. It is situated on a small stream called the Aubette. Manufactures,—woollens, flannels, cottons, and paper. Pop. 5900.

DAROCA, a small town of Zaragoza, in the fertile basin of the Jiloca. It contains a fine old Gothic church. From its position it is very liable to inundations, but the waters are carried off by a magnificent tunnel 2340 feet long, and 24 feet square, constructed in 1560, by a French architect named Pierre Bedel. For the first time since the construction of this great work the town was inundated in 1854, and a large portion of it swept away. Pop. 500.

DARTFORD, a parish and market-town of Kent, 15 miles E.S.E. of Kent, on the river Darent, from which it derives its name. It is celebrated as the first place in England where the manufacture of paper was established, and it still contains extensive paper mills. It had also the priority in the preparation of iron for wire-drawing, and still possesses a considerable trade in iron and machinery. The

Dartmouth || Daru.

water-power of the river is made available for driving cotton, oil, and corn mills, and in the neighbourhood there is an extensive powder manufactory. The parish church is a handsome edifice, and there are four places of worship for Dissenters. Near the town are the ruins of an ancient nunnery founded by Edward III., and occupied temporarily as a royal residence by Henry VIII. and Elizabeth. Pop. (1851) 5763.

DARTMOUTH, a seaport-town of Devonshire, at the mouth of the Dart, 31 miles S.W. from Exeter, and 12 miles from Torquay. It stands in the recess of a spacious bay capable of containing 500 sail, and is defended by an ancient castle and a battery. The river, which is crossed at Dartmouth by a floating bridge, is navigable as far as Totness. The town formerly carried on a considerable trade with Newfoundland, but this has been almost entirely alienated. It is now for the most part dependent on the coasting trade, and the trade with the Mediterranean. The principal exports are cider and barley. Dartmouth is one of the quarantine ports of the channel. The town contains several handsome churches, and munificent charitable endowments. Its occupation was strongly contested in the parliamentary war; the town having been besieged by Prince Maurice in 1643, and retaken by Fairfax in 1646. Pop. (1851) 4508.

DARU, COMTE DE, a peer of France, a member of the French Academy and of the Academy of Sciences, and a distinguished historian, was born in 1767 at Montpellier, where his father held the office of secretary to the intendancy of Languedoc. He entered the army at the age of sixteen, and at the period of the revolution was lieutenant and commissary at war. Like most of the high-spirited youths of that time, he warmly embraced the principles of political amelioration which were then professed, and made the campaign of 1792 against the Prussians. But not long after the battle of Valmy, and the retreat of the Duke of Brunswick, he was arrested as a suspected person, and imprisoned for 18 months, during which he amused his solitary hours with poetical and other compositions. After the guillotine had done tardy justice on Robespierre, and terrorism had ceased, he was liberated; and subsequently he filled several important situations in the commissariat and the office of the ministry of war. When the 18th Brumaire gave France a new master in Bonaparte, the first consul appointed him secretary to the ministry at war; and the day after the battle of Marengo, the victorious chief nominated him one of the commissioners for the execution of the convention concluded between General Berthier and General Melas. Having warmly attached himself to the fortunes of Napoleon, Daru was, in 1805, nominated a counsellor of state and intendant-general of the emperor's military household. In 1806, he was appointed intendant-general of the Brunswick territory, and subsequently commissioner for the execution of the treaties of Tilsit and Vienna, as well as minister plenipotentiary at Berlin. In 1806 he was elected a member of the Institute, and in 1808 an honorary member of the Berlin Academy. In 1811 he was appointed minister secretary of state; and shortly afterwards he received the portfolio of the war department. He accompanied Napoleon in his Russian campaign; and in the council summoned immediately after the capture of Smolensko, to consider whether the French forces should advance farther during that season, he gave his voice decidedly in the negative. When the disastrous retreat from Moscow had commenced, General Matthieu Dumas having fallen into bad health, Daru was obliged to assume the functions of intendant-general of the army; and his capacity for labour, which was happily united with an iron constitution, enabled him to fulfil, with apparent ease, duties which might have killed several men of ordinary strength. After the restoration of the Bourbons, he was made intendant-general to the king; an appointment which he received in December 1814. But on the return of Napoleon from Elba he joined the standard of his old master, subscribed a considerable sum for the purpose of arming the Parisian fédérés, and in his capacity of counsellor of state attached his signature to the celebrated declaration of the 25th March. The second restoration, accordingly, found him compromised by his connection with the government of the Hundred Days; and he retired for a time to private life, in order to devote himself to literary pursuits. But in 1819 he was summoned by royal ordonnance to the Chamber of Peers, where his rectitude of judgment, his administrative knowledge, his business habits, and his talents as a public speaker, rendered him one of the most formidable adversaries of the Villèle ministry, and enabled him to signalize himself as one of the most powerful defenders of the national liberties. In 1821 he published his *History of Venice*, which is by far the most important of his works, and that upon which his literary fame principally rests. It is now universally regarded as the most complete and impartial history of that singular government, equally remarkable for its strength and duration. His subsequent work, the *History of Bretagne*, displays great labour and accuracy, but is devoid of interest except to historical antiquaries alone. His other productions consist of a poetical translation of Horace, a variety of occasional poems, discourses and *éloges* pronounced in the academy, and speeches delivered in the Chamber of Peers. Count Daru died at his residence near Meulan, Sept. 5, 1829, aged sixty-two. His remains were deposited in the Cimitière Montmartre, and five discourses were pronounced over his tomb by MM. Mirbel, Cuvier, Silvestre de Sacy, Ternaux, and Leroy. Lamartine the poet was elected to fill the vacancy in the Academy occasioned by his death.

Darwin.

DARWIN, ERASMUS, a poet, physician, and medical writer, was born at Elston, near Newark, in Nottinghamshire, Dec. 12, 1731. He was the fourth son of Robert Darwin, Esq., and received the early part of his education at Chesterfield school, under the Rev. Mr Burrows. He was entered, with two of his elder brothers, at St John's College, Cambridge; and, being intended for the practice of physic, he took the degree of bachelor in medicine in 1755, defending in his thesis an opinion that the motion of the heart and arteries is produced by the immediate stimulus of the blood. During his residence in Cambridge, Darwin was elected to one of Lord Exeter's scholarships, worth about sixteen pounds per annum, which, from the meagreness of his father's income at that time, was esteemed a desirable acquisition. After having prepared himself for his future profession, by an attendance on the lectures of Dr Hunter in London, and by a severe course of study at Edinburgh, he contemplated the metropolis as the proper theatre for his exertions. Deterred, however, by the improbability of obtaining immediate patronage, Dr Darwin thought it more advisable to settle in the country. The first place to which he went, in the capacity of physician, was Nottingham, where, being disappointed in his hopes of practice, he removed to Lichfield. Here his great capacity and various acquirements were most justly appreciated. He resided at Lichfield for many years, in the enjoyment of an extensive reputation, and a profitable practice.

In the year 1757 Dr Darwin married Miss Mary Howard, daughter of Charles Howard, Esq. By this lady, who died in 1770, he had five children, two of whom died in infancy. The eldest son, Charles, was educated for the medical profession, but died in the twentieth year of his age, very soon after he had finished his curriculum at Edinburgh, where he gained considerable reputation, by endeavouring to furnish a criterion for distinguishing *pus* from *mucus*. Soon after the decease of his wife, Dr Darwin commenced the *Zoonomia*, which, however, he did not publish till long afterwards.

Data ‖ Dathan.

In 1780 Dr Darwin married the widow of Colonel Sacheverel Pole, a lady with a jointure of L.600 per annum. This marriage occasioned his removal from Lichfield to Radbourne, and ultimately to Derby, where he continued to reside till within about two months of his death.

During the last years of his life, Dr Darwin was much subject to inflammation of the chest and lungs; and in the spring of 1801 he had a very serious attack of this disease, from which, after repeated bleedings, he with difficulty recovered. On 10th April 1802 he was attacked with febrile disorder, which at the end of a week proved fatal.

Dr Darwin left a widow and six children, three boys and three girls, by his last marriage. Besides these, he left two natural daughters, whom he had established in a school at Ashbourne, and for whose instruction and assistance he composed and published his *Treatise on Female Education.*

Darwin was distinguished through life for his benevolence of disposition, which was particularly conspicuous in the care which he took even of the lower animals. He was of a middle stature, in person portly and corpulent; his features were coarse, and his countenance, though not wholly devoid of animation, certainly was by no means expressive.

The pretensions of Dr Darwin as a medical philosopher rest chiefly on his *Zoonomia.* Whether this work be considered as a mere repository of curious natural and medical facts, or as a scheme and system of pathological and physiological disquisition, it must be allowed to possess considerable merit. As a philosophical agriculturist Dr Darwin is entitled to high consideration. A small portion of his *Phytologia* is devoted to a fanciful system of vegetable physiology; the second part, divided into three sections, treats of the economy of vegetation; and the third of agriculture and horticulture. Dr Darwin's reputation as a poet does not stand high. As a prose writer he was incorrect; his grammatical errors are numerous, and he was even deficient in orthography. In the year 1758 he published various papers in the *Philosophical Transactions.* In 1782 the Botanical Society of Lichfield published a translation of Linnæus's *Systema Vegetabilium,* the execution of which was principally confided to Dr Darwin. He left a poem entitled *The Temple of Nature,* which was published after his death.

DATA, among mathematicians, a term for such things or quantities as are given or known, by which to find things or results that are unknown. The *data* of Euclid form the first in order of the books which have been written by the ancient geometricians, to facilitate the method of resolution or analysis.

From the primary use of the word *data* in mathematics, it has been transplanted into other branches, as philosophy, medicine, and the like, where it expresses any quantity which, for the sake of a present calculation, is taken for granted to be such, without requiring an immediate proof of its certainty; which is also called the *given* quantity, number, or power. And hence also such things as are known, and from which, either in natural philosophy, the animal mechanism, or the operation of medicine, we come to the knowledge of others unknown, are now by physical writers frequently termed *data.*

DATE (Lat. *datum,* given; from *do,* to give), that addition to a writing of any kind which specifies the year, month, and day, when given or executed. Under this term is usually included also the name of the place where the writing is executed.

DATE, the fruit of the palm. See PHŒNIX DACTYLIFERA; and BOTANY, vol. v., p. 213.

DATHAN, a Reubenite chief who, with Korah and Abiram, conspired against the authority of Moses and Aaron, and was miraculously swallowed up by the earth. (Numbers xvi.)

Datisi ‖ Daubenton.

DATISI, in *Logic,* a mode of syllogisms in the third figure, in which the major is an universal affirmative, and the minor and conclusion are particular affirmative propositions. For example,

All who serve God are kings;
Some who serve God are poor;
Therefore some who are poor are kings.

DATIVE, in *Grammar,* the third case in the declension of nouns, expressing the state or relation of a thing to which some other thing is referred. It is called *dative,* because usually governed by a verb implying something to be given to some person. As *commodare Socrati,* to lend to Socrates; *utilis reipublicæ,* useful to the commonwealth; *perniciosus ecclesiæ,* injurious to the church. In English, in which properly there are no cases, this relation is expressed by *to* or *for.*

DAUBENTON, LOUIS-JEAN-MARIE, a distinguished naturalist, was born at Montbar, in the department of the Côte d'Or, in France, May 29, 1716. His father, Jean Daubenton, was a notary in that place; his mother's name was Marie Pichenot. In his youth he was distinguished for the sweetness of his temper, and by his diligent application to his studies. The Jesuits of Dijon, under whose tuition he was first placed, noticed him in a peculiar manner. Having gone through a course of what was called philosophy under the Dominicans of Dijon, his father, who destined him for the church, and who had made him assume the ecclesiastical dress at the age of twelve, sent him to Paris to study theology. But his predilection for natural history induced him privately to study medicine. Accordingly he attended the lectures of Baron, Martinenq, and Col de Villars, and likewise those of Winslow, Hunault, and Antoine de Jussieu, in the botanic garden. The death of his father in 1736 enabled him to follow his inclination without constraint. Accordingly he took his degree at Rheims in 1741, and returned to his native town with the intention of following the practice of medicine. But fortune destined him for a more brilliant career.

Buffon, also a native of Montbar, had at this time formed the bold plan of giving life to the dry and sterile study of natural history. Too ardent and impatient to brook the tedium of minute and prolonged investigation, he looked around for a man of sufficient patience and sagacity to act a secondary part in the undertaking. Such a man he found in Daubenton, the companion of his infancy.

The character of these two philosophers was almost opposite in every respect. Buffon was violent, impatient, and rash; Daubenton was all gentleness, patience, and caution; Buffon wished to divine the truth rather than to discover it; Daubenton believed nothing which he had not himself seen and ascertained; Buffon suffered his imagination to lead him from nature; Daubenton, on the contrary, discarded from his writings every expression which was calculated to mislead. They were thus happily fitted to correct each other's faults; and accordingly the history of quadrupeds, which appeared whilst they thus laboured together, is the most exempt from error of any of the divisions or departments into which Buffon's great work on natural history is divided.

Buffon drew Daubenton to Paris about 1742, and procured for him the place of demonstrator of the cabinet of natural history, at first with a salary of only 500 francs, but which was gradually increased to 2000. He furnished him likewise with a lodging, and neglected nothing to secure his comfort and convenience. Daubenton, on his side, devoted himself to carry out the views of his benefactor. The cabinet of natural history, which was arranged, and in a great measure collected, by his means, proved of immense service. In the history of quadrupeds he gave the description and dissection of a hundred and eighty-two species of quadrupeds. These details contained a great number of new facts, arranged in such a manner that the most curious results are

Daughter || Dauphin.

often obtained merely by comparing them together. This work procured for Daubenton a very high reputation, and drew upon him the envy of Réaumur, who at that time considered himself as at the head of natural history in France. But the credit and reputation of Buffon were sufficient to prevent his friend from falling a victim to the attack of this formidable antagonist.

In the subsequent parts of his natural history, Buffon was persuaded to separate himself from Daubenton. This injured the precision and value of these parts excessively, whilst it deprived Daubenton of 12,000 francs a-year. Afterwards the intimacy between them revived, and continued till the death of Buffon.

The number of dissertations on natural history which Daubenton published in the Memoirs of the French Academy is so great, that even a list of them would be too long for this place. Descriptions of different animals, dissections, comparisons between the forms of different animals, anatomical examinations of fossil bones in order to determine the animals to which they had belonged, the physiology of vegetables, and different departments of mineralogy, successively occupied him; not to mention his experiments on agriculture and rural economy, which, however, were of more service to him afterwards than all the rest of his labours, on account of the reputation which they had procured for him among the people.

By his lectures, as well as by his publications, Daubenton greatly promoted the cause of science. From 1775 he gave lectures on natural history in the college of medicine. In 1783 he lectured on rural economy. He was appointed professor of mineralogy by the Convention at the Jardin du Roi, and he gave lectures at the Normal School during the ephemeral existence of that institution. He was likewise one of the editors of the Journal des Savans, and contributed to both the Encyclopædias. As a lecturer he was extremely popular, and, what is uncommon, he retained his popularity to the last.

In the year 1799 he was appointed one of the members of the conservative senate, and he resolved to attend the meeting of it. This obliged him to alter his regimen. The season was severe. At the first meeting which he attended he fell from his seat in an apoplectic fit. The most speedy assistance was procured, and he was restored to consciousness. With the utmost calmness he pointed out with his fingers the progress of the paralysis in different parts of his body. After a short illness he died Jan. 1, 1800.

DAUGHTER (Saxon, *dohter*; Ger. *tochter*); a female child. In the Old Testament, the word daughter is used in a variety of other senses: as, for example, to designate a uterine sister, niece, or *any* female descendant; women, as natives, or professing the religion of certain places, as the "Daughter of Zion," "Daughters of the Philistines;" also to denote small towns or colonies belonging to or derived from large cities, &c. This metaphor is illustrated by the almost universal custom of representing towns under the figure of a woman.

DAULIS, in *Ancient Geography*, one of the oldest towns of Phocis, not far from the confines of Bœotia. It was associated in mythology with the tragic story of Tereus, Progne, and Philomela. Daulis was twice destroyed in ancient times; first by Xerxes, in the second Persian invasion; and afterwards by Alexander the Great. Its position, on the top of a strong hill, rendering it important as a military station, caused it to be rebuilt. The ruins of Daulis are still to be seen near the modern village of Dhavlia.

DAUPHIN, a title given to the eldest son of the royal family of France, and heir presumptive of the crown, on account, as is said, of the province of Dauphiné, which in 1349 was granted to Charles Philippe of Valois (afterwards Charles V.), on this condition, by Humbert, dauphin of the Viennois. The dauphin, in his letters patent, styled himself "By the grace of God, eldest son of France, and dauphin of Viennois."

Dauphiné || Daurat.

Most authors who have sought the origin of the name Dauphin and Dauphine, seem to have indulged too much in conjecture. Duchesne is of opinion that it was the grandson of Guy the Fat who first bore the name of dauphin. But Chorier observes, that William, canon of Nôtre-Dame at Grenoble, who wrote the life of Margaret, daughter of Stephen earl of Burgundy, married to Guy, son of Guy the Fat, calls the latter simply Guy the Old, and the former always Count Dauphin; and he adds, that no record nor monument ever attributes the title of dauphin to Guy the Fat, or to any of his predecessors. Hence the word must necessarily have taken its rise in his son, all of whose successors so constantly assumed it that it became the proper name of the family. Guy died in the year 1142, in the flower of his youth; so that it must be about the year 1120 that the title originated, and without doubt, on some remarkable occasion. Chorier observes further, that this prince was of a military disposition, and delighted in nothing but war; and again, that it was the custom of the cavaliers to deck their casques, their coats of arms, and the housing of their horses, with some figure or device peculiar to themselves, and by which they were distinguished from all others engaged in the same combat or tournament. From all these circumstances, he conjectures that this Guy chose the dolphin for his symbol, that this was the crest of his helmet, and that he bore it on his coat in some notable tournament or battle in which he distinguished himself. Such, according to Chorier, is the real origin of the appellation.

The seigneurs or lords of Auvergne have likewise borne the appellation of *dauphin*; but the dauphins of Auvergne did not bear that title till a considerable time after those of the Viennois, and even received it from them. The manner of their doing so may be briefly explained. Guy VIII. dauphin of Viennois, had by his wife Margaret, daughter of Stephen earl of Burgundy, a son and two daughters. The son was his successor Guy IX. Beatrix, one of the daughters, was married to the Count d'Auvergne, who, according to Blondel, was William V., or rather, as Chorier and others think, Robert VI., father of William V. This prince lost the greater part of the county of Auvergne, which was taken from him by his uncle William, assisted by Louis the Young; and he was left master of only the little canton of which Vaudables is the capital. But he had a son whom he called Dauphin, on account of Guy, or Guignes, his uncle by the mother's side; and from his time his successors, holding the same petty canton of Auvergne, styled themselves *dauphins of Auvergne*, and bore a dolphin for their arms.

DAUPHINÉ, an ancient province of south-eastern France, now forming the departments of Isère, Drôme, and Hautes-Alpes. Its first Celtic occupants were the Allobroges and Caturiges, and it remained under their sway till the time of Charles Martel. When annexed to the territory of the French king, the title of dauphin, now extinct in the line of independent counts, was given to the eldest son of the royal family.

DAURAT, or DORAT, JEAN (1507–1588), a French poet, born in the Limousin. He studied at the University of Paris, and succeeded Stracellus as professor of Greek. He had an excessive fondness for anagrams, and his enthusiasm led him to write a French and Latin commentary on the *centuries* of the prophet Nostradamus. His rage for verse-making amounted almost to a disease. Scaliger, who entertained a high opinion of his learning and abilities, and ranked him with Cujas as a critic, informs us that Daurat spent the latter part of his life in endeavouring to find all the Bible in Homer. In the reign of Henry II. he was preceptor to the king's pages; and Charles IX., who took great delight in his conversation, honoured him with the title of his poet.

Davenant || David.

DAVENANT, JOHN (1576–1641), a learned English prelate, was born at London, where his father was a wealthy merchant. He was educated at Queen's College, Cambridge, and ultimately became Margaret professor of divinity, and master of his college. He was sent to the synod of Dort in 1618; and three years after was elevated to the see of Salisbury. His principal works are an Exposition of the Epistle to the Colossians, and Prelections on certain disputed points in theology, including a Treatise on Justification.

DAVENANT, *Sir William*, a distinguished dramatic poet of the seventeenth century, was born in 1605 at Oxford, where his father kept the Crown Inn. He was entered at Lincoln College, Oxford, and on leaving the university became page to the Duchess of Richmond, and afterwards entered the service of Lord Brooke. On the death of Ben Jonson he was created poet-laureate; but political troubles compelled him almost immediately afterwards to retire to France. On his return he was knighted by the king, at the siege of Gloucester, in 1643; but after a short residence in England, he again retired to France, where he rendered himself still more obnoxious to the king by changing his religion and engaging in the service of Henrietta Maria, the queen-mother. By her he was commissioned to undertake an expedition to Virginia; but having been captured at sea, he was taken prisoner and thrown into the Tower. At the intercession of Milton and others he was liberated, and established a theatre, on the stage of which he exhibited declamations illustrative of moral virtue, accompanied by recitative music. After the Restoration, the regular drama reappeared upon the stage, but most of Davenant's pieces were disfigured by the combination of English and French styles. His works consist chiefly of dramas and addresses. Gondibert, an unfinished epic, was written during his residence in Paris, and is dedicated to Hobbes. He died in 1668, and was buried in Westminster Abbey. In imitation of Ben Jonson's epitaph, his tomb bears the inscription, "O rare Sir William Davenant." In personal appearance Davenant bore a striking resemblance to Shakespeare. A story was current in his own day that he was an illegitimate child of the great poet, who, on his journeys to London, had frequently to put up at his father's inn. Certain it is that Davenant never discountenanced the circulation of such a rumour. His son, Dr Charles Davenant (1656–1714), was inspector of plays to James II., and attracted considerable attention by his Essay on Trade, and his pamphlets on the political and financial measures of the day.

DAVENTRY, a parish and market-town in the hundred of Fawsley, Northamptonshire, 13 miles N.W. from Northampton. It stands on an eminence near the source of the Avon and Nen, and carries on an extensive manufacture in shoes and whips. Pop. (1851) 4430.

DAVID (*i.e. Beloved*), the psalmist of Israel, was born at Bethlehem, and was the youngest son in a princely family of Judah. He was shepherd of his father's flocks when privately anointed by Samuel to fill the throne of the apostate Saul; but his skill as a musician brought him on several occasions to court, to soothe the melancholy of the king, and his personal bravery ultimately raised him to the rank of royal armour-bearer. Having probably retired for some time to his rustic duties, he was recognized neither by Saul nor his captains when he presented himself for single combat with Goliath. His splendid victory, however, soon roused the morbid jealousy of the king; and in his fits of melancholy Saul made several ineffectual attempts to destroy him. Convinced at last that there was a method in the royal madness, David precipitately retreated from the court, and narrowly escaped falling into the hands of the emissaries of Saul. The flight of Abiathar to the rebel, after the massacre of the priests by Saul, now roused the piety of the Hebrews as his heroic deeds had roused their valour, in his favour. For a time he sought refuge with the Philistines, and feigned insanity in order to escape the machinations of their princes. When this retreat became dangerous, he enjoyed a precarious shelter in the cave of Adullam. At last, recommending his family to the protection of the king of Moab, he assumed the defensive, and at the head of 600 men, principally malcontents, he captured the frontier fortress of Keilah. In the wilderness of Ziph he received a consolatory visit from Jonathan, the crown-prince; and twice in the pursuit the person of Saul fell into his hands, but he refused to pave his way to the throne by regicide. Retiring to Ziklag, which he had received from Achish, he engaged in excursions against the predatory enemies of Israel, on whom he was inflicting a dire revenge for the burning of his city, when the death of Saul called him to the vacant throne. Having been recognised as king by the tribe of Judah, he fixed the centre of his administration at Hebron, an ancient city, honourable by its association with Abraham, and appointed one of the cities of refuge at the entrance of the Israelites into Canaan. At this crisis a faint opposition was stirred up in the other eleven tribes in favour of Ishbosheth, Saul's son; but the coalition fell to pieces, and was suffered to die away in silence. After the battle of Gilboa, the Philistines entirely disappear from the field, content perhaps with having broken the power of Saul, and calculating probably on the friendship of the hero whom they had recently sheltered amongst them. Feeling themselves unequal to the task of subjecting the land of Israel, it is probable that they were glad to welcome the prospect of peace held out by the dissensions of the kingdom in regard to the succession. At Hebron David strengthened himself by forming an alliance with the daughter of Talmai, king of Geshur; and it was here that six of his sons were born. In the eighth year of David's reign (B.C. 1048), the rulers of the eleven tribes rendered homage to him as the king appointed by Jehovah, and the event was solemnized by a feast. With the assassination of Ishbosheth the hopes of the house of Saul were extinguished; but the consolidation of the Israelitish power under one constitutional kingdom roused the fears of the surrounding princes. After defeating the Philistines in the valley of Rephaim, David addressed himself to the siege of Jebus or Jerusalem, whose citadel had till then remained in the hands of the Jebusites. At an early period of his history David had recognised the strength of the fortifications of Jerusalem, and had chosen the forts which belonged to Judah as the safest place in which to deposit the head of Goliath. The strength of his arms, however, now enabled him to seize on the Benjamite fortress, which that tribe, from its weakness, had never been able to wrest from the Jebusites. The previous bipartite division of the fortresses (compare Joshua xv. 8, and xviii. 16) thus absolves us from the necessity of regarding the incident in David's earlier history as an anachronism. Selecting it for his residence, he built a palace on Mount Zion; and soon after removed the ark of the covenant, the throne of Jehovah, from Kirjath-jearim to Jerusalem. The disorganized state of the priesthood during the time of Saul, is apparent from many incidental notices in the narrative. They were now, however, appointed to their various sacred duties, and the monarch himself set a public example of piety, by forgetting his dignity in presence of the ark. His intention to build a temple as a palace for the throne of God, was defeated by Nathan and reserved for his successor. As the author of the inspired psalmody, he conferred a more lasting boon on the universal church. Under David the arms of the Hebrews were victorious in every quarter. The Nomadic Arabs, the Amalekites, Edomites, Moabites, and even the Philistines and Ammonites, were forced to bow to their dominion. The auxiliary kings of Maachah, Bethrehob, Zobah, and Tob, were defeated by him; and even

David.

David. Hadadezer, the king of Nisibis, an ally of the Assyrians, was obliged to remain quiet on the eastern side of the Euphrates, and leave to the Hebrews the kingdom of Damascus as far as Berytus. The last days of David were afflicted by the inevitable results of polygamy and despotism. The rebellion of Absalom, the insurrection of Sheba, and the conspiracy of Adonijah, followed hard upon each other, and peace was restored only by the decisive measure of raising Solomon to the throne. Of all David's sons Absalom had naturally the greatest pretensions to the throne, and his popularity and address gained him numerous adherents in his insurrection. Multitudes flocked to his standard at Hebron; and if the prompt advice of Ahithophel had been carried into effect, David would either have been imprisoned or slain in his own capital. The delay of the rebels facilitated his escape, and soon he had mustered sufficient force to crush their army in the field. The slaughter of Absalom by Joab in the retreat put an end to the hopes of the rebels. Far more unaccountable is the insurrection of Sheba; but the vigorous tactics of Amasa isolated him from his followers, and the few who were with him in Bethmaachah compounded for their own safety by throwing their chieftain's head over the wall. The conspiracy of Adonijah, supported by the priestly influence of Abiathar, and the military experience of Joab, seemed more formidable than either of the previous risings; but on the elevation of Solomon to the throne an amnesty was proclaimed, and the coalition quickly fell to pieces. David died at peace in Jerusalem, in the seventy-first year of his age, thirty-three of which he had reigned over the whole people of Israel, and seven over the united tribes of Judah and Benjamin, at his capital in Hebron. In regard to the character of David, his scrupulous attachment to the principles and practice of the theocracy gained him the appellation of the "man after God's own heart;" and it was doubtless in this spirit that many of his political acts of vengeance were perpetrated. Of his own generous disposition, we have many unmistakeable proofs, even in his later years; as, for example, his choice of pestilence to be the instrument of national punishment, which unlike war or famine struck alike at the peasant and the prince. Certainly he was no ideal model of human perfection; but the flagrant enormities of which he was on several occasions guilty, and more especially the never to be forgotten outrage on the wife of Uriah the Hittite, must be read in the light of those psalms which have not only supplied the language of contrition to penitents of every age, but were the predestined utterances of the Redeemer's agony.

DAVID, *Jacques-Louis*, the founder of the modern French school of painting, which he led to the study of antique sculpture. He was born at Paris in 1750; and in 1774 went to Rome, where he devoted himself particularly to historical painting. In this department he soon began to evince considerable talents. In 1784 he finished his Oath of the Horatii, which he had been commissioned by Louis XVI. to design from a scene in the *Horaces* of Corneille. This work gave a certain impulse to the national taste; but though the figures be correctly drawn, their attitudes are constrained and theatrical; the colouring is hard, and deficient in what is technically termed *juiciness*. In the same year he painted his Belisarius; in 1787 appeared his Death of Socrates; and these were followed in quick succession by other works. He had begun to distinguish himself also in portrait-painting, and might have followed out a tranquil and brilliant career; but on the outbreak of the revolution, he was seized with the universal mania, and mixed himself up with some of the most revolting transactions of that bloody period. In 1789 he finished his large picture of Brutus condemning his sons to death. He also furnished the designs of the numerous monuments and republican festivals of that time. In 1792 he was chosen an elector in Paris, and afterwards a deputy; and during the Reign of Terror he David's, St was one of the most zealous Jacobins, and wholly devoted himself to Robespierre. At the trial of Louis XVI. he voted for the death of that unfortunate prince. In January 1794 he presided in the convention. After the fall of Robespierre, he was in great danger, and his fame as a painter alone stood between him and the guillotine. Amongst the scenes of the revolution which David strove to immortalize by his pencil are the murders of Marat and Lepelletier; and particularly the Oath of the Jeu de Paûme, and the entrance of Louis into the National Assembly. In 1799 he executed the Rape of the Sabine Women, which is regarded as his masterpiece, and by the exhibition of which he realized, it is said, L.4000 sterling. In 1804 he was appointed first painter to the emperor, and received commands to execute four pieces,—amongst which the coronation of Napoleon was particularly distinguished. Among his finest works of this period are many representations of the emperor, particularly that in which, as first consul, he is represented on horseback on Mount Bernard, pointing out to his troops the path which led them to victory. This piece is now in Berlin. In 1814 he painted Leonidas, the last work which proceeded from his pencil before he quitted Paris on the reverses of his imperial master. When Napoleon returned from Elba he appointed David a commander of the legion of honour. After the second restoration of Louis XVIII. he was included in the decree which expatriated all the regicides. He established himself in Brussels, where he painted Cupid leaving the arms of Psyche. The last of his productions, Venus, Cupid, and the Graces, disarming Mars, was much admired at Paris. David died in exile at Brussels, December 29, 1825. Various opinions are entertained of his merits. It cannot be denied that his pictures are marked by cold correctness and knowledge of the antique; but the works of the bloody agent of the Reign of Terror scarcely can be said to exhibit the fire of true genius. His most celebrated productions, the Oath of the Horatii, and the Rape of the Sabine Women, were purchased by the French government, and are now to be seen in the gallery of the Luxembourg.

DAVID'S, ST, an ancient and decayed episcopal city of Wales, Pembrokeshire, situated on the small river Allan, 15 miles from Haverford-West. A religious establishment was founded here at a very early period, and appears to have been deemed of the highest importance by the ancient Britons. The ecclesiastical buildings suffered severely from a Danish force about 911; and were again much injured by Sweyne, the son of Harold, in 993. William the Conqueror, who entered Wales with a great army, visited this place as a pilgrim and devotee, and made an offering at the shrine of St David. The cathedral, episcopal palace, St Mary's College, and the other ecclesiastical buildings, were inclosed within a lofty embattled wall, more than 1200 yards in circumference, with four strong and handsome gateways. The present cathedral, occupying the site of the more ancient structure, is a venerable Gothic cruciform edifice, commenced in the reign of Henry I., and completed in that of John, but now in a very dilapidated state. A richly ornamented square tower, 127 feet high, surmounts the western end. The length of the building within the walls is 307 feet, of the nave 128, of the choir and chancel 99. The bishop's throne is of exquisite workmanship. Many of the tombs are old and curious. The aisles north and south of the chancel are roofless, and the cloisters and some other parts are mere heaps of ruins. Of the bishop's palace, founded by bishop Gower in the fourteenth century, and one of the most magnificent edifices of the kind in the kingdom, parts of two sides only remain. It appears to have formed a complete quadrangle, inclosing an area of 120 feet square. The grand entrance is a beautiful but ruined gateway. Of St Mary's College, founded by John of Gaunt in 1365, the only relic is a chapel which has long been without a roof,

Davidists || Davila.

and is fast going to decay. The shrine of St David was for ages regarded as possessing a peculiar sanctity, and was resorted to by crowds of pilgrims. At the western extremity of the town is an ancient cross, where the market was formerly held. Besides the few clergy who perform duty in the cathedral, the inhabitants of St David's are chiefly labourers employed on the adjacent farms. Every part of the surrounding country was at one time covered with chapels, crosses, and sainted wells. It still abounds with relics of Druidical usages. St David's Head, the most western point of Wales, is a lofty, rugged, and gloomy promontory, about two miles N.W. of the city.

DAVIDISTS, or DAVID-GEORGIANS, an heretical sect, the followers of David Joris, who was born at Delft in 1501. This man was the son of a market-crier, and early made himself conspicuous by his fanatical opposition to the Roman Catholics. He joined the Anabaptists in 1534, and in his preaching tours became an object of general persecution. In 1542 he published his *Book of Wonders*, from which the most extravagant opinions, in regard to his own Messiahship, and his contempt of morality, have been extracted by his enemies. For twelve years before his death he lived at Basle in communion with the Reformed church, under the feigned name of John von Brugge. His followers, in spite of laws passed against them, maintained themselves in Holland till the middle of the seventeenth century.

DAVIES, SIR JOHN (1570-1626), a celebrated poet and lawyer of the age of Queen Elizabeth, was a native of Tisbury in Wiltshire. He is chiefly known now by his didactic poem, entitled *Nosce Teipsum*. After holding a number of minor legal appointments, and sitting in the Irish parliament, Davies died suddenly of apoplexy immediately after he had been chosen Lord Chief Justice of England.

DAVILA, ARRIGO CATERINO, a celebrated historian, was born October 30, 1570, at Sacco, a village near Padua. He was the youngest son of Antonia Davila, grand constable of Cyprus, who, on the taking of that island by the Turks in 1570, had been obliged to retire into Spain, from which his family supposed that they had derived their name and origin. From Spain Antonio repaired to the court of France, and settled his son Louis and two daughters under the patronage of Catharine de' Medici, whose name he afterwards gave to the historian. Young Davila was brought early to France; and at the age of eighteen he signalized himself in the civil wars of that country, and had a horse killed under him at the siege of Honfleur in 1594. His last exploit there was at the siege of Amiens, where he fought under Henry IV. and received a wound in the knee. After peace had been established in France, in 1598 he withdrew into Italy, whither he had been recalled by his father, and afterwards entered into the service of the Venetians. While at Venice he wrote his admirable work entitled *Historia delle guerre civili di Francia di Henrico Caterino Davila, nella quale si contengono le operationi di quattro re, Francesco II., Carlo IX., Henrico III., et Henrico IV., cognominato il grande*, in fifteen books (Venice, Tommaso Baglioni, 1630, 4to), which contains everything worthy of notice that passed from the death of Henry II. in 1539 till the peace of Vervins in 1598. He continued to serve the republic of Venice with great reputation, till an unfortunate adventure put an end to his life in 1631. Happening to pass through Verona with his wife and family on his way to Crema, which he had been appointed to defend, and demanding, according to the usual custom of persons in his station, a supply of horses and carriages for his retinue, a brutal Veronese, called *Il Turco*, entered the room where he and his family were at supper, and being mildly reprimanded for his intrusion by Davila, discharged a pistol at him and shot him dead on the spot. The accomplices of the assassin also killed the chaplain of Davila, and wounded most of his attendants. But his eldest son Antonio, a youth of eighteen, avenged the death of his father by killing the murderer on the instant. All the confederates in this dreadful tragedy were secured next morning, and publicly executed at Verona.

Davis || Davits.

There is only one opinion concerning the merit of Davila as a writer. His style is singularly exempt from the vices which prevailed at that time, and, though less pure than that of Guicciardini, is more compact and concise, and at the same time distinguished for its admirable facility. He appears indeed to have taken great pains to discover the truth, to have derived his information from the best sources, and to have spoken in general with much freedom. But this explicitness is sometimes affected by his individual position and connections, and also by the prejudices of his age and country. An Italian of this period could not possibly hold the balance even between the Catholics and Protestants. A man who owed the fortune of his sister, of his brother, and also the commencement of his own, to Catharine de' Medici, and whose very name reminds us that he had been devoted to her service from the period of his birth, could not be an impartial judge of the conduct of the queen-mother. He has accordingly been censured, and not without reason, for the partiality which he evinces towards that bold, bad woman, dwelling upon her address and her prudence, when he should have exposed her profound dissimulation, perfidy, and cruelty. But notwithstanding some other grave faults, on which this is not the place to expatiate, his history remains with all the eminent qualities that distinguish it, whilst its defects can no longer be productive of error or misconception.

The edition which Davila published of his history was very incorrect. It is said that he had offered the work to several publishers of Venice, but that they had all refused it, with the exception of Baglioni, whose presses were idle, and who undertook to print it; on the condition, however, that if any preferable employment came in his way, the printing of the history should be postponed. But when the edition was finished it met with so rapid a sale that the whole was disposed of in a week. It is added that it was reprinted under the same date, and that 15,000 copies were sold in the course of a year, but this appears to be greatly exaggerated. The editions which followed (Venice, 1634 and 1638; Lyons, 1641; and Venice, 1642) were scarcely less faulty than the first; but a better, and indeed a very beautiful one, issued from the royal press at Paris in 1644, folio. The work was translated into French by J. Baudoin, Paris, 1642, in two vols. folio—a translation which has been several times reprinted; into Spanish by Basil Varen de Soto, Madrid, 1651 and 1659; and into English, first by William Aylesbury, London, 1647, folio; and next by Charles Cotterell, London, 1666, folio. Lastly, it was translated into Latin by Pietro Francesco Cornazzano, Rome, 1745, in 3 vols. 4to. The best edition of the original work, however, is that printed at Venice in 1733, 2 vols. folio.

DAVIS, JOHN, a famous navigator of the sixteenth century, was born at Sandridge, near Dartmouth, Devonshire. He distinguished himself by making three voyages along the northern shores of America, in order to discover a north-west passage to the East Indies, and was the discoverer of the straits which still bear his name. He afterwards performed five voyages to the East Indies, in the last of which he was slain in a desperate encounter with some Japanese, near the coast of Malacca, Dec. 27, 1605. He wrote an account of his second voyage for the discovery of the north-west passage, a voyage to the East Indies, and several other tracts. A quadrant invented by him continued in use until superseded by that of Hadley.

DAVIS'S STRAITS, that part of the Polar Sea lying between Greenland and Cumberland Island, and extending from Cape Farewell to Disco Island. It forms the medium of communication between Baffin's Bay and the North Atlantic Ocean. It was discovered by Davis in 1586; and is now the principal resort of whalers in the Northern Ocean.

DAVITS, beams of wood or iron, with sheaves or blocks at their ends, projecting over a vessel's side or stern, to hoist on the boats.

Davy. DAVY, SIR HUMPHRY. This eminent philosopher was born on the 17th of December 1778, in the small town of Penzance, in Cornwall, of very respectable parents, in the humbler walks of life. In that place he received the elements of his education, until 1793, when he was removed to the grammar-school of Truro, then under the direction of the Rev. Dr Cardew. There is scarcely any thing worthy of record in the early years of Davy, except the facility with which he appears to have gleaned the substance of any book that happened to engage his attention, and his early predilection for poetry.

No biography of Davy should omit the disinterested friendship of Mr Tonkin, a respectable medical practitioner of Penzance. This amiable man had adopted the mother of Davy and her sisters, under circumstances of deep distress; and his kindness was extended to all her children, particularly Humphry, whose intended professional career was probably influenced by that of his friend and patron.

In 1794 Davy lost his father, and his mother found herself under the necessity of becoming a milliner in Penzance, whilst young Davy was, in 1795, apprenticed to Mr Borlase, then practising as a surgeon-apothecary, but who afterwards became a physician in that place.

While yet very young, our philosopher had exhibited traces of an ardent, inquisitive mind, an inclination for devising experiments, and for examining the productions of nature. On entering the service of Mr Borlase, his attention was turned to chemical investigations, which he pursued with a characteristic enthusiasm, to the neglect of the humbler art of compounding medicines. His chief laboratory at that time was the garret of his friend Mr Tonkin, who was occasionally alarmed and annoyed by unexpected explosions. His defective apparatus was supplied by the fertile resources of his own ingenuity. It was during this period that he attempted to investigate the nature of the air contained in the vesicles of sea-weed; and his ingenuity in supplying his want of more perfect instruments is well illustrated in the facility with which he contrived to supply the place of an air-pump, by an old French injecting syringe, which accident put into his hands. With this he made several experiments, and actually employed it as an air-pump, in his first original paper on the Nature of Heat and Light.

Davy was not of a temperament or cast of mind to remain long in obscurity. The panting after scientific renown had early taken possession of his soul; and while still the apothecary's apprentice, and regarding medicine as his future means of support, he felt aspirations after distinction in the paths of philosophical discovery; but he was in some degree indebted for an earlier emergence from the obscurity of his native place, to the accidental notice of Mr Davies Giddy Gilbert. The attention of that gentleman had been arrested by the strange contortions of countenance of an ungainly boy, whom he observed hanging over the hatch-gate of Mr Borlase's house; and on being informed that the boy was "a son of Davy the carver, and very fond of making chemical experiments," he sought the acquaintance of young Davy, and was ever afterwards his steady friend.

Another accidental acquaintance was not without its influence on the fortunes of Davy. The late Mr Gregory Watt, long an invalid, had been recommended by his physicians to try the mild air of Cornwall, and took up his lodgings in the house of Mrs Davy. Their first intercourse was not cordial. Watt was taciturn and reserved; and young Davy, with that want of tact which is not uncommon at his age, instead of endeavouring to recommend himself by showing his knowledge of any branch of experimental or natural philosophy which he had studied, sought to make an impression on the valetudinarian inmate of his mother's house by crude and flippant metaphysical speculations. Watt was disgusted, and retired within himself, until an incidental remark of Davy on the imperfection of the French theory of combustion and calcination arrested the attention of the former. They then began to discuss questions congenial to the minds of both, and soon became attached friends. Davy.

It was through these two gentlemen that the subject of our memoir was introduced to Dr Beddoes, who had visited Cornwall on a geological tour, in company with his friend and philosophical opponent Professor Hailstone of Cambridge. The abilities of Davy were favourably shown during the friendly contentions of these rival geologists; and their judgment being advantageously impressed by the encomiums of Gilbert and Watt, Davy was soon afterwards engaged by Dr Beddoes to superintend a pneumatic medical institution, which that able but eccentric man had just then established at Bristol, for the treatment of diseases.

After some negociation, Davy, much to his own satisfaction, received the appointment of superintendent, and repaired to Bristol in 1798, before he had completed his twentieth year. Mr Borlase readily gave up Davy's indenture; but this removal was a severe disappointment to Mr Tonkin, who had placed his fondest hopes on seeing his young friend settled as a practitioner in Penzance.

Davy was now placed in a sphere where his genius could expand; he associated with men engaged in similar pursuits; he was provided with suitable apparatus; and he speedily entered upon that brilliant career of discovery which has rendered his name illustrious among philosophers. It was not his original intention to abandon the study of medicine; but after his engagement with Dr Beddoes had terminated, he had intended to prosecute his medical studies at Edinburgh; a plan which he was induced to abandon by the all-engrossing interest of his chemical discoveries.

Soon after his removal to Bristol, his speculations on *Heat, Light, and Respiration*, appeared in Beddoes's "West-Country Contributions." In that essay, written before he left Cornwall, he endeavoured to prove the immateriality of heat, by showing its generation from the friction of two pieces of ice under the exhausted receiver; but his reasoning on this point was inconclusive, and his mode of insulating the ice very imperfect; whilst it is well known that heat will radiate through the most perfect vacuum. His speculations on Light and Respiration are extravagant, and savour little of the spirit of philosophical induction. It was unfortunate for Davy that he had not a more judicious adviser than Beddoes, a man singularly devoid of philosophical caution, and easily led astray by the loosest analogies.

Davy's first scientific discovery was the detection of siliceous earth in the epidermis of the cannæ, reeds, and grasses. Though the chain of induction be simple, yet the steps give a favourable specimen of his method of investigating phenomena. A child had accidentally discovered, that on rubbing together two pieces of *bonnet-cane*, a faint light was emitted; on examining the fact, he found, that on striking them together, vivid sparks were produced, like those emitted by the collision of flint and steel. On stripping off the epidermis the luminous property was lost, and analysis showed that the epidermis contained silex. The shining appearance of the stems of reeds, corn, and grasses, induced him to examine them also, and he found that they all yielded silex, even in larger quantity than the cane.

About the same period he made his first gaseous discovery, the respirability of *nitrous oxide*. The first intimation of its intoxicating qualities is given in a letter to

Davy. his friend Mr Gilbert, dated April 16, 1799. Soon after, he examined its properties more accurately, administered it to various individuals, and published an account of his discoveries in a volume entitled *Researches Chemical and Philosophical, chiefly concerning Nitrous Oxide and its Respiration.* This essay breathes a very different spirit from his first. It exhibits good models of cautious induction from ingeniously contrived experiments, and shows a happy talent for analyzing the different circumstances which influence the chemical changes observed.

Fortunately for Mr Davy, while the impression from this publication was still fresh on the public mind, the establishment of the Royal Institution in London, under the auspices of Count Rumford, had taken place; and a lecturer of talent was wanting to fill the chemical chair. Dr Hope of Edinburgh has the merit of thus early discovering the high talents of Davy, and of introducing him to the notice of the count; and he was, in the beginning of 1801, chosen lecturer to the institution, and director of the laboratory.

It has been said, that on his first appearance in London, his ungainly exterior had prejudiced Rumford and some other directors against him; but when he began to lecture, he won the approbation of all. His lectures became a fashionable lounge; his ingenuity and happy facility of illustration gained him a high reputation; his company was courted by the choicest society of the metropolis; and soon his presence was regarded as an indispensable requisite in the brilliant soirées of the gay and fashionable world. Adulation paid to talent became fashionable; and at the early age of twenty-two Davy had triumphed over considerable personal defects, and found himself the idol of an admiring capital.

Those who had enjoyed an opportunity of observing him at Bristol, had remarked the simplicity of his mind and manner at that period; and they had noticed his talent for discussing difficult questions, even where his information was exceedingly defective. That the extravagant adulation of the metropolis, so soon after his appearance there, should have been injurious to his native simplicity of manner, is far less surprising, than that it did not entirely destroy that ardour in research which conducted him to fame.

Davy's style of lecturing was well adapted to command the attention of his audience; it was animated, clear, and impressive, notwithstanding the naturally unharmonious tones of his voice; whilst the ingenuity of his happily devised experiments, and the neatness of their execution, were calculated to fix the attention of his hearers. How much these circumstances are calculated to affect the usefulness and popularity of a teacher, is well illustrated by the different impression made on nearly the same audience by the no less original but more profound lectures of Dr Thomas Young, which were discontinued by the committee of the Royal Institution two years after the appearance of Davy.

The young chemist was fortunate in the time of his commencing his metropolitan career. Experimental chemistry was beginning to be the fashion of the day, and it was a very general topic of conversation among the upper circles. Voltaic electricity had just been found to possess the most extraordinary powers of effecting decompositions of chemical compounds; and innumerable experimental chemists, aware of the field of discovery which this powerful instrument promised to open to these researches, were most anxious to possess a powerful galvanic battery. The liberality of the committee of the Royal Institution supplied what few private individuals could afford; and early in his first course as *professor* of chemistry, Davy was put in possession of a battery of four hundred five-inch plates, and one of forty plates a foot in diameter. With these his Davy. early and most brilliant investigations were conducted; and their liberality and his ingenuity were rewarded by the discovery of the metallic bases of the alkalies.

The first communication of Davy to the Royal Society was "an account of some galvanic combinations formed by an arrangement of *single* metallic plates and fluids," which was read in June 1801. This paper is the first of that series of electro-chemical investigations which have immortalized his name. In all hitherto constructed piles, the series had consisted of not less than two metals, or of one plate of metal, another of charcoal, and some interposed fluid. He showed in this paper, that the usual galvanic phenomena might be energetically exhibited by a single metallic plate and two strata of different fluids, or that a battery might be constructed of one metal and two fluids, provided one of the fluids was capable of causing oxidation on one of the surfaces of the metal. Between this communication and his next paper on galvanic phenomena five years elapsed; a period during which many interesting discoveries were made by other philosophers; but Davy had not been idle. In 1802 he was appointed professor to the board of agriculture; and, in addition to the duties of his situation in the Royal Institution, to which that of joint editor of the *Journal* had been added, he gave a course of lectures on the connection between agriculture and chemistry, which was annually continued for ten successive years. In 1803 he was admitted a member of the Royal Society, of which he became first the secretary, and ultimately the president; and he continued to enrich the transactions with numerous memoirs on different branches of experimental philosophy for twenty-five years. Indeed his most valuable productions are contained in the Philosophical Transactions; and it is on these detached papers that his claims to celebrity almost entirely rest. Of his other publications, the Elements of Chemical Philosophy was a signal failure, and only the first volume ever saw the light. His Elements of Agricultural Chemistry had some popularity, though they have scarcely added any thing to our previous stock of knowledge; but there is scarcely one of his communications to the Royal Society which does not announce some new and important fact, or does not elucidate some general principle of experimental philosophy.

He had undertaken to deliver some lectures on the principles of the art of tanning, and had been furnished with the means of obtaining practical and experimental knowledge on the subject. In the course of his preparation for these lectures he discovered some new facts, which were first noticed in the journals of the institution, and afterwards embodied in an elaborate communication to the Royal Society, entitled *An account of some experiments and observations on the constituent parts of certain astringent vegetables, and their operation in tanning,* read in February 1803.

In 1805 he read two papers to the Royal Society. The first was *An account of some analytic experiments* on the Wavellite, which he affirmed to consist of alumine and water. In this analysis he overlooked the presence of fluate of alumine, which was detected in it by the Rev. William Gregor; and still more unaccountably did both the British chemists fail to detect in the mineral phosphate of alumine, which was found afterwards by Berzelius to constitute one third of it. The second paper of Davy, *On the method of analysing stones containing a fixed alkali, by boracic acid,* is really an important addition to analytic chemistry. His method is founded on the strong affinity of that acid for different earths at the point of incandescence, and on the ease with which these borates are decomposed by the mineral acids.

Davy. We now approach the period of Davy's great discoveries.

The power of the pile to effect decompositions was shown in 1800 by Nicholson and Carlisle, and immediately extended by Cruickshank. The appearance of alkalies and acids at opposite poles of the battery had been noticed by different philosophers, but it was reserved for Davy to connect these discoveries by one general law, and to illustrate his theory of Voltaic action by some most happily devised experiments, in the Bakerian lecture, read to the Royal Society in November 1806. It will be sufficient to state, that he satisfactorily showed that the liberation of acid at the positive pole, and of alkali at the negative pole, proceeded entirely either from the decomposition of the vessels used in the experiment, the impurity of the water subjected to analysis, or from the elements of the atmosphere uniting with the hydrogen or oxygen of the water to form ammonia or nitric acid. By a series of very elegantly conducted experiments, he showed that in all Voltaic decompositions the tendency of the electric action was to collect the acid of the compound at the positive wire, and its bases, whether alkaline, earthy, or metallic, at the other pole. He proved that such transfers were not confined to the immediate neighbourhood of the poles, but extended through the whole galvanic circuit which connected them; and that even an acid might be conveyed from one wire to the other, *through* an alkaline, earthy, or metallic solution, without entering into union with it, provided the substance transferred did not form an insoluble compound with the interposed solution. When it did form an insoluble compound, it was withdrawn from the Voltaic action, and consequently its transference was stopped. After examining a great number of such phenomena, he generalized the results by stating, that hydrogen, the alkalis, earths, metals, and certain oxides, are attracted by negatively electrified, and repelled by positively electrified metallic surfaces; that oxygen and acids are attracted by positively, and repelled by negatively electrified metallic surfaces.

After these practical elucidations, Davy proceeded to investigate the law of electro-chemical action. In repeating and extending the researches of Bennet, Cavallo, and Volta, on the electricity evolved by the contact of bodies, Davy showed, that substances capable of chemical union exhibited unequivocal symptoms of opposite electrical states; that the mutual chemical attraction of the elements of a compound are subverted by inducing an electrical state opposite to that natural to them; while their chemical union is promoted by increasing their natural electric energies. Hence he drew the inferences, that electro-chemical combinations and decompositions are referrible to the law of electric attractions and repulsions, and that both "chemical and electrical attractions are produced by the same cause, acting in the one case on the particles, in the other on the masses."

The whole of this beautiful memoir is a happy example of most admirably devised experiments, legitimate deductions, or ingenious inferences. What is fully established, is carefully discriminated from what rests on probable conjecture; and it raised the reputation of Davy to the highest pitch. It procured for him not only the willing homage of his own countrymen, but it was crowned by the French Institute with the medal of three thousand francs, founded by the first consul for the encouragement of discoveries in galvanism; a proud triumph of scientific reputation over national jealousy, and the implacable acrimony of our then national hostility.

Davy's next discovery was the most brilliant of all, though it may be questioned whether it be that which places his talents in the highest point of view. The decomposition of the alkalies by galvanism had been a favourite speculation with several philosophers; but the want of a sufficient power had always opposed an obstacle to success. Davy had the command of vast galvanic power, and applied it to this problem. His first attempts were made on solutions of potash, without effect; his next efforts were made on fused potash placed on a disc of platina, connected with the negative pole, and having its upper surface in contact with the positive wire. The potash began to fuse; strong effervescence took place at the positive wire, while metallic globules appeared at the other, which continued to form, and speedily to burn and explode with a very bright flame. He soon discovered a method of repressing their combustibility, by investing them with a film of naphtha; by which means he was enabled to collect the metallic globules for examination. Davy.

He found that they were so light as to float in every fluid except recently distilled naphtha; that they had the brilliancy of mercury; that at the ordinary temperature of the air they are malleable, and so soft as to be spread out with a knife; that this metal melts at about 150° Fahrenheit, but at 32° it is a hard crystalline solid, brittle, and extremely splendent; and that in all its states it is a perfect conductor of electricity; in short, that it possessed every general property hitherto recognised in metals, except its extremely low specific gravity. The metallic globules were soon converted into potash in the air; and when brought into contact with water, or even with ice, instantly took fire and burnt, giving rise to potash. The effervescence at the opposite pole he ascertained to be owing to the evolution of oxygen gas. To the metal thus obtained he gave the name of *potassium*. The rapidity and energy with which potassium attracts oxygen from almost all bodies, showed that it is a valuable instrument of analysis in the hands of the chemist. Davy pursued a similar process with pure soda, and obtained from it a metal of analogous properties, to which he gave the name of *sodium*.

This splendid discovery appears to have been made in October 1807, was read in November of that year to the Royal Society; and in the following year the results of Davy were fully confirmed by Gay-Lussac and Thenard, who succeeded in decomposing potash by iron filings in a red-hot gun-barrel. In the Bakerian lecture of 1807, Davy mentions the probability of the earths having also metallic bases; but his discoveries were suspended, and very nearly closed for ever, by a severe illness, attended with fever and delirium, which attacked him soon after the reading of his second Bakerian lecture, the consequence of severe bodily exertion and high mental excitement. In March 1808 he was able to resume his labours; but during this interval, baryta and lime had been decomposed by Berzelius and Pontin, who obtained the result by negatively electrifying mercury in contact with portions of the pure earths. Their oxygen was thus driven off, and their bases united into amalgams with the mercury.

These experiments were communicated to Davy, who, in June 1808, read a memoir on that subject to the Royal Society. His paper then describes the amalgamation of strontia, and his process for obtaining the amalgam from magnesia. He also stated that he had succeeded in obtaining the metal of barytes from the amalgam; that it was white like silver, of a higher specific gravity than water, and fluid below a red heat. He attempted unsuccessfully to decompose argil, silex, and zircon, though the results showed a high probability of their having metallic bases. The curious experiment of amalgamating ammonia had occurred to Berzelius and Pontin, and they had communicated the result to Davy. This new subject he pursued with eagerness, and confirmed their results, but

Davy. could not succeed in distilling off, as he seems to have expected, the compound metallic basis; an idea founded on analogy, but not very probable. It is needless to discuss the various conjectures on the nature of the new metals of the alkalies and earths, to which the discoveries of Davy gave rise; some of the ablest chemists of the day considered them as probable compounds of *hydrogen*, with some unknown bases. This opinion has not derived any confirmation from subsequent research; and, with regard to the ammoniacal amalgam, it is now generally regarded, not as a true metallic alloy, but as a species of mechanical mixture of ammonia, or its elements, with mercury.

The third Bakerian lecture, read in December 1808, and its appendix of next spring, contain an account of various attempts to effect the decomposition of certain bodies which had not been resolved into their elements. The subjects discussed in this paper were handled with his usual ingenuity; but his success did not equal his own or the public expectation. The only certain result was the proof that hydrogen could not be obtained by any known means from potassium, and that therefore we ought to consider it as a simple body.

In his experiments on ammonia, by the medium of potassium, he obtained an olive-coloured substance, which he considered as an amalgam, and appears to have been sanguine in the idea that he had decomposed nitrogen in this process; but was afterwards compelled to admit his failure. His next inquiries were into the nature of sulphur, phosphorus, and carbon, which he suspected to contain hydrogen, and his experiments led him to believe that these substances contained it in minute quantities; but his conclusions are now considered as erroneous, and the minute portion of hydrogen obtained is regarded as due to the presence of water in the inflammables, or to the obstinacy with which some of them absorb and retain different gases. The third subject discussed was the nature of boracic acid, from which he obtained a basis, by him then considered as of a metallic nature; but he was anticipated on this subject by Gay-Lussac and Thenard, who investigated the subject more completely, established the analogy of the radicle of boracic acid with carbon, and the substance is now called *boron*. The other subject of inquiry, "The Nature of Muriatic and Oxymuriatic Acids," is remarkable as an ingenious defence of a theory of their formation, which he mainly contributed some time afterwards to overthrow.

It may be interesting to remark, that the original 500 plate batteries of the institution were so worn in the course of Davy's experiments as to be unserviceable; but a liberal voluntary subscription among the members, in July 1808, put him in possession of the most powerful Voltaic battery ever constructed, consisting of 2000 double plates, with a surface equal to 128,000 square inches. The results, however, produced with this stupendous power did not add one new fact of any importance to science. All Davy's splendid Voltaic discoveries were made before it was in use, and it only served to show the phenomena of galvanism with greater brilliancy.

The fourth Bakerian lecture, read in November 1809, contained the same views, and added little to scientific discovery, though every part of it exhibits the talent and ingenuity of the author; but in his researches on oxymuriatic acid, and on the elements of muriatic acid, we find Davy overturning the theory he had laboured to defend in former Bakerian lectures, adducing new proofs of the oxymuriatic acid being a simple body, and muriatic acid a compound of that body and hydrogen.

It had indeed been previously shown by Cruickshank, that the mixture of oxymuriatic acid and hydrogen, in equal proportions, produces common muriatic acid; and the same fact had been more thoroughly investigated by Gay-Lussac and Thenard, who proved that no water is formed during the process, and that, in all cases where oxygen is evolved from oxymuriatic acid, water is always present, and muriatic acid invariably appears. Davy not only confirmed and extended the experiments of these philosophers, but, as it appears to us, has an undoubted claim to priority in deducing from the facts the legitimate consequence, viz. that oxymuriatic acid is, as Scheele, its discoverer, had supposed, a simple body; and that muriatic acid is a compound of hydrogen and that body, for which he proposed the name of *chlorine*. Davy.

In his Bakerian lecture in 1810, and in his essay read February 1811, he considers the changes which these views render necessary in chemical nomenclature, and announces the discovery of a compound of chlorine and oxygen, to which he gave the name of *euchlorine*, a term which has been since changed for the more appropriate appellation of *protoxide of chlorine*, to distinguish it from another compound of these substances, which he discovered while in Italy in 1815, and which is termed the *peroxide of chlorine*. While on this subject, we may remark, that this latter was discovered while engaged in a controversy with Gay-Lussac on the nature of *chloric acid*, the discovery of the latter; in which, we are compelled to say, neither the temper nor the philosophic dignity of our countryman appear to advantage.

The reputation of Mr Davy was now at its zenith; and he was invited by the Dublin Society to give a course of lectures on *electro-chemical science*, which he commenced on the 8th November, and concluded on the 29th of that month, in 1810, and for which he received 500 guineas. The Dublin Society, in the following year, invited him to give two courses, one on the *Elements of Chemical Philosophy*, and the other on *Geology*, for which he was remunerated by a sum of L.750; and the Provost and Fellows of Trinity College did themselves honour by investing Davy with the degree of LL. D.

In 1811 our author was employed to adopt some means for ventilating the House of Commons; a task which he seems to have undertaken without any previous study of the subject; for his attempts were a signal failure, from a miscalculation of the diameter of the pipes necessary to carry off the vitiated and to supply fresh air to so large a building, and became a source of considerable mortification to himself, as well as of malignant pleasantry to the witlings of that period.

In the following year, the connection between Davy and the Royal Institution was dissolved, by his giving his farewell lecture on the 9th April 1812.

On the preceding day, he had received the honour of knighthood from the hands of the prince regent; and on the 11th of that month he was married to Mrs Apreece, daughter and heiress of Charles Kerr, Esq. of Kelso, and the possessor of an ample fortune.

This important step is admitted by his warmest friends to have produced a change in the deportment of Davy. From that time he seemed to regard patrician rank, and the adventitious distinctions of society, with no philosophic indifference; and he is alleged to have lowered his ambition to meaner objects than were to be won on the fields of scientific investigation.

During the next two or three years, Sir Humphry Davy produced little important to science; and we find him rather following than directing the steps of others. He made two communications to the Royal Society in 1812. The first was on *Some Compounds of Phosphorus and Sulphur*, in which the most important matters are two new definite compounds of phosphorus and chlorine, and a proposition to name all the precipitates from aqueous solutions

Davy. *hydrats*, because he found them to contain water in definite proportion. The name was unfortunate, especially as in the same paper he had proposed the prefix *hydro* for compounds into which hydrogen entered as a definite ingredient. In the second paper he described a detonating compound of chlorine and nitrogen, but which had been some time before discovered in France. The first, and, as it proved, the only volume, ever published of his *Elements of Chemical Philosophy* appeared in 1812; and in the following year he published his *Elements of Agricultural Chemistry*, the substance of the lectures which he had some years before delivered to the Board of Agriculture. His paper on fluoric acid read in 1813 to the Royal Society, was little more than a confirmation of the analytic experiments of Ampere, who established that the base of fluoric acid unites with oxygen to form that acid, and that acid with boron to form the *fluoboric acid*.

In the latter part of 1813, Sir Humphry Davy obtained the permission of the French emperor to travel in France; and in October of that year he went, with his lady and Mr Faraday, to the Continent. His visit to Paris brought him personally acquainted with the principal French *savans*, among whom he particularly singled out Ampere as his chosen friend; but this feeling was at a subsequent period, we are grieved to say, changed into one of bitter hatred on the part of Davy; who so far forgot himself as to exert all his influence to prevent Ampere's election as a foreign member of the London Royal Society.

The most remarkable circumstance arising out of Davy's visit to Paris was the proof it afforded of his utter want of any relish for the sublimest productions of the pencil and the chisel, with which the French capital then abounded. He was well received by the French philosophers; he was honoured by their flattering attentions; but we are constrained to say that he returned their courtesies with an arrogance and ridiculous affectation of superiority, which justly offended, and tended much more to lower English philosophy than to elevate Davy in their estimation. This was peculiarly unfortunate; for every little feeling of national jealousy seems to have been banished from their minds, and we fear that the odium of want of cordiality must rest with our countryman. But another act of ill-judged interference completed the disgust which his absurd conduct in other respects had excited. Before the time of Davy's visit to France, Courtois had discovered *iodine*, and Gay-Lussac and Thenard were engaged upon its properties. Some of that substance was given to Davy by Ampere, and he immediately began to examine it. On the 11th of December he offered to the Institute a general view of its nature and relations, and transmitted to London an account of its properties, which was read to the Royal Society on the 20th of January 1814. This paper is introduced with the remark that "Gay-Lussac is still engaged in experiments on this subject; and from his activity and great sagacity a complete chemical history of it may be anticipated." This priority of occupation ought to have prevented Davy from the ungenerous anticipation.

From Paris Davy proceeded, in the end of December, to Montpellier, and from thence to Italy by the Col de Tende. At Genoa and Florence he continued his experiments on iodine, which he obtained from the ashes of various fuci. At the latter place he made experiments also on the combustion of the diamond with the great lens in the cabinet of natural history; and he discovered that, after the diamond has been once ignited, it will continue to burn with splendour in pure oxygen, though the source of heat has been withdrawn. Thence he proceeded by Rome to Naples, where he was engaged on observations on the phenomena of Vesuvius, and collected specimens of the colours used by the ancients in their pictures, which formed the subject of a memoir to the Royal Society. The most interesting part of this paper is, that the fine blues of the ancients were formed of silex, soda, and copper; and that they may be exactly imitated by strongly heating together three parts of copper filings, fifteen parts of carbonate of soda, and twenty of powdered flint, for two hours. After spending the winter in Italy, he returned on the 23d of April to London. Davy

The year 1816 is memorable in the history of Sir Humphry Davy, as that in which he turned his attention to a method of preventing the dreadful accidents from explosions of fire-damp in coal-mines. The frequent accidents in the Newcastle and Sunderland collieries from such explosions had given rise to the formation of a society for ascertaining how they could be prevented; and the Reverend Dr Gray, the president, requested Davy's opinion. After he had visited the mines, specimens of fire-damp were transmitted to him in London. He began by an analysis of the gas, and by ascertaining the limits of its exploding properties. He found that it would not explode when mixed with less than six times, or with more than fourteen times its volume of atmospheric air; that air rendered impure by the combustion of a candle will not explode fire-damp, though the candle will still burn for a time; that if a candle be burnt in a close vessel, with small apertures only above and below the flame, no explosion will take place, even in an exploding mixture; that in this case the flame within will be enlarged, but no explosion will reach outward; and that the gas from mines will not explode in a tube less than one eighth inch in diameter.[1] From these principles, Davy proposed several different lamps, some of which strongly resemble the contemporary inventions of Murray and Clanny; but all were finally superseded by the simple lamp of Davy, in which a small oil light was covered by a cylinder of wire gauze.

The introduction of this beautiful invention was for a time violently opposed by prejudice and passion; but the experience of the miners of Britain, Belgium, and other countries, has confirmed its utility and comparative safety. This triumph of Davy's genius, exerted as it was in the cause of suffering humanity, is the noblest monument to his fame; and the debt of gratitude is enhanced by the disinterested manner in which his discovery was freely communicated, without any idea of a pecuniary reward. The coal-owners of Newcastle and its vicinity, impressed with the important services conferred on them by Davy's discovery, presented him with a superb service of plate, embellished with a suitable inscription.

The succeeding years of the life of Sir Humphry Davy, though they do not present any remarkable discoveries, were by no means spent in inactivity. The world is usually unjust in its anticipations from those who have done much, and is apt to feel disappointment at any symptom of relaxation in those who have contributed most to the public excitement.

In 1815, 1816, and 1817, he read various communications to the Royal Society on the subject of fire-damp, and on the nature of flame, for which he received the Rumford medals. In 1818 and 1819 he produced four memoirs "On the fallacy of the experiments in which Water is said to have been produced by the decomposition of Chlorine," on "Some Combinations of Phosphorus," "Obser-

[1] This last fact was discovered, however, long before by Grotthus, and was by the late Dr Murray of Edinburgh applied, at the very time Davy was engaged on the subject, to the construction of a safety-lamp for mines, which may be seen in the Edinburgh Philosophical Transactions.

Davy. vations on the Formation of Mists over Lakes and Rivers," "On Electro-magnetism." In 1818 Sir Humphry, who had made some previous experiments on unrolling the papyri of Herculaneum, was sent by the British government to examine the manuscripts in the Neapolitan museum, in order to attempt on the spot their evolution. He soon satisfied himself that these papyri had not been charred, but altered by the percolation of water, or merely by the application of tuffaceous ashes. His remarks on them, contained in his paper to the Royal Society in 1821, are highly ingenious, but no success attended his labours, probably from the unfortunately irremediable condition of the Herculanean papyri; but he also hints at obstructions thrown in his way by the persons employed in the museum. During this excursion, he published at Naples an account of the thermal baths of Lucia, from the waters of which are deposited silica and oxide of iron, which he conjectures to have been held together in solution in the bowels of the earth; and he inferred that the oxide of iron was held in solution as a *protoxide* by silica, which, with Berzelius, he conceived to act the part of an acid.

In 1820 Davy returned to England, and on the death of Sir Joseph Banks, in that year, was elected President of the Royal Society. The opinions of members were divided between him and Dr Wollaston; but the latter peremptorily refused to be put in nomination, and lent all his influence to support the pretensions of the former. It is doubtful how far Sir Humphry's pursuits and temperament qualified him for filling this station with advantage to the society. With regard to his high claims to the distinction, there can only be one opinion; but unfortunately he lent himself to the petty cabals of a coterie during his possession of the chair. His ill-concealed partiality for the aristocracy of birth over that from which he alone drew his own rank, the *aristocracy of talent;* the preposterous assumption in his own person, on some occasions, of a patrician haughtiness, and a neglect of the ordinary courtesies of society, procured him many enemies; and when he resigned the chair, he had become one of the most unpopular presidents that had for years ruled the society.

In the year 1821–22, he continued to make some experiments on electro-magnetism, and electricity *in vacuo*, but in his results he was anticipated by other observers; and in his memoir on electrical phenomena *in vacuo*, he has not arrived at any definite conclusion, except that electric light, and attractions and repulsions, may be exhibited in the most perfect vacuum we can form. In his paper on the fluids contained in the cavities of natural crystals, Davy showed that these cavities were filled with fluids less dense than those under atmospheric pressure; and he thence inferred that such crystals must have had an igneous origin. In most of his experiments the fluid seems to have been water; but in some later investigations, particularly in those of Dr Brewster, the fluids in crystals appear to be more varied in their nature.

In 1823 the interesting discovery by Mr Faraday, of the condensation of certain gases by mechanical pressure, nduced Sir Humphry Davy to repeat the experiment; and he succeeded, by heating them in strong sealed tubes, to convert sulphurous acid and prussic acid gases into liquids. His paper on this subject contains some rather fanciful conjectures on the probable application of these condensed gases as mechanical powers.

In the same year he investigated the cause of the rapid decay of copper sheathing on ships. The subject was proposed by the admiralty to the president and council of the Royal Society, and Sir Humphry undertook the investigation of the cause, and its remedy. It occurred to him, that as sea-water only acts on the copper when it is in a *positive* state of electricity; if he could render it slightly *negative*, it would be defended from the action of sea-water. For this purpose he attached to plates of copper portions of iron or of zinc, and he had the satisfaction of finding that they remained unchanged on immersion in sea-water. He therefore communicated to government, in January 1824, his discovery of a remedy for the defects of copper sheathing; and immediate orders were given to put his scheme into practice on a cutter, while models were fitted up and floated in sea-water at Somerset House. These trials appeared so perfectly satisfactory, that immediately orders were issued to apply plates of iron, or "*protectors*" as they were called, to many ships belonging to the royal navy; and many merchant-men were fitted out with the same. Davy.

A short experience however showed, that though the copper was protected from corrosion, an unlooked-for evil of another kind speedily arose. The bottoms of the "protected" ships soon became extremely foul. The negative state of the copper sheathing favoured the deposition of the calcareous matter from sea-water, the growth of seaweeds, and the adhesion of enormous *lepades* and *balani* everywhere to the copper; so as most seriously to impede the sailing of the ships. This was proved, not only in the navy, but extensively in the merchant service in London, Liverpool, and other sea-ports; so that in spite of the ridiculous attempts of a *clique* of the pretended friends of our philosopher at first to deny, and afterwards to conceal the facts, orders were everywhere given to remove the protectors. This was a severe mortification to Davy, whose temper it appears greatly to have ruffled. He had read an elaborate memoir on the subject to the society in June 1825, and the navy order for the discontinuance of the protectors followed in July. The infirm state of Sir Humphry's health probably increased his irritability; and much of what has been placed to the mortification of unsuccessful exertion, and sensibility to ill-applied and unjust sarcasm on this occasion, ought, in all probability, to be ascribed to the approaches of disease, that was undermining the constitution of the philosopher. In 1826 his health had visibly declined, and his friends began to perceive that he was with difficulty able to indulge in his favourite sports of angling and shooting. On returning to London from Somersetshire he was unable to attend the anniversary dinner of the Royal Society. In January 1827 he published his six anniversary discourses on awarding the royal and Copley medals. Early in 1827 he went abroad, and soon reached Ravenna, where he seemed to derive some intermission of his ailments, which he describes as arising "from determination of blood to the brain; at last producing the most alarming nervous symptoms, and threatening the loss of power and life." In the summer, to avoid the heats, he removed to Salzburg, from which city he sent in his resignation of the president's chair of the Royal Society, from a conviction of the necessity of mental and bodily repose. In the end of autumn he returned to England, and removed to London in the winter, where he published his *Salmonia* in the spring of 1828. This work, though inferior in interest to the delightful pages of Isaac Walton, in imitation of which it is written, is yet an interesting performance.

Shortly before Davy quitted England, he communicated to the Royal Society his paper on Volcanoes, chiefly from observations made on Vesuvius in 1820; in which he advocates the idea that volcanic phenomena depend on the oxidation of the bases of the alkalies and earths (an opinion which was before maintained by Humboldt), while Davy at the same time thinks that there are strong proofs, in the increasing temperature as we descend in mines, of a central fire

In 1828 Sir Humphry Davy quitted his native country for the last time, and spent the summer and autumn in his favourite amusement of angling and in shooting near Laybach. In the winter he descended into Italy, and fixed his residence at Rome, whence he sent his last communication to the Royal Society, *Remarks on the Electricity of the Torpedo*, which was written in Illyria in October. The chief peculiarity of this paper is his finding that the electricity of the torpedo has no effect on the most delicate galvanometer, which he ascribes to the torpedo's influence being exerted, not in a continued stream, but in instantaneous and successive shocks; an idea confirmed by the same want of magnetic influence in moderate shocks from the Leyden phial.

Sir Humphry had suffered from a previous paralytic attack; at Rome he had another, which greatly alarmed his friends, and made his wife and his brother hasten to his assistance. They were soon with him; and he having become eager to quit Rome for Geneva, the party set out by easy journeys for the latter place. On the 28th May he slept at Chambery, and at three next afternoon arrived at Geneva, dined heartily at four o'clock, and was unusually cheerful. During the night an attack of apoplexy came on, and he expired at three o'clock in the morning of the 30th May 1829. His remains were deposited, with all the honours which a public funeral could bestow, in the State where he had breathed his last.

A posthumous work, entitled *Consolations in Travel, or the Last Days of a Philosopher*, shows a high degree of fancy, and an almost poetic inspiration; and, whether we regard the matter or the manner, is an evident offspring of a bold imagination.

We have sufficiently characterized the various productions of this eminent man in our review of his life. We have alluded to those little infirmities which mix themselves with the aspirations of genius with no unfriendly intention. They are specks on its bright mirror, which they do not obscure; but as every thing connected with such a man belongs to history, they should not be passed over in silence; for while the example of his great qualities are held up to animate the exertions of unfriended talent struggling with obscurity, the consequences of his infirmities may become valuable lessons to check the presumption of successful genius. (I. S. T.)

DAWES, Richard (1708–66), a classical scholar, best known by his *Miscellanea Critica*, published in 1745, was born at Market-Bosworth, Leicestershire, and educated at the Charter-house School and at Emmanuel College, Cambridge, of which he became a fellow in 1731. His attempt to translate Milton into Greek hexameters was unsuccessful, although among English scholars he had deservedly a considerable reputation. He was a man of coarse manners and violent antipathies, and a bitter enemy of Bentley. The controversies between these two eminent men abundantly prove that the *odium criticum* is scarcely less violent than the *odium theologicum*.

DAWLISH, a watering-place in Devonshire, 12 miles south from Exeter. The only building of importance is the public baths, recently erected. Besides an ancient parish church, it has three Dissenting chapels. Pop. (1851) 2671.

DAX, an arrondissement of the department of Landes, in France. Area 905½ square miles, comprising 8 cantons and 108 communes. Pop. 108,415.

Dax, Ax, or Acs (*Aquæ Tarbellicæ*), an ancient town of France, department of Landes, capital of the above arrondissement, situated in a fertile plain on the left bank of the Adour, 32 miles S.W. of Mont-de-Marsan. It is surrounded by old walls flanked with towers, and has a cathedral, episcopal palace, hall of justice, prison mineralogical museum, agricultural society, &c. It possesses numerous thermal medicinal springs. Manufactures—earthenware, pitch, oil, thread, leather, &c.; and it has some trade in corn, wine, brandy, and wood. Pop. 5238. Before the Roman conquest of Gaul, Dax was the capital of the Tarbellii.

DAY. See Calendar, vi., p. 75; Astronomy, iv., p. 22.

DAYTON, a city, capital of Montgomery county, state of Ohio, N. America, situated at the confluence of the Mad and Miami rivers, 66 miles W.S.W. of Columbus. It is a place of quite recent date. In the beginning of 1829 the Miami Canal, between Cincinnati and Dayton, 60 miles in length, was completed,—and from that date the prosperity of the town commenced. Pop. (1850) 10,977. Dayton is connected by railway with Cincinnati, Toledo, Xenia, &c. A canal from the Mad river, four miles above the town, furnishes an important motive power to manufacturers and others. It has extensive manufactures of railway carriages, stoves, paper, linseed oil, and oilcake. There are two market-houses, and an elegant court-house.

DAZE, a term among English miners to designate any glittering stone, particularly such as contain laminæ of mica.

DEACON (διάκονος, *minister, servant*), the name given to the lowest grade of office-bearers in the Christian church. From the appointment of the seven Hellenic deacons (Acts vi.) we learn that their duty under the apostles was simply to distribute alms from the public fund. In the early church, however, they soon came to usurp higher functions. They assisted the bishop and presbyter in the service of the sanctuary; in the administration of the Eucharist they handed the elements to the people; they instructed the catechumens; and in some cases baptized, and even exercised the judicial power of the bishop over the inferior clergy.

In the Church of England, the form of ordaining deacons declares that it is their office to assist the priest in the distribution of the holy communion; in which, agreeably to the practice of the ancient church, they are confined to the administering of the wine to the communicants. A deacon in England is not capable of any ecclesiastical promotion, yet he may officiate as a private chaplain, as curate to a beneficed clergyman, or as lecturer to a parish church. He may be ordained at twenty-three years of age, *anno currente*; but it is expressly provided that the bishop shall not ordain the same person a priest and deacon in the same day. In Presbyterian churches, as in apostolic times, the deacons have charge only of the pecuniary affairs of the congregation. In the Roman Catholic Church it is the deacon's office to incense the officiating priest or prelate; to lay the corporal on the altar; to receive the patten or cup from the subdeacon, and present it to the person officiating; to incense the choir; to receive the pix from the officiating prelate, and carry it to the subdeacon; and at the pontifical mass, when the bishop gives the blessing, to put the mitre on his head, and to take off the archbishop's pall and lay it on the altar.

Deacon, in Scotland, also denotes the president of an incorporated trade.

DEACONESS, a female deacon, the name given to those women in the Christian church who undertook for the female portion of the church a duty similar to that discharged by the deacons towards the male church members and catechumens. The remnant of such an order existed in the Latin Church till the tenth or eleventh century; and in the Greek till the twelfth century.

DEAD-LIGHTS, ports or shutters to close in the cabin windows of a ship in bad weather.

Dead-Reckoning, in *Navigation*, the estimation that is made of the place where a ship is situated, without having recourse to observation of the celestial bodies. It is made by observing the distance she has run by the log, and the course on which she has been steered, making allowance for drift, lee-way, &c.

Dead Sea. See Asphaltites.

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THE education of those unfortunate persons, who, from birth or early infancy, have been destitute of the sense of hearing, and who are therefore precluded from receiving instruction in the ordinary way, must obviously be attended with peculiar difficulties. The senses being the only inlets to knowledge, and one of the most important of these inlets being closed, an extensive class of ideas and of associations belonging to them is totally excluded from their minds; and, as the principal medium of mental intercourse does not exist, we are obliged to resort to new and less perfect channels of communication, and to employ peculiar methods and artifices in imparting knowledge. The invention and employment of means calculated to attain these purposes constitutes a particular art, having for its object the instruction of the deaf and dumb; an art which, though it has not hitherto been dignified by any specific appellation, is so highly interesting in a moral as well as philosophical point of view, that we conceive it incumbent upon us to present our readers with some account of the principles on which it is founded, and of the methods which experience has shown to be the most successful.

The proportion of children born deaf, and who must as a necessary consequence remain mute, was formerly supposed to be much smaller than it really is; as appears from the great number of cases which have presented themselves to notice, since the formation of various establishments for the express purpose of their instruction. The celebrity which the Abbé de l'Epée acquired at Paris for his success in this art drew forth into view a multitude of persons of this description, much greater than had ever before been suspected to exist. It was discovered that about two hundred deaf and dumb persons were living in Paris alone; a number which, calculating from the proportional population, would give above three thousand for the whole of France before the revolution. The same apparent increase has been remarked in every town where similar institutions have been formed; whence we may conclude that this congenital defect is by no means unfrequent.

It is scarcely necessary to observe, that the incapacity of speech in such persons as are designated by the term of *deaf and dumb*, results altogether from the want of the sense of hearing, and not from any physical imperfection in the organs of speech. Some fanciful writers, indeed, have ascribed it to an alleged sympathy between the organs of hearing and the organs of speech, by which the disease or defect of the former is communicated to the latter; but for this notion there does not appear to be the slightest foundation. All who are deaf from birth must necessarily be dumb; that is, they must be incapable of using language, the sound of which they have never had the perception of, and which they consequently could never attempt to imitate. From a strange inattention to this circumstance, it was usual, even with parents who noticed the slowness of their progress in comparison with other children, to ascribe it to a natural imbecility of intellect, which, they took it for granted, was equally irremediable with the organic defect from which it originated, and effectually precluded all attempt at instruction, and all hope of rendering them useful members of society. Their minds were accordingly suffered to remain without culture; they were abandoned to themselves, degraded from the privileges of men, and exiled from the community of rational beings. To such a culpable extent was this prejudice carried, that it has been the practice in some countries to destroy as monsters all children who remained at three years old incapable of either hearing or speaking. In France the very birth of such children was accounted a sort of disgrace to the family from which they sprung; and the duties of humanity were deemed to extend no further in their behalf, than to the maintenance of their animal existence, whilst they were carefully secluded from the eyes of the world, either within the walls of a convent, or in some hidden asylum in the country. Abandoned thus early to their fate, and regarded as little better than idiots, it is not surprising that their future behaviour should have been such as might seem to justify the narrow views which had prompted this ungenerous treatment. All motives to exertion being withheld, and all desire of improvement being repressed, the faculties soon languished, and became paralysed, for want of proper objects on which they could be exercised; and in time the man sunk to the condition of the brute.

That the neglect and oblivion to which these wretched outcasts of humanity were consigned, were founded on very mistaken notions of their mental powers, has since been fully proved by a great number of instances in which the exertions of benevolent and persevering instructors to convey to them knowledge of various kinds have been crowned with the most signal success. Yet the enterprise has still appeared one of the boldest and most arduous that could well be attempted, and every instance of success excited much astonishment even in persons of great knowledge and scientific attainments. So impressed was Dr Johnson, for example, with the notion of its extraordinary difficulty, that he represents the education of the deaf and dumb as a great philosophical curiosity. The study of the means by which these effects are produced must therefore be highly curious in itself, as throwing light upon that science, which is interesting above all others, namely, the science of the human mind. But it has yet a higher claim to our attention, as being directed to a purpose of great and immediate practical utility. What object can be more worthy of praise, or more congenial to a benevolent heart, than the redemption of a kindred spirit from the degraded and forlorn condition to which it appeared to have been doomed? What occupation can be more delightful in itself than to awaken the dormant powers of the mind, to usher a new world to its acquaintance, to furnish it with the instruments and materials of thought, to open unbounded channels of intercourse with the living and the dead, to inspire the soul with fresh powers as well as motives to exertion, and, by supplying unlimited sources of intellectual and moral improvement, to place within its reach the purest and most elevated enjoyments of which our nature is susceptible?

Before entering into the detail of the particular methods adapted to convey instruction to the deaf and dumb, it will be necessary to inquire more precisely what is the general end we should propose to ourselves in their education, and what are the leading objects to which our endeavours ought, in conformity with this end, to be directed. And it appears to us, that the great and fundamental object should be, to qualify our pupils to hold ready communication with the rest of the world, that is, with persons who, having the faculties of hearing and speech, employ the current language of the country for purposes of mutual intercourse. They must, above all things, be

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taught the use of ordinary language, both as an instrument for expressing their own thoughts, and for understanding those of others. This qualification, it is evident, is absolutely essential to their becoming members of that community from which, by nature, they would have been excluded, and to which it is our chief aim to restore them: it is essential to their deriving advantage from, or being of any utility to that community, a reciprocation of interests in which consists the true value and dignity of human nature. It is the only foundation on which they can hereafter build any solid acquirement. Once masters of language, they possess the key to all the sciences, and have access to every species of human knowledge; and their future progress will be proportional to their own diligence, and will be impeded by no obstacles except those which their own exertions are competent to remove.

Language, or the ordinary medium of communication between men, is either spoken or written. To enable the deaf and dumb to speak, so as to be perfectly understood by others, and to enable themselves to understand readily what is said by persons speaking to them, is doubtless the ultimate stage of perfection in the art which we are considering, and would in fact be nearly equivalent to a restoration of the privileges which nature had refused them. But whether we regard such perfection as attainable, and as worth the pains requisite for success, or whether we limit our views to more moderate qualifications, the knowledge of written language must still be an indispensable preliminary in every system of education. Let us first, therefore, direct our attention to the means of communicating to the deaf and dumb this fundamental acquisition. For this purpose it will be necessary to have a clear view of the real nature of the class of ideas we are proposing to instil into the mind of our pupil, and of the real condition of that mind by which they are to be received.

Speech, being the expression of ideas by oral sounds formed into words, is by far the most ready and universal mode of communication among mankind, and must therefore have long preceded the invention of written language, which has accordingly been formed upon the model of speech. Writing, instead of being the direct sign of ideas, as is the case with hieroglyphical characters, or, more properly speaking, rude portraits of external objects, consists of symbols of the particular sounds composing oral language. Written words are in fact the signs of other signs; the one set of signs being addressed to the ear, and the other to the eye. The perceptions of hearing are intermediate links of association between the visible appearances of the written characters, and the ideas they are intended to convey to the mind. This circumstance is the source of the principal difficulties which stand in the way of all instruction to one who is deaf and dumb, one in whom these intermediate perceptions can have no existence, whilst a very different process must be employed for establishing in his mind a connection between ideas and certain signs; because, for want of this step in the process, he is incompetent to trace any regular correspondence or appropriate adaptation of these signs to the ideas they are designed to represent. To an ordinary child, whose ear is already familiar with the name of an object as spoken, and in whose mind the association of the sound with the corresponding idea is firmly established, the learning the use of the letters expressive of such sound is a comparatively easy step in his education. The infant lisping for the first time in broken and faultering accents the endearing name of its parent and its nurse, has in fact made a prodigious stride; he has already entered into human society, and has begun to participate in its blessings. His stock of words daily increases; he feels the value of his new acquisition; his ideas multiply; his powers are developed. Pleasure animates his efforts, and attends every stage of his progress. To learn his native tongue is a sport; to repeat what he has learned is ever a fresh source of delight. The mighty task is accomplished without any extraordinary interference on the part of the instructor, or laborious effort on that of the pupil. Who would dream of appointing a master to supersede nature in teaching the infant to speak? In this act, as in that of walking and running, the scholar of nature, where all around unconsciously aid her in the work, will be found the best proficient. Far different is the lot of that hapless and solitary being, who, born without the sense of hearing, is doomed to eternal silence, and is shut out from the inspiring influence of social intercourse. Debarred from the chief avenue to information at this early and critical period of his intellectual growth, the blandishments of his nurse, the caresses of his parents, the accents of praise or blame, the cry of pain or pleasure, in vain salute his ear. He is already but half a human being. Insulated from the main portion of the world, he must live chiefly within himself; his untutored mind must be left to its own slender resources in the acquisition of knowledge and his progress must therefore be both slow and limited. He is an eagle whose unfledged wings have been clipped, and who stalks on the ground, unconscious that his inheritance lies in another element.

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So deeply rooted do the associations become, which are thus established in our infancy, between ideas and sounds, that we cannot easily perceive how much we have owed to them, and how much of our subsequent acquisitions has been founded upon them; nor can we readily place ourselves in the situation of a child bereft of these advantages, so as to understand the nature and force of the difficulties with which he has to contend in every step of his progress. We might suppose, if we had not attended to these considerations, that the whole business of the tutor of the deaf and dumb would be to point out the words to his pupil, while he, *by some other means*, communicated to him the ideas of which they are the representatives. It might be presumed that, by frequent repetition of the same process, the pupil could not fail to learn to connect the two together in his mind, and that he would have no occasion to trouble himself with whatever sounds the rest of the world might associate with these written characters; sounds which, as to him they have no existence, so neither do they anywise concern him; and which may be regarded but as useless stepping-stones in forming a communication which he is enabled to accomplish at a single stride.

If such be the illusions into which a prejudice natural to every one tends to betray us, a little reflection on the laws by which associations between ideas are established in the mind will be sufficient to dispel them. There is manifestly a great difference in the comparative facility with which ideas of different kinds become associated in the mind; and since memory consists in the strength and permanence of the associations, there is consequently a great difference in the facility with which different kinds of ideas become impressed and retained in the memory. Some ideas unite immediately, as by a natural affinity, and cannot afterwards be disjoined. In other cases the connection is remote and difficult, and the ideas, like grains of sand, refuse to adhere together. Some intermedium must be found, which may cement and consolidate their union. Some analogy or relation must connect every new idea with a former idea already existing in the mind, before it can become the subject of recollection. The facility with which such connections can be formed will depend much upon the number and variety of ideas already in store, as well as upon the ease

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with which the successive transitions can be made from one to another. In casual and apparently arbitrary associations, there exist always a number of invisible links that compose the chain of connection; and the facility with which these links can be formed determines the readiness of the association. We recollect a new name that we see written, from its resemblance to some other name previously known; but it is by means of the sound which it would have when pronounced that this association is effected. That this is the case will soon become apparent, when we reflect on the difficulty experienced in retaining new and barbarous words, of which the pronunciation is difficult or grating to the ear. That we learn them by the ear more than by the eye, is also shown by the difficulty we should find in recollecting an arbitrary combination of the same number of consonants, which would of course not admit of being pronounced as a word. We should in this case be driven to the expedient of interposing vowels, in order, as it were, to give them breath, and transfer the task from the eye to the ear; although it is evident that the addition of these vowels would increase the number of things to be remembered. All this will appear in a still stronger light, if we impose upon ourselves the task of learning by heart a set of characters equally familiar to us with the letters of the alphabet, but which do not afford a similar resource, at least not in so direct a manner. Let us, for instance, open a book of logarithmic tables, and try to learn a page or two by heart; we shall soon be sufficiently convinced of the arduous nature of the undertaking. Just so it is with the deaf and dumb. The printed letters of a book are to them so many separate ciphers, distinguished indeed from each other by their form, but having no perceptible medium of association, and of which the apparently endless variety of combination, like those of the figures of logarithms, are sufficient to perplex the most sagacious observer, and baffle the most retentive memory. To them all distinctions into vowels and consonants, into long and short syllables, all the varieties of metre, and all the harmony of verse, have no existence; these belong to creatures of another world, from which they are doomed to an eternal exclusion. No wonder, therefore, that their own untutored efforts should be utterly inadequate to give them the remotest conception of the use of language; and that the records of history have never exhibited to us a single instance of a person deaf from birth, or even having lost the hearing at an early age, who has taught himself to read or write a single word.

But the deaf and dumb child lies under the further disadvantage of possessing a smaller stock of ideas to set out with than other children. His faculties of observation have been less called into play, and the sphere of their operation has been more limited. The task of the instructor is, in this instance, analogous to that of the agriculturist who redeems a savage land, which the plough has never loosened, and where the soil has not been fertilized by previous vegetation. He has to sow the first seed it has yet received, and must watch with anxious solicitude every stage of its growth and fructification. Deprived at the outset of the ordinary resources of communication, what means are we to employ in order to awaken the attention of our pupil, and how can we make him sensible of the object of our endeavours, and animate him to those exertions which are necessary to their success, and which habitual indolence have probably rendered difficult and irksome?

But resources yet remain; and art has triumphed over all these obstacles, numerous and formidable as they may appear. The deaf and dumb child has in truth still the means of acquiring a large stock of ideas of a certain class, and has a certain range of expedients by which he communicates with others. When we read the exaggerated statement which some authors have given of the deficiencies of such children, we can easily discern the influence of preconceived theory in distorting obvious facts, and the false colouring which they have derived from a vivid imagination. "What," says Sicard, "is the condition of the deaf and dumb child considered in himself, and before any species of education has begun to establish connections between him and the rest of his species, or with that great family to which he appertains by his external form? He is a perfect nullity in that community; a living automaton; a statue like the one imagined by Bonnet, and after him by Condillac; a statue in which every sense in succession has yet to be unlocked, and directed to its proper objects, in order to supply the want of that one of which he is so unhappily deprived. His actions being limited to mere physical movements, prior to the removal of the envelope which cramped and confined his reason, he is not endued even with that instinct which is allotted to the brutes, and which is their only guide. He is therefore to be considered merely as a kind of walking machine, of which the organization, with regard to the effects that result from it, is inferior to that of animals. To denominate him a savage, is to assign him a higher rank than appertains to his miserable condition; for he is not even on a level with the savage, either in moral relations, which, to a certain extent, exist among all savages, or in means of intercourse with his fellow-creatures. With regard to the latter, indeed, he is much inferior to the savage, who can always communicate with others by language, however rude and inarticulate may be the sounds which compose it. These sounds are the means of fixing ideas in the mind, and afford the medium of comparison among those ideas, whence result combinations, judgments, and reasonings. Being destitute of these means of communication, and of these signs which fix and determine the power of recollection, all the impressions he receives are transitory, and the images fugitive; nothing remains in his mind to which he can refer what is passing within him, and which can serve as a term of comparison. His ideas can only consist of such as result from direct impressions; none can be derived from reflection. So that, being unable ever to combine two such ideas together, for want of the signs by which they could be laid hold of and retained, it is impossible for him to arrive at even the simplest process of reasoning." Condillac had already advanced the same doctrine, and had even gone the length of asserting that the deaf and dumb from birth could have no power of memory, because they were deprived of those artificial signs by which alone the associations could be fixed and rendered permanent. He compares their minds to those of brute animals, and even believes that they are equally incapable of carrying on any train of reasoning.

But the results of observation are quite at variance with these conclusions, derived from speculative reasoning. The real education of the deaf and dumb child, like that of him who is possessed of hearing, may be said to commence from the period of its birth. Dr Watson judiciously observes, that "persons born deaf are in fact neither depressed below nor raised above the general scale of human nature, as regards their dispositions and powers either of body or mind. They are human beings, individually differing from their kind only by an accidental defect. This defect is not such as to disturb the course of nature in the first stage of the growth of the mental faculties, though, while it operates as a bar to the acquisition of language, it retards and almost precludes their expansion after this stage." The whole of the visible and tangible

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worlds are still open to them; hearing at so early an age can give them comparatively but little assistance in acquiring the knowledge of external objects; and it is always some time before the discovery is made of their being insensible to sound. Still their sensibility expands; their affections are called into play; their passions are excited nearly as in other children, though the means may be somewhat different. The visible marks of attention the child receives from those around, their caresses, their smiles, and their frowns, all make their corresponding impressions on its tender mind; it lives in the looks of those on whom it is dependent. Its whole attention being turned to the study of these visible appearances, the only language which it has to learn, its proficiency in the interpretation of these appearances is comparatively greater. The gestures of its parent it acknowledges by responsive gesticulations, and expresses in this primitive language of nature all its feelings, conditions, and passions. Far from being the living automaton delineated in the closet by theorising metaphysicians, it differs but little in early infancy from other children; and has even some advantages in the superior quickness of the eye, in the more expressive play of the features, and in the more ready apprehension of the slightest look or gesture it observes in others. It is remarkable, indeed, that the defect of hearing is generally not discovered till at an advanced period. Though the child remains mute, the real cause is not readily acknowledged. Doubts and fears may indeed be entertained; but hope is kept alive by parental fondness, and inspires a thousand excuses. A year or two thus slips away, when it is gradually remarked, that when a want is to be made known, or an approval or aversion expressed, it is done by a motion of the hand, head, or countenance; and in place of the loquacious and engaging prattle usual at his age, there is silence, or only inarticulate sounds. At times he is pensive and cheerless, no doubt feeling the disappointments necessarily resulting from incapacity to make himself fully understood by those about him, who, possessing a more perfect medium of mental intercourse, are too apt to be inattentive to the signs and gestures of the little mute. Yet his mind, instead of presenting a total blank, is in fact furnished with a multitude of ideas, arranged indeed after his own peculiar method, but still affording an extensive foundation for future attainments. Already has he established a species of intercourse with those around him, by the language of pantomime, derived from nature, and improved by his own ingenuity. Already does this simple language comprehend the use of nouns, pronouns, verbs, and above all interjections, though he is totally unconscious of the nature or existence of these grammatical distinctions; just as he has moved and jumped, without being aware that he was effecting these actions by means of muscles and tendons, ligaments and bones.

It is therefore in the study of this species of pantomime, which is the native language of the deaf and dumb, that the first duty of the instructor consists. He must, in truth, begin by taking lessons from his pupil, and condescend to learn his language, in order to qualify himself for teaching him his own. He must study to familiarize himself with this language, by frequent intercourse with his pupil, and engage his affections by repeated offices of kindness. No better preparation can be devised for the exercises which are to follow, than this intercourse of the heart and interchange of confidence. Curiosity, a principle of action in which deaf and dumb children are generally by no means deficient, and which the judicious tutor will be careful to stimulate and sustain, will give him a strong hold in directing their exertions. On the other hand, they are very apt to be discouraged by the consciousness of their own inferiority, and are thrown into despondency at the idea of the immense interval which they feel must ever separate them from others. This feeling it is our duty to soften as much as possible, by removing the occasions which may give rise to it, and diverting the attention to more cheering views of their own powers, and to the prospect of their advancement. Perhaps it is even better, in many cases, that the truth should be in some degree disguised, and that they should be left, at least at first, in ignorance of the extent of the disadvantages they labour under. For this reason, we should not be disposed to adopt the plan practised by the Abbé de l'Epée, in order to explain to them the nature and uses of that sense which they do not inherit. The expedient which he hit upon for this purpose may be briefly described. Having collected his pupils round a large tub full of water, which was allowed to subside till perfectly at rest, he let fall into it perpendicularly an ivory ball, directing their attention to the undulations of the water, which struck against the sides of the vessel. He then moved a hand-screen backwards and forwards rapidly in a room, so as to put in motion feathers, or other light bodies, floating in the air at some distance; and explained to them that the room is as full of air as the tub was of water, and that the air set in motion strikes the sides of the room, as the waves did those of the tub. He next took up a repeating watch, and applying the fingers of his pupils to the hammer, made them feel the rapid succession of strokes which it produced. He now informed them that the ear of every person contains an apparatus of the same kind; and that the air, in its passage from the body which has set it in motion, enters the ear and sets in motion the little hammer which is placed there. He gave his pupils to understand, that the reason why they do not hear is because they have no such hammer in their ears, or because its motions are impeded, or the part on which it strikes is void of sensibility. "Whenever," says he, "I have given this explanation, I have observed it to make very different impressions on different individuals. Some expressed great delight at having acquired the knowledge of what hearing consisted in. Others became affected with profound melancholy on learning that either they were destitute of so useful an instrument as this hammer, or that the one they had could not be used. The first two girls to whom this information had been imparted could not conceal their ill-humour on finding that the house-cat and the canary bird had each their little hammers in the ears, while they themselves had none."

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The first and most important lesson to be taught to our pupil is, that written words have a meaning, and suggest to all persons of education the same definite idea. In teaching him the meaning of words, we should follow as much as possible the natural order in which they are generally acquired by those who have the sense of hearing. The first and simplest kind of knowledge is that which relates to the material world. We must commence, therefore, by instructing him in the names of external objects, beginning with those that are best known to him, and oftenest recur to his view. The name of an object of this kind, such as *hat*, may be written in large letters on a board; and the attention of the child being directed alternately to the name and to the object itself, which is to be presented to it at the same time, he will gradually be brought to understand that a certain relation exists between them, though what that relation is, we are not to expect that he will as yet be able to comprehend. The idea of this relation will become more distinct when a similar process has been followed with regard to several other names. Occasionally we may find it difficult to convey by this means the least notion that the one is the

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sign of the other; the child being unable to conceive how what appears to him to be an irregular collection of crooked lines, bearing no resemblance in form to the object pointed out in connection with them, can serve as its type. Experience, derived from the observations we may lead him to make, will, however, gradually teach him this lesson. Sufficient has been done to excite his attention; let us now, in his presence, call upon other children, more advanced in their education, to direct their eye upon these mysterious characters, of which the immediate consequence will be their pointing to the object. The effect produced by the word will be observed by the attentive pupil, and will make its due impression. Let three or four words be written at the same time on the board, and the corresponding objects placed on an adjoining table. On each of these words being pointed out to the advanced child, he will bring the proper article from the table. We shall now have an opportunity of ascertaining how far the proceeding has been understood by the younger pupil, by repeating the experiment on himself. If he lay hold of the proper object, it is clear that our meaning has been understood, and that the first step, the most difficult of all, has been accomplished.

Care must all this while be taken that our pupil impute not to any circumstance or quality in the words shown to him, different from that of their form, the significancy which he finds them to possess. We must show him, for instance, that their particular situation on the board is not the circumstance from which it derives its meaning. This we can do by changing the order of the words, or by writing them on paper, and in different modes, preserving always the same precise form of the letters. It is evident that in these preliminary exercises we should give the preference to very short words, such as box, pen, shoe, cap, ring, and the like. The association between the name and the object should be strengthened by frequent repetition, and also by occasionally varying the mode of impressing it. The process we have just described, for instance, should sometimes be reversed, the child being required to point out the name when the object is shown to him. In fact, we should neglect no means of assuring ourselves that we are fully and perfectly understood, and that the associations we are labouring to establish are firmly rivetted in his mind.

We are, however, by no means to trust to a single associating principle in establishing these essential connections; we should multiply as much as possible the ligaments which compose the union. The child, while learning written words, should be made to copy them himself, so that, by dwelling upon their forms sufficiently, they may make an indelible impression on his mind. We should from time to time show him the objects, and require him to write their names himself. In these preliminary lessons it is obvious that much assistance may occasionally be derived from drawings of the objects we may wish to point out, but which may not be immediately at hand. The Abbé Sicard has availed himself, with much ingenuity, of this mode of denoting objects as an introduction to the use of written words.

He begins, for instance, by tracing the outline of a familiar object, such as a key, on a black board, with a chalk pencil; and placing the object itself before the eye of his pupil, he will readily understand the resemblance of the design with what it is meant to represent. He does the same with other objects, and exercises his pupil in pointing out the objects denoted by each drawing, which of course is to him a mere amusement. He next writes the name of each object within the outline of the figure on the board, and, after effacing the outlines, so that nothing but the words remain, signifies to the pupil that he is still to consider what he now sees as the representation of the drawing, that is, of the object denoted by the drawing. These methods, which are susceptible of variation according to circumstances and the ingenuity of the instructor, are to be understood as applicable only to the early lessons; for, after the pupil has once thoroughly understood the value and use of words, all the drawings on the slate should be laid aside, and the more useful medium of written language should be exclusively resorted to.

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With regard to the choice of objects, of which the names may compose the first lessons, we should select those to begin with which are of immediate interest and utility, such as the different parts of the body, articles of dress and of furniture, and common instruments in most frequent use. We should see that every thing that is learned is learned perfectly, by frequently going over the same lesson, so that they may all be deeply engraven on the memory. We must recollect that repetition is the principal means of impressing the memory; and this is the more necessary in the case of the deaf and dumb, as a principal barrier to their acquisition of language consists in their having few means of reviewing words and phrases but by direct instruction or prescribed study.

But our pupil is not always confined to his apartment; and he can hardly take a step beyond its threshold without meeting with something that he knows very well by sight, and of which it will be useful to him to know the name. We cannot remove it into our school-room, to teach him its name there; nor can we very conveniently carry our writing tablets with us on all occasions. Engravings of such objects will, however, readily supply us with the means of extending our instructions to them also, and, by furnishing us in small compass with the lines that bound their visible appearances in perspective order, will enable us to preserve the remembrance of them, and to keep them in readiness for every purpose. Association will at once recall to our minds the properties that manifest themselves to our other senses, and enable us to read and interpret this picture-language as we would any other collection of artificial signs. A vocabulary, on the plan originally recommended by Locke, consisting of "those words standing for things which are known and distinguished by their outward shapes, accompanied by draughts and prints," will therefore be of great utility, and shorten the labour both of the teacher and learner. For this express purpose, Dr Watson has had a set of plates engraved, containing delineations of objects most generally met with and commonly known. These engravings are annexed to his book of *Instruction of the Deaf and Dumb*, and represent above six hundred different objects, being comprised in eighty octavo pages. They are accompanied by a printed vocabulary, consisting of the names of all the objects thus represented, as also of most of the words explained in the earlier lessons, before the engravings are had recourse to. The first time of going through this vocabulary, the heads or generic names under which the objects are classed are not regarded; but, in a subsequent revision, these are particularly attended to, and their relations to the subordinate specific names are fully explained.

The analysis of words into letters is the next step of importance in the early education of the deaf and dumb. It should follow almost immediately upon their complete comprehension of the use of words. They should be shown, as soon as they have learned a small stock of words, that these words are formed from a certain limited number of characters, or letters of the alphabet. Various modes of familiarizing them with this knowledge may be adopted. One of the most simple is, to have each letter written on a small piece of card, of which a number, disposed in parcels, and arranged in proper order, may be

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contained in a box. After making the child observe a written word that he already knows, we should point out to him the first letter, and take out the same letter from the box; then indicating to him the next, we may conduct his hand to the proper letter in the box, and continue this operation till the word is completed. He will soon reject our assistance, and seek the letters for himself. By practising a little in this way, he will very soon have learned the alphabet, and will understand its use, and will be able, of his own accord, to compose known words with the letters thus furnished him. He must all this time be diligently exercised in writing, so as to acquire facility in forming and joining letters in a running hand. He must be taught the various forms of letters, according to the different ways in which they are used, and the purposes to which they are applied. The capital, small, and double letters, both in the Roman and Italic types, must be perfectly learned, by frequent and daily practice. Writing being an operation to which deafness offers no impediment, nothing particular need be said respecting the method of teaching it. It is proper, however, to remark, that it cannot be taught too early, as, agreeably to the observations formerly made, every variation in the mode of exercising the attention to any set of objects is of material assistance to the memory of those objects.

It will also be advantageous to instruct our pupil, as soon as he is familiar with the use of letters, in another mode of visible communication, very easy to be acquired, namely, by the manual alphabet, as it is called; that is, the expression of letters by different positions of the fingers. This art is valuable on many accounts; in the first place, as being a very quick and ready means of communication; and, secondly, as it is a method very generally understood and practised by other persons besides the deaf and dumb. This art of talking with the fingers is commonly learned at school, and is easily retained, or recovered if lost. It furnishes a substitute for the pencil, or pen and ink, when the materials for writing are not at hand. The deaf and dumb, when properly instructed, can converse with the utmost rapidity by this method; habit enables them to follow with the eye motions which, to others, would be too rapid for observation; they readily catch at the meaning of a word or question before it is half spelt.

In the common methods of indicating letters by the fingers, both hands are employed. Some persons have thought it would be attended with advantages, in point of convenience, to contrive a manual alphabet that would require the use of one hand only. Periere claims the invention of this method, to which he has given the pompous name of *Dactylology*, a term which the Abbé de l'Epée proposes to change to *Dactylolaly*. It appears, from a book published near two centuries ago, in which are engravings of different positions of the fingers of one hand, representing the several letters, that this method was well known at that time in Spain. Sicard, in his *Cours d'Instruction d'un Sourd-Muet de Naissance*, has given a plate of the manual alphabet employed in this institution. It would appear, however, to be a considerable objection to this single-handed alphabet, that it is not in general use among other persons, so that it cannot assist the deaf and dumb beyond the precincts of his school. These alphabets are, however, so easily acquired, that it must always be worth while for him to learn them both.

There is yet another mode of visible intercourse, still quicker in its operation than the former, and which it may occasionally be very convenient to employ. It is that of indicating the forms of the letters by the point of the finger moved in the air, constituting, as it were, an aërial writing, which, by a little use, is quickly followed with the eye. It must be recollected that, to a spectator who stands before us, the writing would appear reversed if traced in the ordinary manner. This must be remedied by the letters being written in a reversed form, a method which may be readily acquired by practising before a looking-glass. If the person to whom we addressed ourselves were behind us, there would evidently be no necessity for this artifice, since the motions of the fingers would be seen by him in the same aspect as by ourselves. By means somewhat similar, namely, by tracing the letters with the finger on any part of the body, such as the hand or the back of the person with whom we wish to communicate, we may easily converse with him in the dark, a situation in which the deaf are peculiarly helpless.

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Having proceeded thus far in our instructions, having taught our pupil the use and conventional meaning of words, having familiarized him by the various modes of writing and reading, with their visible appearances, and put him in possession of a copious vocabulary of the names of objects of common occurrence, we may be considered as having achieved the most difficult, and, certainly, the most important part of our task. There yet, however, remains much to be done. Substantives are all that he at present knows; but the expression of thought and passion, the affirmation or denial of the relations between ideas, demand words of another class, or, as they are called, other parts of speech. The most natural order of proceeding would seem to be that of teaching him next the use of adjectives, and the relation in which they stand to substantives. A few examples of adjectives, denoting sensible properties of objects, such as those of colour and form, connected with substances that possess these properties, will very soon give them this knowledge, and enable them to apply these adjectives properly. The meaning of pronouns and of verbs are next to be pointed out, with their various modifications of person, number, and tense. All this should, in our opinion, be taught wholly by examples; for which purpose, short and simple sentences should be selected, of which the meaning may readily be conveyed by the assistance of pantomimic language, and will soon be collected by the pupil himself, whose sagacity in observing the occasions on which such expressions are employed will lead him to the discovery by a natural process of induction.

A method proceeding on a diametrically opposite principle has been adopted by teachers of the first eminence on the Continent, who insist upon the necessity of teaching the deaf and dumb all the parts of speech, one after another, with critical and philological precision, and in exact conformity with the order of the analysis of the different classes of words. They appear to forget that, in the case of ordinary children, nature pursues a very different course. These learn their native language in a short period, without all the technical apparatus of the pedagogue. The study of the rules of grammar is more especially useful in teaching a new language to a person who is already conversant with his own. The business of the teacher is here, indeed, reduced chiefly to that of translation; whilst the substance is the same, it is the form only that is varied. Dr Watson is decidedly of opinion that, naming perceptions as they arise, without regard to metaphysical or grammatical distinctions, is the only sure and direct road to the acquisition of a language by those who have only the natural language of gesture and feature to assist them in acquiring it. For let it be strictly borne in mind, that the analogy between the natural deaf and those who hear, in learning a language, holds only with respect to the first language, or the mother tongue. There can be very little in common with them, in the learning of a foreign or dead language, by the latter; for in this case the

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mother tongue always serves to explain the terms of the language to be acquired, an advantage of which the deaf and dumb are totally deprived; and yet, if we compare the progress they make with that generally made by young scholars in what are termed the learned languages, in the same length of time, we shall, for the most part, have reason to draw a conclusion in favour of the plan of following nature in teaching a language. It should not, however, be forgotten, that, fairly to estimate the attainments of a deaf scholar, he should rather be compared, though subject to great disadvantages, to a child of an age equal to the length of time he has been under tuition, than to a youth having all his faculties who has been long at school.

Whilst proceeding through the vocabulary of substantives, we are recommended by the same judicious author, in order to give variety to the lessons, to teach the pronouns, personal and demonstrative, &c. at suitable intervals, always making the learner write the words with his own hand. Then the verbs *to be, to have*, and the other auxiliaries, are to be learned or varied according to third persons, joined to nominative cases, as, *I am, he has*, &c. The meaning of all these is learned by application in examples. When he says *I*, he points to himself; when he says *you*, he points to the person teaching him; *he*, to a third person, &c. Nothing is more obvious to the eye than number as a property of things; we, therefore, easily learn to count *one, two, three*, &c.

These preliminaries being settled, we proceed to the construction of short sentences, without learning the rules of syntax. Thus, for instance, we may say, *this is my pen, that is your pen, that is his pen, these are our pens*, &c. *I have one body, I have two hands*, &c. showing the meaning by pointing out the objects and their relations already perceived by and familiar to the learner, though he could not express them. By way of practice, he is taught to change the substantive, till he can himself give examples, and rightly apply all the words in such sentences, which, in general, he is not a little proud to do. Examples might be multiplied indefinitely in the application of each of the parts of speech, but enough have already been shown in illustration of the general principle of the process. In all cases, examples should be furnished to the learner till the effect intended be produced on his mind; that is, till it appears by examples given by himself that he rightly applies the word intended to be illustrated. These exercises should be introduced as reliefs to the less amusing, but, in the first instance, more important business of learning the vocabulary.

The system of instruction we have already alluded to, as opposed to the simple process now detailed, is founded upon the employment of a peculiar medium of communication between the teacher and his pupils. This medium, totally different and independent of ordinary language, is formed by a set of artificial signs for the expression of ideas, consisting, not of words, but of certain gestures assumed by convention as the representative of those ideas. These signs may, indeed, be considered as being virtually words, though wearing a different form. They in fact perform to the deaf all the functions of words, since every word in the language is represented in this system by its peculiar and appropriate gesture. In instructing the deaf and dumb according to this method, care is taken that, on their learning the meaning of any written word, the particular gesticulation appropriated to it shall be learned in conjunction with the word. The Abbé de l'Epée, the original inventor of this ingenious system, which was adopted and extended by his successor the Abbé Sicard, gives the following account of the circumstances which first turned his attention to the subject, and paved the way to the invention.

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Two sisters, both deaf and dumb, resided at Paris in a street opposite to the society entitled *Les Pères de la Chrétienne*. Father Fanin, one of the associates of that community, had attempted, but in a way not sufficiently methodical, to supply the deficiencies of instruction to which the loss of the faculties of hearing and of speech had subjected them; but he was unfortunately carried off by a premature death before his labour had rewarded him with any degree of success. The two sisters, as well as their mother, were inconsolable for the loss they had suffered, when a fortunate accident introduced to them a person eminently qualified to fill the place of him they mourned for. The Abbé de l'Epée had occasion to call at their house. The mother was out, and while he was waiting her return, he put some questions to the young ladies; but their eyes remained fixed on their work, and they gave no answer. In vain did he renew his questions; they were still silent. Not suspecting that the ears of those whom he was addressing were closed to all earthly sound, he was lost in conjecture at the insensibility they manifested, when the mother arrived, and the mystery was resolved. So strong was the impression produced by this incident, that his thoughts were, from that moment, bent upon devising means of restoring to those unhappy young women the faculties of speech, and the means of intellectual intercourse. After meditating long on the subject, it occurred to him that every language is but an assemblage of signs, in the same manner as a series of drawings is a collection of figures, the representations of a multitude of objects. Gestures are also signs; and we may figure every thing by gestures, as we paint every thing by colours, or express every thing by words. Every object has a form, and every form is capable of being imitated. Actions strike our sight, and we are competent to delineate and describe them accurately by imitative gestures alone. Words are but conventional signs. Why should not gestures serve the very same purposes? Why may there not be framed a language of gestures as there has been a language of words?

Full of these impressions, the abbé was not long without revisiting the family who had inspired him with so much interest; it is easy to imagine the joy his presence gave them. He was eager to try the success of his newly invented imitative art. He began his drawings, his gesticulations, his writings, conceiving he had but to teach a new language; while, in fact, he had first to form minds wholly uncultivated. Severe were the toils and the difficulties, and bitter the disappointments, he had to encounter in these first essays. He showed his pupils merely letters, which he taught them to imitate; but nothing like ideas could in this way ever reach their minds; the act of imitation had been purely mechanical. Even when the objects themselves, denoted by words, were pointed out, still no conception of the relation in which they stood to each other was formed; for written words were not images. It was not enough that the abbé had invented gestures to correspond with every word in the language; the necessary medium of communication was still wanting; he had no fulcrum for his apparatus to rest upon; and he was moving in a world placed beyond the narrow sphere of their conceptions. He was striving to teach a foreign language by a grammar written in that very language, without reflecting that an idiom, the words and the syntax of which are alike unknown, cannot be taught but by the aid of a dialect with which it is capable of being compared. No such comparative grammar exists for those whose ideas are limited to what may be suggested by transient sensations, resulting from instinctive wants. In leading his pupils to write words as signs, he was endeavouring to lead them to what they did not know, by set-

ting out from what was equally unknown. He succeeded, it is true, in enabling them to transcribe whole pages of the most abstract disquisitions by the intermedium of gestures; but these gestures, which they had mechanically associated with certain characters, conveyed to them no notions of the real signification of those characters; for, as in every language words are but conventional signs, it is clear that, before their meaning could have been agreed upon, there must have existed some prior language mutually understood by the parties making the agreement.

Notwithstanding the radical and glaring defects of De l'Epée's method, which must have precluded it from ever being of the slightest utility to those who followed it, the ostentatious display of that kind of success he obtained, and which was of a nature particularly calculated to impose upon a superficial observer, excited the astonishment and applause of a host of spectators; and being seconded by the impulse of his religious zeal and beneficent charity, it soon raised him to a high degree of reputation. His fame spread itself all over Europe, and his lectures and exhibitions attracted everywhere crowds of enthusiastic admirers. There were not wanting persons, however, who saw through the delusion. At a public exhibition of the pupils of the Abbé Storck, who were taught according to this method at Vienna, Mr Nicolai, an academician of Berlin, proposed to the abbé to require one of his pupils to describe in writing the action he was about to perform. The challenge being accepted, the academician struck his breast with his hand, upon which the deaf and dumb boy immediately wrote the words, *hand, breast.* Mr Nicolai withdrew, satisfied with this proof of total failure. It was evident that, notwithstanding all this parade of learning, and their quickness in writing down any question, together with its answer, both had been equally dictated by their master, in the same language of gesture, but without any corresponding ideas, or the exertion of any intellectual faculty, except that of memory. They were utterly incapable of composing a single sentence of their own accord; and it was found, accordingly, that their spontaneous answers to the questions asked them were limited to the monosyllables *yes* and *no*, of which it is even doubtful whether they fully understood the meaning. It is more easy to conceive than to describe the disappointment which the parents must have felt at the discovery of the real ignorance of their children after so many years of instruction, and after the brilliant manner in which they acquitted themselves in their public probations. The secret is, indeed, betrayed in some letters of the Abbé de l'Epée, published by Sicard, in a note to the work already referred to, in which he avows that his views of education were limited to the mechanical qualifications necessary to enable his pupils to perform their parts in a public exhibition, namely, that of writing words upon certain gestures being made to them, without the least intelligence of their import, and of course without the power of employing these words, either as instruments of thought, or as vehicles of meaning.

The Abbé Sicard, who had been for some time the assistant, and was afterwards the successor, of De l'Epée, whilst he retained the system of artificial signs contrived by the latter, soon discovered that the intellectual education of his pupils should be the chief object of his efforts, and, in the pursuit of this object, struck out for himself a new path. An opportunity soon occurred for the development of his plan, by his appointment as teacher to a school which had been recently established at Bordeaux, by the Archbishop M. Champion de Cicé; and among the first pupils presented to him for admission, was a boy and his sister, belonging to a numerous and indigent family, of whom five were deaf and dumb. They lived in an obscure cottage in a remote part of the country; and the sole occupation of John Massieu, the name of the boy, had been to tend his father's flock of sheep, amidst heaths and forests; and whatever habits he had contracted were those of a savage life. On being brought to Bordeaux, for the purpose, as he thought, of looking after other flocks, his astonishment and alarm at the new objects he beheld were extreme. His suspicions were awakened by every look directed towards him, and he shrunk from all intercourse with those who sought his confidence. His dull and vacant countenance, his timid and embarrassed air, his frigid and sullen reserve, all denoted a being unsusceptible of education. By judicious management, the prospect brightened; his faculties were developed; his intellectual powers were gradually excited and exercised; his capacity for receiving instruction expanded, and he made rapid strides in the acquisition of every kind of knowledge. He is at present distinguished by his intelligence, acuteness, and general information; and is not only conversant with literature, but expresses himself with facility, clearness, and elegance. Sicard has detailed in his work the several steps of his instruction, as a model of his general method; of which, however, after what has been already said, only a short notice will be sufficient.

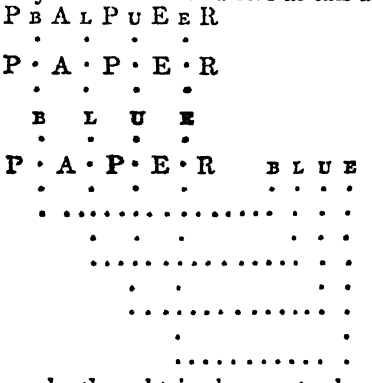
The object of his first lessons is to teach his pupil the relation between the names of objects and the objects themselves; the analysis of words into the letters of the alphabet; and the particular gesture which he is to attach to each word as its distinctive sign. He then explains the meaning of collective words, as distinguished from those denoting individual objects or parts of objects. Thence he proceeds to general terms, applicable in common to a number of individuals, and to generic names comprehending a number of species; and, lastly, ascends to the most general and abstract words, such as *being, thing, object.* The qualities which are expressions of the accidents, variations, and modifications of objects, and are denoted by adjectives, are next taught. He endeavours to make his pupil conceive these qualities, in the first place, as inherent in the objects themselves, and next as being capable of being detached, by a mental operation, from such objects, though, in fact, they have no existence but as united with them. We shall here give a specimen of the contrivances he had recourse to in assisting his pupils to understand such abstract conceptions. Taking seven pieces of paper, each white on one side, and coloured on the other with one of the primitive colours, he places them on a table, before a black board, with their white sides uppermost. He then writes the word PAPER on the board, leaving sufficient intervals between the letters for the insertion of other letters. Then turning the sheet painted blue, so that the coloured side is now uppermost, he writes the word BLUE between the letters of the former word, but in smaller characters, thus,

PBALPUEER.

The same thing is done successively with regard to the other sheets of paper, inserting the name of its respective colour between the letters of the word PAPER, which is repeated for that purpose. This being finished, the blue sheet is again turned down, so that its white side is presented; upon which the smaller letters, composing the word *blue*, are effaced, while the other letters, P, A, P, E, R, are allowed to remain. By this process the pupil is taught to consider the quality as part of the object, or as inherent in it. In like manner, he proceeds with other adjectives, such as *round, square*, and the like, expressing the form of objects; writing them in the intervals of the letters composing the name of the respective objects; effacing them, and substituting others, according as the form of the object is varied.

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In order to lead his pupil to form the abstraction of the quality thus expressed, that is, to the use of the adjective as a separate word ready to be applied to different substantives, he employs the following diagram, the different lines of which he traces before his eyes, in order to point out the steps by which he is to arrive at this abstraction.



The two words, thus obtained separate, he afterwards unites by a connecting line, thus,

PAPER — BLUE.

The next step, in order to form this into a complete sentence, is to insert the word *is*, instead of the line; of which line it may accordingly be regarded as the substitute and representation.

PAPER IS BLUE.

By thus making his pupils understand the nature of a verb, and afterwards teaching them that the verb can express either an existence or an action. *past*, *present*, or *future*, he leads them to the system of conjugation, and to all the shades of tenses adopted in various languages. The various significations and inflections of pronouns, with the corresponding affections of verbs, in regard to number and person, are conveyed to the minds of the deaf and dumb, by contrivances very analogous to the preceding, and which need not be dwelt upon, after the example already given. They proceed upon the general principle of connecting together by lines the words, denoting the ideas, which are the component parts of other ideas, so as to express their union; and writing in the place where the lines unite, or, in place of the other words in a similar diagram, the name of the compound idea. Another part of Sicard's system is the employment of a system of ciphers, written on the top of every word or member of a sentence, according to the office it performs in that sentence; by the help of which his pupils are better enabled to analyze it into its essential parts, distinguishing the name of the object which is either acting or receiving an action, the verb and its regimen, direct, indirect, or circumstantial, and thus comprehending and displaying every part of speech. Thus he instructs his pupils in the science of universal grammar, applicable to the primitive expressions of signs, as well as to all spoken and written languages.

Of the system of artificial signs, which is represented by Sicard as the essential groundwork of all this knowledge, and as the principle means of imparting it, there is much room to doubt the practical advantage. To the praise of ingenuity its author has certainly a claim; but it can scarcely be regarded as any approach to a philosophical language, being as much founded in metaphor and distant analogies as any existing language. With speech it cannot bear any comparison in point of quickness, for the modulations of the voice are capable of being executed with a rapidity far exceeding that of gestures. There is, besides, hardly any mode of fixing the idea of a gesture by some visible type, as there is that of sound by writing, which serves at all times to renew the impression with perfect correctness. Hence the difficulty of forming a vocabulary of gestures, even to those already in possession of the use of written language, of which we must, of course, suppose our pupils ignorant. These gestures, it is pretended, are engrafted on the natural language of pantomime, but this natural language can carry us but a very little way in the expression of thought. Every action, the visible part of which can be imitated by gesture, admits easily of being so expressed; as the action of eating, by lifting the hand to the mouth, followed by the motion of the jaws; and of sleeping, by closing the eyes and reclining the head. The expression of different passions, of approbation or disapprobation, of surprise, of inquiry, &c. may all be signified very intelligibly by modifications of the countenance. It is in this simple manner, observes Dr Watson, that two or more deaf and dumb persons are enabled to hold instant converse with each other, though brought together for the first time from the most distant parts. Thus far these signs may be termed *natural;* but the naturally deaf do not stop here with this language of pantomime. When they are fortunate enough to meet with attentive companions, especially where two or more deaf persons happen to be brought up together, it is astonishing what approaches they will make towards the construction of an artificial language. By an arbitrary sign, fixed by common consent, or accidentally hit upon, they will designate a person or a thing, and only that particular person or thing, by this sign, which is ever after used by them as a proper name. It is remarkable, that, although in the first instances of inventing or applying these sign-names, if they may be so called, they are guided by some prominent, but perhaps by no means permanently distinguishing mark; such as, in the case of a person, a particular article of dress being worn, the first time of becoming acquainted, an accidental wound, though it leave no scar, a peculiarity of manner, and the like; yet, after having fixed upon it, they never vary, notwithstanding the peculiarity that guided their choice should have long ceased to be observable in the person of the individual they have so designated. Nor will they fix upon the same sign for another of their acquaintance, though, at the time of first meeting him, he may have the same mark about him which they had used to specify a former person. This fully proves that they regard the sign merely as a proper name; and they receive it as such from one another, without inquiry as to its origin. Thus, supposing a person, the first time he should be particularly taken notice of by one who is deaf and dumb, had accidentally cut his face, and wore a patch, it is a hundred to one that this would, from henceforward, be his distinguishing mark, unless some one else of the deaf person's acquaintance had already been so distinguished. The wound might be cured, and the patch removed; but the deaf person would uniformly put the end of his finger to the part of the face where the patch had been worn, when he wanted to point him out. And lest those to whom he might be desirous of afterwards communicating something concerning this person should not comprehend him, he will not fail to introduce him to them by repeatedly pointing to him, and then to the mark by which he means to describe him, till he thinks he has sufficiently engaged their attention. By similar contrivances, places and things, as well as persons, nay, even qualities and circumstances, are distinguished by the deaf, in an astonishing manner. To attempt in words a description of those signs would be endless, because they are various as the fancies and circumstances of their inventors. Yet being grafted on the parent stock of natural and universal signs, they may in some measure be regarded as different dialects of the same language.

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Hence every one who undertakes the arduous task of teaching the deaf and dumb, should sedulously turn his attention to the study of that language termed *natural*, where it consists of gesture and feature, in order to enable him to comprehend, as far as possible, the signs of his scholars, which at first more or less differ from one another, as they more or less resemble those signs universally intelligible. Of how much importance it is to the teacher to understand these signs, will readily be apprehended, if any one will attempt either to teach or learn a language, without having another common to master and scholar. But never let any thing so chimerical be thought of as an attempt to turn master to the deaf and dumb in the art of forming signs. What should we expect from an European who should undertake to teach his own regular, copious, and polished language to a South Sea Islander, who was henceforward to live among Europeans, and whose scanty vocabulary extended only to a very few words, barely sufficient to enable him to express, in a rude manner, what was required by the uniformity of his condition and the paucity of his thoughts? Should we suspect that the teacher would set about new-modelling, methodizing, and enlarging this rude and imperfect language, as the readiest method of making the islander acquainted with the European tongue, especially when this new-modelled language, after all the pains bestowed in forming and teaching it, could be of no manner of use but to assist the intercourse between these two persons? If this supposition appear ridiculous, how much more fanciful and useless is an attempt to methodize signs for the instruction of the deaf and dumb. Would it not be a more natural and rational mode of procedure for the teacher to begin by watching the objects and occasions to which the scholar applied the words of his barbarous speech, that by knowing these he might gradually substitute the words of the language to be taught, using the *former* only as an introduction to the latter? It should never be lost sight of, that deaf people are not educated to live always among persons in their own unfortunate situation. Were this the case, indeed, an artificial language of methodized signs might be of important use. But as they are intended to mix with their fellow beings, in social habits and necessary avocations, we have to open a channel to this intercourse; and this cannot be done so effectually by any other means as by teaching them the language of the country where they reside.

To these judicious remarks of Dr Watson may be added the consideration, that our object in educating the deaf and dumb is not so much to make them acute grammarians and subtile metaphysicians, as to render them useful members of society. Experience shows that the more simple and ordinary modes of instruction will effect this latter purpose in less time, and with better success, than the former can be accomplished by the complex and elaborate system we have been considering.

Another most important branch of the education of the deaf and dumb remains to be considered, namely, the teaching them to speak, and to understand what is spoken by others, by observing the motion of their lips. That any person, without the guidance of the sense of hearing, should be enabled, merely by studying the position and action of the organs of voice, to utter articulate sounds with any tolerable perfection, would at first view appear scarcely credible. Experience however has shown, that the task, though laborious and tedious, is not attended with this extreme difficulty. Even the earliest attempts of those who have cultivated this art appear to have been as completely successful as those of modern instructors. Great patience and perseverance would seem to be the qualities chiefly necessary to ensure success in ordinary cases. When we talk of success, however, it must be stated, that a wide difference must ever remain perceptible between the speech of the deaf and of those who hear. This artificial speech is evidently laborious and constrained, conveying frequently the idea of pain as well as of effort. As it cannot be regulated by the ear of the speaker, it is often too loud, and generally monotonous, harsh, and discordant. It is often, from this cause, scarcely intelligible, except to those who are accustomed to its tones. It is only, indeed, to such as are in habits of daily intercourse with them, that it fully answers the purpose for which that gift was bestowed on man, namely, the communication of thought.

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It may, indeed, be a matter of some doubt, whether these advantages, limited as they must necessarily be, are a sufficient compensation for the time and labour consumed in their attainment, and which might perhaps be better employed. The decision of this question, as far as it concerns any particular individual must, however, depend in a great measure on peculiar circumstances, such as his condition in life and future destination. The Abbé Sicard, perhaps from a predilection for the method of artificial signs, renounced the pursuit of this object, as not worth the pains, and as interfering with his general plan. In Great Britain this art has been at all times cultivated with more assiduity and with greater success than on the Continent. The experience of Dr Watson is decidedly in favour of its utility. In support of his opinion he states one argument, which must doubtless be allowed to have considerable weight. The more numerous are the means of association, he justly observes, the more perfect will be the recollection, or, in other terms, the more frequent the recurrence of words, and their corresponding ideas to the mind. Thus, persons who can hear, speak, read, and write, retain a discourse much better, and have far greater facility in expressing themselves, than persons who possess only two of these faculties; that is, illiterate persons, who can hear and speak, but who cannot read nor write. Now as deaf and dumb persons, educated without articulation, can only have two of the means, viz. the third and fourth; that is, the impressions made upon the eye by characters, and the action of the hand in writing; can it be questioned that we render them an essential service by adding the actions of the organs of speech; a very powerful auxiliary, since by it words become, as it were, a part of ourselves, and more immediately affect us? In learning the pronunciation of the letters, a very important operation is going on in the mind of a deaf person; namely, the association, in the memory and understanding, of the figures of written or printed characters, with certain movements or actions of the organs of speech. The very habit of regarding the one as the representative of the other, paves the way for considering combinations of those actions or characters as the signs of things or of ideas; that is, significant *words*, written or articulate. We who hear consider words chiefly as *sounds;* the deaf who have learnt to speak consider them rather as actions proceeding from themselves. And this gives language to them a sort of tangible property, which is of vast importance both as respects its retention in the memory, and as it respects one of its most important uses, the excitation of ideas in their own minds. On this account the time, the labour, and attention, necessary to articulate speech by those who are dumb, through want of hearing, would be well bestowed, even if their speech were not intelligible to others. Deaf persons having learnt to speak are frequently overheard speaking softly to themselves; that is, rehearsing words or sentences, either for the purpose of better remembering them, or of framing such expressions as they think will best convey their ideas.

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The act of speaking is evidently an operation purely mechanical; and the instruments by which it is performed are the lungs, windpipe, and larynx, the tongue, nostrils, lips, and the various parts of the mouth. The lungs supply breath like the bellows to a musical organ; and the shortening or elongation of the cavity of the pharynx and mouth produce the varieties of grave and sharp tones in the voice, though these tones are again modulated by the movements of the parts of the larynx, which are disposed so as to expand or contract the aperture of the glottis. The articulation of syllables, or the formation of the different letters, begins after the breath has been emitted through the larynx, and is accomplished by means of the mere external organs of speech, that is, the mouth, nostrils, tongue, teeth, and lips.

The following is the process employed by Dr Watson in teaching the pronunciation of the vowels. "The first step," he says, "is to obtain a clear and distinct sound from the throat (in a voice tolerably well pitched, for this is our *materia loquelæ*), as of *a* in the word *wall*, &c. To effect this, and to habituate the pupil to associate the sound which he is learning to form with the figure of the letter which is to be its representative, this is distinctly traced upon paper, or any convenient tablet, and he is made to look at it for a minute or two; he then, if of acute intellect, will look up, with some anxiety in his countenance, as if he would ask what he is to do with it. The sound is then slowly and fully pronounced, and the learner made to observe, by his eyes, the position and motion of the external organs of speech, and to feel the astriction of the muscles of the larynx, by placing his finger upon the throat, carefully making him perceive the difference to be felt there between sound and silence. Having made these observations for a minute or two, he will seldom hesitate to attempt an imitation of what he has been observing; and that, for the most part, successfully. When the contrary is the case, nothing more is necessary than patient and good-natured perseverance; for if he perceive that his failure has excited chagrin or disappointment in his teacher, he will make another effort with great reluctance. The sound once acquired must be practised sufficiently to avoid any danger of losing it; for the greatest care must be taken, all throughout his progress, never to proceed to a new sound till the preceding has become familiar, and unattended with doubt as to the manner of producing it. A contrary practice would lead to endless vexation. A principal requisite is to keep the learner in good humour, and to make him think that he is doing well beyond expectation; nothing is more discouraging than to put him back." In the same manner he proceeds to the simple sounds of the other vowels, and then to the consonants.

By the powers of the consonants are meant the positions and actions of the several organs employed in their formation, without the addition of any distinct vocal sound. For although frequent mention will be made of sound in the throat, in their formation, it is to be understood as so confined by the position of the organs, as not to partake of any of the sounds represented by the vowels.

By closing the lips, sounding gently in the throat, forcing them asunder by the emission of the breath, and carefully avoiding to let any of it pass through the nose, we have the power of B. After the same manner is formed the power of P, but without sound in the throat. M requires the lips to be closed, the sound is made in the throat, and the breath suffered to escape through the nose.

The power of C, or what is called its hard sound, that is, the sound of K, is formed by raising the back part of the tongue to the roof of the mouth, near the uvula, and forcing it away again rather quickly, by an emission of the breath, without sound in the throat. G has the same formation, with the addition of sound in the throat.

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The power of D is produced by placing the tip of the tongue against the two rows of teeth, which are to be quite, or nearly shut, sounding in the throat, emitting the breath in removing the tongue from the teeth, and, at the same time, opening them a little. T has the same formation, only without sound in the throat.

By placing the upper row of teeth upon the under lip, and gently emitting the breath, without sound in the throat, we have the power of F. V has the same formation, with the addition of sound in the throat.

H is a mere emission of breath, with the mouth a little open.

J has the power of D and SH combined.

L is formed by raising the point of the tongue to the roof of the mouth, near the upper teeth, sounding in the throat, and suffering the breath to escape freely on each side of the tongue.

The power of N is formed by raising and pressing the tongue to the palate, with the whole of its upper surface, so that no breath may escape except through the nose; the lips being kept open, and a gentle sound being made in the throat.

For Q, join K and W.

R is variously formed; but the surest and easiest way of teaching its power to a deaf person is by elevating the fore part of the tongue to the palate, and, with the assistance of the breath, causing a vibratory motion of it, accompanied with a gentle sound in the throat.

In forming S, place the tip of the tongue just below the under teeth, raise the sides of it to the palate, leaving a small aperture in the middle, through which the breath is to be forced, without sound in the throat, which will be intercepted by the teeth being shut, and form the hissing sound required. Z requires the same position of the organs, with the addition of sound in the throat.

X is compounded of K and S.

CH is compounded of the powers of T and SH.

SH has a power nearly resembling that of S, and requires a position of the organs something similar, except that the tip of the tongue must be drawn back, instead of touching the gums and teeth; and the current of the breath emitted must be intercepted by the under teeth only in part; the rest must be suffered to escape between the rows of teeth, which must be a little opened for that purpose.

TH requires the tongue to be a little advanced between the two rows of teeth, and the breath emitted between it and the upper row, which must, nevertheless, be nearly in contact with it; this will produce the sound of TH, as heard in the word *think*. It has another power, requiring precisely the same position of the organs, but with the addition of sound in the throat, heard in the word *this*, &c.

NG represents a strong nasal sound; to form it the tongue is drawn back and raised to the roof of the mouth, towards the uvula; a sound is made in the throat, and forced through the nose.

It is evident that when the power of a consonant is acquired, it needs only to be combined with the vowels to form syllables; as *ba*, *ab*, &c. These the pupil pronounces almost at sight, as he does also *bab*, and any other combination of a vowel and a consonant or consonants, if well grounded in the foregoing formations of them. From the easiest combinations we proceed to the most complex, and by practice acquire a readiness in pronouncing the longest polysyllables.

Whilst acquiring the faculty of speaking, the deaf and

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dumb imperceptibly learn to distinguish by the eye the words spoken by others. "It is truly astonishing," says Dr Watson, "and would hardly be credited by any one who had not seen it, how readily deaf persons, who have themselves been taught to speak, catch words, and even long sentences, from the mouths of those who address them. Yet, in this sort of conversation, it is indispensable that the speech should be immediately directed to the *spectator* (we must not call him *auditor*), who must have an opportunity of observing every motion of the muscles (as far as these can be seen externally) and countenance, in order to make out the discourse. On this account it is impossible for a deaf person to understand the conversation of a mixed company, a discourse from the pulpit, or an harangue to an assembly, where the speaker does not immediately address him."

After the sketch we have thus given of the principles on which the different departments of the education of the deaf and dumb should be conducted, it only remains for us to consider the best order in which we should proceed with their lessons and studies, and the period within which we may reasonably expect that they are to be completed. In giving directions with this view, we shall still take Dr Watson as our guide.

Schools for the deaf and dumb, in which a great number are instructed at the same time, afford peculiar advantages to the teacher, and are very favourable to the proficiency of the scholars. By associating with others, who, being equally deprived of hearing, are on a level with regard to the difficulties to be surmounted, they are relieved from the continual sense of inferiority which oppresses and disheartens the deaf child when placed in the midst of those who have the perfect use of all their senses; and the influence of example, and a spirit of emulation, will operate with due force in exciting them to intellectual exertions. Dr Watson finds, by experience, that one deaf person may be employed to teach another with the happiest effect. So much so, that when he happens to be for the moment at a loss to make one of slow apprehension understand a lesson, he turns him over to one of his school-fellows who has learnt it, and never without advantage to both. For it is with the deaf as with every one, that we ourselves learn best by endeavouring to teach others.

The acquisition of the pronunciation of letters, of syllables, and of words, with their correct orthography, contained in the vocabulary already described, together with such additional exercises as will most obviously exemplify the application and meaning of the connecting parts of speech, will be sufficient occupation to the pupil during the first year of his attendance upon the school; and when the capacity is good, great progress is usually made in these particulars during this period. He is then prepared for longer exercises, and for the application of the words he has learnt, in the construction of longer sentences, to which he, of course, requires to be led on by easy and familiar examples. A sort of colloquy, or dialogue, must be entered into with him. The questions at first must be all on the teacher's part, and the answers must be formed for the learner, in the most obvious words and phrases that will convey his ideas, in strict conformity to which they must constantly be framed. Due attention being paid by learner and teacher, the good effects of this method will presently appear. The latter will soon be agreeably surprised by his scholar changing parts with him, and becoming, in his turn, the interrogator; and that, too, in a way that will show he practically understands analogy.

It will be useful to set aside certain stated periods, as once or twice in a week, for the repetition of words already learnt; taking care to see minutely that correct ideas are annexed to each. When the whole of the words in the select vocabulary, substantives, verbs, and adjectives, have been gone through several times, and the reader can correctly spell, speak, and point them out (if the names of things engraved), or show their signification by his signs (if the names of actions, or qualities, &c.), then he is to enter upon a work as yet altogether new to him. He is to go over his vocabulary again, and to learn a short definition of each word; that is, to tell the meaning of words by words. This employment is prescribed, not because he will better understand the words in his vocabulary by being taught to define them, but because an opportunity is thus afforded of enlarging it, by the introduction of synonymous words, and words that are defined in some way from those we are defining; and these new words enable us to explain others. So that, by this means, and by our colloquial exercises, our vocabulary is daily and almost imperceptibly enlarging. This is strictly analogous to the manner of acquiring a first language by those who hear. The conjugation of verbs is, in the mean time, to be carefully attended to; and one example, at least, through all the moods, tenses, and persons, should now be performed every morning, till the pupil can write any person of any mood or tense required.

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By this time, probably about the third year of the learner's progress, supposing in him the requisite attention and capacity, it will be proper and necessary to begin the reading of printed books, for the sake of profiting by the information they contain. As far as the mere act of reading is concerned, we have no new difficulty to surmount, for all our exercises and lessons have, in fact, been read as well as written by the learner. The difference between printed characters and those used in writing has, of course, not been unobserved. What constitutes the chief impediment to making sense of what is met with in books, is the promiscuous use of words, without regard to our selections. What is to be done when we meet with a word which we have never seen before? Precisely that which is done with all children under similar circumstances; explain it by the substitution of a word of which the meaning is known, if it can be done; if not, pass it over till a favourable opportunity shall occur to show its meaning by an example. If no such opportunity ever occur, then can the meaning of the word be of no great moment to the learner.

In order to discover the progress he has made, and is daily making, and to assist him in the composition of sentences, or the expression of his thoughts in writing, he is now required, every day, to furnish, according to his capacity, a certain number of lines from his own ideas. He is at liberty to choose his subject; he may relate what he has seen in his walk or his play-ground, or he may unfold the stores of his memory relative to more distant places and periods. He may ask questions, and seek for information of any kind. His rude essays at expression are often curious, and require some skill in the language of pantomime to discover their meaning by his own explanations. This being attained, it is put into correct but easy language; he commits it to his memory thus corrected; and goes to work again, "at his leisure hour in the evening," for the next day, generally profiting considerably by the alterations it was necessary to make in his preceding essay. We have now a new channel of communication opened; and the knowledge of the meaning of words, and their use in the construction of sentences, which we have already acquired, may be carried to almost any given degree of perfection and extension. Frequent conversation and intercourse, by the words of the language he has learnt, is of the very utmost importance to a deaf person,

especially if he should have but little leisure or inclination for reading, as the means of extending his knowledge of language, and of enlarging his conception of things, and as the means of retaining what he has acquired. Every one will readily perceive this, who considers how easily a foreign or dead language is lost for want of reading, writing, or speaking in it.

The asylum for educating the deaf and dumb children of the poor, established in the immediate vicinity of London, by private subscriptions, in the year 1792, was originally under the very able superintendence of Dr Joseph Watson. *Five* years being, generally speaking, deemed sufficient to accomplish that course of instruction which was thought most essential to such children, destined to earn their bread by the labour of their hands, and *fourteen* being the earliest age at which they could be apprenticed, it was judged best, for the economical purposes of the institution, not to receive them before the age of nine years.

An institution of a similar kind was also established at Birmingham, under the superintendence of Mr Thomas Braidwood, who had previously conducted a private school for the deaf and dumb at Hackney. Though the original design did not go beyond that of a day-school, yet afterwards, by the zealous exertions of a number of its friends, a liberal subscription was raised for providing a building fitted for the reception of children from distant places. This building was completed and opened in January 1815, and is sufficient to contain forty children. In various other towns also similar institutions have been established.

In June 1810 a society was instituted in Edinburgh for the education of deaf and dumb children. The first teacher was Mr John Braidwood, a member of the family which has done so much for the instruction of this interesting class of persons. On his removal, a short time afterwards, Mr Robert Kinniburgh was appointed teacher of the school, and this gentleman long continued to discharge the duties of his office with equal ability and success. The number of the pupils at present (1854) is fifty-seven. All of them are boarded in the society's house, where they are taught reading, writing, geography, and arithmetic, and are carefully instructed in the principles of the Christian religion. They are also, in some cases, taught to express their wants and ideas in articulate speech; and all are instructed to communicate their sentiments by written language, which they do with great facility. No child, except under special circumstances, is admitted under eight years of age. Besides the above-mentioned branches of education, which all the pupils are taught in common, the female pupils are taught needle-work, and those of an inferior station are qualified by suitable instruction for becoming domestic servants. Some of the boys are also taught to be tailors, or shoemakers, or learn some other useful craft. Since this institution commenced its labours, a very large number of pupils, both male and female, have left school more or less instructed, and, by having their rational and moral powers awakened, qualified to become useful members of society. The system of tuition followed in the Edinburgh school is nearly the same as that of the London institution.

The pupils occasionally undergo public examinations, and they never fail to gratify the assembled audience, particularly by their promptitude in defining abstract terms. The following, on the word *Music*, may serve as a specimen: "*Music*, the language of sentiment and the breath of the passions; a harmonious and sweet sound, such as the sound of a piano-forte or a violin. *Language*, a medium of conversation between one man and another: it is either artificial or natural. *Natural*, not acquired, not taught, not learned. *Artificial*, cultivated by art, not natural. *Sentiment*, thought, opinion, the judgment of the mind. *Breath*, life, moving air. *Passions*, such as extreme love, anger, zeal. *Harmonious*, concordant or agreeing. *Sweet*, delicate, luscious, pleasing to the ear or taste. *Sound*, a noise; I cannot hear what is called sound. *Piano-forte*, a large curious musical instrument used by ladies. *Bagpipe*, an instrument consisting of a leathern bag and pipes used by Highlanders." At these examinations, too, they exhibit their attainments in geography and arithmetic, and display a minute acquaintance with the facts and doctrines of the Christian religion; and the specimens of composition which are produced not only manifest much good sense and accuracy, but sufficiently controvert the assertion, that none of the deaf and dumb can ever be taught to write grammatically. The public are permitted to visit the school every Tuesday from twelve to one o'clock, for the purpose of examining the various classes.

The institution was established and is wholly supported by private subscription, and by the aids contributed by auxiliary societies in some of the other towns in Scotland. Its expense for one year, ending 31st December 1853, was L.1338.

Although the institution has been liberally patronized by the public, yet its income has always been insufficient to meet its expenditure. In consequence of this the directors have been generally under the painful necessity of preferring those applicants who could afford to pay a part of the expense of their own maintenance during the period allotted for their education. However, in not a few cases where the parents or friends have been found unable to contribute any portion of this expense, it has been wholly defrayed by the institution.

Besides this institution, Edinburgh possesses in Donaldson's Hospital (which has accommodation for 300 poor children) the means of instruction for a limited number of deaf and dumb pupils. The number of these in 1853 was 26 boys and 21 girls. For an account of this noble establishment, see EDINBURGH.

Various institutions for similar objects have been formed on the Continent. The asylum for the deaf and dumb at Paris, which was formerly under the management of the Abbé Sicard, has for its object not only to enable the pupils to communicate their ideas and to form their understanding, but also to qualify them to earn their subsistence. On quitting the asylum, they are all capable of following a trade or profession. Their apprenticeship begins on their first entering the institution, and is terminated with their instruction. This apprenticeship takes place under the inspection of ten masters, viz., a printer, an engraver of precious stones, a copperplate engraver, a drawing-master, a turner, a mosaic artist, a tailor, a shoemaker, a cabinet-maker, and a gardener. All these masters reside in the asylum, and receive their board and a salary.

Institutions formed more or less upon the model of that at Paris have been established in Portugal, Spain, Italy, Switzerland, Baden, Wurtemberg, Bavaria, Austria, Prussia, Saxony, Hesse-Cassel, Nassau, Hanover, Brunswick, the Free Towns of Germany, Belgium, Holland, Denmark, Sweden, Russia, Poland, the United States of America, Canada, Mexico, and Bengal, to say nothing of those in Great Britain and France. But in comparatively few of them is any attempt made to teach the pupils to speak.

Number of deaf and dumb in Great Britain.

By the census of 1851 in Great Britain, 12,553 persons (6884 males and 5669 females) are returned as deaf and dumb. Of this number, 10,314 are in England, 2155 in Scotland, and 84 in the Islands in the British Seas. The subjoined table (No. 1) shows the proportion which the deaf and dumb bear to the general population; and from it we learn that in Great Britain 1 in every 1670 inhabitants is a deaf-mute, in England 1 in 1738, in Scotland 1 in 1340, and in the islands 1 in 1704. These numbers and proportions would be slightly increased if allowance were made for the omission of infants, with respect to whom, owing to the difficulty of ascertaining the existence of deafness and

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consequent muteism in the first years of life, the returns are unavoidably imperfect. The above numbers will therefore be received as an under-statement of the actual state of deaf-dumbness. But as the same defect of necessity exists in the returns of other countries, no erroneous conclusions will be formed from using them for the purposes of comparison.

According to the most recent returns, the average proportion of the deaf and dumb to the population of Europe generally is found to be 1 in every 1593 persons. In Holland, Belgium, and other states presenting chiefly a flat surface, the proportion is much smaller than in Norway and Switzerland; indeed, in some of the Swiss cantons, where cretinism is prevalent amongst the mountain passes, there is 1 deaf-mute in every 206 inhabitants. In Ireland the average is 1 in 1380 persons; and in the United States of America, where, however, the returns (census 1850) are admitted to be very defective, 1 in 2366.

Looking at the distribution of the deaf and dumb over the face of Great Britain, we find them to be more common in the agricultural and pastoral districts, especially where the country is hilly, than in those containing a large amount of town population. The northern counties of Scotland, which include the wild and mountainous region of the Highlands, present the highest average—1 in 1156 of the population; then the south-western division of England, with 1 in 1393; followed by the southern counties of Scotland, 1 in 1480; and the Welsh division, 1 in 1542. We have already seen that the south-western and Welsh divisions of England and the northern counties of Scotland contain the largest proportional number of blind persons.

TABLE No. 1.—*Number of the Deaf and Dumb, and their Proportion to the Population.*

	Population.	Number of Deaf and Dumb.	Proportion to Population.
GREAT BRITAIN AND ISLANDS IN THE BRITISH SEAS . .	20,959,477	12,553	One in 1,670
ENGLAND AND WALES .	17,927,609	10,314	1,738
SCOTLAND . . .	2,888,742	2,155	1,340
ISLANDS IN THE BRITISH SEAS	143,126	84	1,704
ENGLAND AND WALES. Divisions.			
I. London . . .	2,362,236	1325	1,783
II. South-Eastern. .	1,628,386	836	1,948
III. South-Midland .	1,234,332	649	1,902
IV. Eastern . . .	1,113,982	669	1,665
V. South-Western .	1,803,291	1,295	1,393
VI. West-Midland. .	2,132,930	1,325	1,610
VII. North-Midland .	1,214,538	694	1,750
VIII. North-Western .	2,490,827	1,237	2.014
IX. Yorkshire . .	1,789,047	1,042	1,717
X. Northern . .	969,126	471	2,058
XI. Welsh . . .	1,188,914	771	1,542
SCOTLAND.			
Southern Counties . .	1,813,562	1,225	1,480
Northern Counties . .	1,075,180	930	1,156

Cretins, most of whom are deaf-mutes, are found in some of these localities: the disease of cretinism is also accompanied by mental imbecility in a greater or less degree.

The proportion of deaf-mutes is lowest in the northern division of England—1 in 2058 inhabitants; and in the north-western division (Cheshire and Lancashire), where a nearly similar average prevails, 1 in 2014.

Although as a general principle a greater degree of prevalency of deaf-dumbness seems to exist in rural and hilly localities than amidst urban and manufacturing populations yet exceptions are remarked on applying this test to the counties, and the smaller subdivisions composing them. The following English counties, for example, present widely different results, scarcely to be explained by a reference to their physical or geographical peculiarities:—

Deaf and Dumb.

Yorkshire, East Riding....	1	Deaf and Dumb in every	2231	inhab.
Monmouthshire.....	1	... ...	2300	...
Kent (*Extra-Metropolitan*)	1	... . .	2343	...
Durham.....	1	... ...	2480	...
Huntingdon.....	1	... ...	3016	. .
Hereford.....	1	Deaf and Dumb in every	1054	inhab.
Worcester.....	1	... ...	1160	...
Derby	1	... . .	1272	...
Cornwall.....	1	... ...	1278	...

The relative numbers of the sexes are in all countries much more disproportionate amongst the deaf and dumb than amongst the blind. In Great Britain and in England and Wales there are 121 male deaf-mutes to 100 females; in Scotland the inequality is somewhat greater, namely, 125 males to 100 females; in the Islands in the British Seas there are 121 males to 100 females. The Irish returns give the reversed proportion of 111 females to 100 males.

In every 10,000 of the general population of each sex in Great Britain, 6·7 males and 5·3 females are deaf and dumb. But while the returns for the whole country exhibit a larger proportion of males, the reverse obtains in some localities; thus in Berks, Bedford, Salop, Derby, and Monmouth, more females are returned than males relatively to the numbers living of each sex.

An examination of the ages of the deaf and dumb presents results the opposite of those indicated by the tables relating to the blind. It has been shown that blindness is found chiefly in persons in advanced life—47 per cent. of the blind being upwards of 60 years of age—and to a small extent amongst young persons.

The subjoined table (No. 2) exhibits the proportions which the deaf and dumb and the blind bear to the male and female population living at different ages in England and Wales. It will be seen that of the deaf and dumb the highest proportions exist at the periods of age ranging between 5 and 25 years—the numbers gradually diminishing as the ages advance. The blind, on the other hand, increase at each period from infancy to old age—after 55 very rapidly, and nearly in the same ratio as the general mortality.

TABLE No. 2.—*England and Wales.—Proportion of the Deaf and Dumb and the Blind at different Ages to the Male and Female Population.*

Years of Age.	To every 100,000 *living* at each age, the Proportion of			
	Deaf and Dumb.		Blind.	
	Males.	Females.	Males.	Females.
0.....	24·1	18·2	21·8	17·8
5.....	86·8	72·5	33·1	26 0
10.....	91 8	75·3	38 7	34 0
15	74 8	56·6	52·7	37·3
25	65 0	49·9	64·0	43 1
35.....	57·7	49·4	102·0	60 7
45..... ...	56 1	44 2	166 7	113 0
55.....	52·6	44 9	289 4	225·9
65....	51 1	37 9	637·9	539 0
75.....	49·5	44·5	1,305·0	1,251·5
85 and upwards.....	37·8	20 0	2,802·3	2,870·5

Of the 12,553 deaf-mutes, only 783, or 6·2 per cent., had reached 60 years of age—a fact showing the unfavourable position of this class as regards length of life; while those under 20 years of age, although the numbers are unquestionably deficient, amounted to 47 per cent. The incompleteness of the returns for the years of early life, arising

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from the uncertainty which must exist with respect to infants, and the natural indisposition of parents to form a painful conclusion on the subject while the slightest grounds for doubt exist, has already been adverted to. A rough estimate of the omissions from this cause may be made by assuming the deaf-mutes under 5 years of age to bear the same proportion to the general population of the same age as the persons aged 5 years and upwards bear to the residue of the population. In 1851, there were in Great Britain, of 5 years of age and upwards, 18,222,518 persons, of whom 11,993 were deaf and dumb. If a like proportion existed amongst the population under 5 years of age (2,736,959 persons), 1801 deaf-mutes, instead of 560, would have been returned under the first quinquennial period of age. The addition of 1241 cases would raise the percentage of those under 20 years of age to 52, and lower that of the ages above 20 to 48; but as the omissions would not be so frequent in the fourth and fifth years of age as in the earlier years, the supposed number to be added is probably too large.

In London a larger proportion is observed between 5 and 15 years of age than elsewhere; a circumstance attributable to the institutions for the deaf and dumb established in the metropolis. Throughout the country, however, a very small number, scarcely more than 1100, were returned as inmates of schools or asylums; and when it is remembered that even partial instruction can be imparted to persons in their condition only by a special course of training, and then with great difficulty, the inadequacy of the existing provision for their education will be apparent. Without careful instruction, the deaf-mute is sometimes highly dangerous to society.

A Spanish Benedictine monk, of the convent of Sahagun, in Spain, named Pedro de Ponce, who died in 1584, is the first person who is recorded to have instructed the deaf and dumb, and taught them to speak. He has, however, left no work upon the subject; though it is probable that the substance of his method is contained in a book of Bonet, secretary to the constable of Castile, printed at Madrid in 1620, under the title of *Arte para ensenar a hablar los Mudos*. The following is a catalogue of the principal works in connection with this subject:—

Philocophos, or the Deaf and Dumb Man's Friend; by Dr John Bulwer, 1648. Also, by the same author, in 1644, *Chirologia, or the Natural Language of the Hand;* and *Chironomia, or the Art of Manual Rhetorique.*

Dr Wallace's *Grammatica Lingua Anglicana;* and a treatise prefixed to it, *De Loquela, ac de sonorum omnium formatione.*

A Letter from Dr Wallace to Mr Boyle, in the *Philosophical Transactions* for July 1670; and another from the same, in the volume for 1698.

Helmet's *Alphabeti vere naturalis Hebraici brevissima Delineatio*, Salzburg, 1657.

In the *Philosophical Transactions* for January 1668, an account is given of a small tract published the preceding year by the same author, entitled *Alphabetum Naturæ.*

Dr Holder's *Elements of Speech, with an Appendix concerning persons Deaf and Dumb*, 1669.

Treatise concerning those that are born Deaf and Dumb. By George Sibscote, 1670.

G. Dalgarno's *Didascalocophus, or the Deaf and Dumb Man's Tutor*, 1680.

C. Amman's *Surdus Loquens*, 1692; and *Dissertatio de Loquela*, 1700.

Defoe's *History of Duncan Campbell*, who was born deaf and dumb, but who himself taught the deaf and dumb to understand. London, 1720.

The *Mémoires présentés à l'Académie Royale*, 4to, Paris, 1678, contains a valuable memoir of Periere.

Institution des Sourds et Muets, par la voie des Signes Méthodiques; ouvrage qui contient le projet d'une Langue Universelle, par l'entremise des Signes naturels assujettis à une méthode, Paris, 1776, an anonymous work of the Abbé de l'Epée. A new edition appeared in 1784, much altered, and with the title of *La véritable manière d'instruire les Sourds et Muets, confirmée par une longue expérience.* This last work has been introduced into the *Encyclopédie Méthodique des Arts et des Métiers*, under the article *Muets et Sourds*, and it was translated into English anonymously in 1801.

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An Essay on the Method of Teaching the Deaf and Dumb to Speak, by Dr William Thornton, is to be found in the third volume of the *Transactions of the American Philosophical Society.* Philad. 1793.

Cours d'Instruction d'un Sourd-Muet de Naissance, et qui peut être utile à l'Education de ceux qui entendent et qui parlent. Par Roch-Ambroise Sicard, Paris, 1800. A second edition appeared in 1803.

Mémoire ou Considérations sur les Sourds-Muets de Naissance, et sur les moyens de donner l'ouie et la parole à ceux qui en sont susceptibles. Par U. R. T. le Bouvyer Desmourtiers. Paris, 1800.

Instruction of the Deaf and Dumb. By Joseph Watson, LL.D., 2 vols. 8vo. Lond. 1809.

Théorie des Signes pour l'Instruction des Sourds-Muets. Par R. A. Sicard, 2 tom. 8vo. Paris, 1808.

Recueil des Définitions et Réponses les plus remarquables, de Massieu et Clerc, Sourds-Muets, aux divers questions qui leur ont été faites, dans les Séances Publiques, de M. l'Abbé Sicard à Londres. Auquel on a joint l'Alphabet Manuel des Sourds-Muets, le Discours d'Ouverture de M. l'Abbé Sicard, et une Lettre explicative de sa Méthode. Par M. Laffon de Ladébat. *Avec Notes et une Traduction Anglaise*, par J. H. Sievrac. London, 1815.

Methoden-Buch zum Unterricht für Taubstumme, von Michael Ritter, Pfarrer zu Kallham in Ober-Oesterreich. Wien, 1828.

Der durch Gesicht und Tonsprache der Menscheit wiedergegebene Taubstumme, von Dr Graser. Bayreuth, 1829.

Gelegenheitliche-Aeusserungen über menschliche Bildung, besonders über die Bildung der Taubstummen, von Franz Hermann Czech. Wien, 1830.

Uebersicht der Taubstummen und der Anstalten für deren Bildung, in Preussichen Staate Berlin, 1830.

Didérot, *Lettre sur les Sourds-Muets.*

Troisième Circulaire de l'Institut Royal des Sourds-Muets de Paris. Paris, 1832, 8vo.

Diderot alludes to the possibility of a child being born at once deaf and blind, a possibility which has also been anticipated by the Abbé Sicard, in the preliminary discourse to his *Cours d'Instruction*, where he suggests different methods of instruction that might be attempted in circumstances so apparently hopeless. The first instance in which this deplorable combination of defects is recorded to have occurred in any individual, is mentioned by Dr Watson, in a quotation from the *Gentleman's Magazine* for November 1808. He also adds another example in the person of James Mitchell, whose history has been narrated by the masterly pen of Mr Dugald Stewart, in a memoir published in the *Transactions of the Royal Society of Edinburgh* (vol. vii. p. 70), and also in the appendix to the last volume of his *Elements of the Philosophy of the Human Mind.* Mr Wardrop, who performed upon him the operation of couching, has also given us some valuable and interesting particulars of his case, in a separate work, entitled *History of James Mitchell, a Boy born Blind and Deaf, with an account of the Operation performed for the Recovery of his Sight.* (London, 4to, 1813). In the eighth volume of the *Transactions of the Royal Society of Edinburgh*, are to be found *Additional Communications respecting the Blind and Deaf Boy, James Mitchell*, by Dr John Gordon, a gentleman

Deal ‖ Death-Watch.

who had paid particular attention to the case of Mitchell, and from whom Mr Stewart acknowledges that he received much of the information contained in his paper. This volume also contains a paper *on the Education of James Mitchell*, by Dr Dewar; and an additional communication from the same author on this subject. Two interesting cases of the same kind, which occurred in the United States of North America, are given in Dr Daubeny's Travels. (P. M. R.)

Debateabl Land ‖ Deccan.

DEAL (Sax. *dælan*, to divide), fir timber sawn into planks.

DEAL, a municipal and parliamentary borough, market-town, and parish, in the hundred of Bewsborough, Kent, 8 miles N.N.E. from Dover. It derives its trade and importance from the vicinity of the Downs, a fine anchorage between the shore and the Goodwin Sands, in which large fleets of wind-bound vessels may lie in safety. This circumstance gives rise to an extensive trade in victualling and naval stores at Deal. The Deal pilots are famous for their skill and daring, and a considerable portion of the inhabitants is engaged in boat-building. The town is also resorted to for sea-bathing. The great mass of the population reside in Lower Deal, which consists of three principal streets lying parallel to the beach. In Upper and Middle Deal the houses are detached, and inhabited by the wealthier classes. There are three churches belonging to the Establishment, and an equal number to the Dissenters. In the neighbourhood are Sandoun and Deal castles, erected by Henry VIII., and Walmer castle, the official residence of the warden of the Cinque Ports, to which, as member of the port of Sandwich, Deal has been annexed. Along with Walmer and Sandwich, Deal returns two members to the imperial parliament. Pop. (1851) 7067.

DEAN (Fr. *doyen*, the eldest of a corporation; Lat. *decanus*, from *decem*, one set over ten persons), in England, is an ecclesiastical dignitary in a cathedral or a collegiate church, and the head of a chapter. He is the second dignitary of a diocese; and was so named because originally he was set over ten canons or prebendaries. In former times the dean was elected by the chapter, in virtue of a *congé d'élire* from the king, and letters missive of recommendation; but in the chapters founded by Henry VIII. out of the spoils of the monasteries, the deanery is donative, and the installation merely by royal letters patent.

A *Rural Dean*, or arch-presbyter, had jurisdiction originally over ten churches; but afterwards he became only the bishop's substitute, to grant letters of administration, probate of wills, &c. The office is now merged in that of the archdeacon and chancellor.

Deans in Peculiar, are deans of particular parishes and churches, or of rural districts that have jurisdiction within themselves, being independent of the ordinary of the diocese.

Dean and Chapter, the council of a bishop, to aid him with their advice in the affairs of his see. See CHAPTER.

Deans of the Chapel Royal. See CHAPLAIN.

Dean of a Monastery, a superior established under the abbot, to whom was intrusted the care of ten monks: hence his name.

Dean of Guild, in the municipal system of Scotland, the head of the merchant company or guildry, who has the superintendence of all buildings, public and private, within the burgh; and in this respect his functions may be said to resemble those of the ædiles of ancient Rome. See GUILD.

Dean of the Faculty of Advocates, in Edinburgh, the president and chief officer of that body.

There are also deans of the several faculties in the universities.

Dean, Forest of. See GLOUCESTERSHIRE.

DEATH-WATCH, a name given to a small kind of beetle, *Anobium tesselatum*, remarkable for producing a ticking noise, like the beat of a watch, by striking its head with great force and quickness several times in succession against the plane of its position. These insects infest old houses, where they get into the wood. The ticking sound appears to be the signal-call of the sexes, and when no answer is returned, the insect repeats it in another place. The number of strokes is usually from seven to eleven. It appears to share this power of pulsation in common with some other insects. The name death-watch is derived from a prevalent superstition among ignorant people, that this ticking sound is a presage of death. See *Anobium*, in index to ENTOMOLOGY.

DEBATEABLE LAND, that part of Great Britain which lay between Scotland and England when the kingdoms were distinct, and to which both nations laid claim.

DEBENTURE (Lat. *debeo*, to owe), in a general sense, a writing acknowledging a debt; applied more particularly to a kind of certificate used at the custom-house, which entitles a merchant to receive a bounty or drawback of duty already paid on the exportation of specified goods.

DEBRECZYN, or DEBRETZIN, a royal free city of Hungary and, after Pesth, the largest in the kingdom, is situated in a sandy plain 114 miles E. of Pesth, with which it is connected by a railway. It is the capital of the county of Bihar. Debreczyn is an ill-built straggling town, with houses almost all of one story and thatched, while the streets are unpaved and dirty. Among its principal buildings are the town-hall, several churches, monasteries, and hospitals, the orphan asylum, and the Protestant College. This last has a library of 20,000 volumes, and is attended by upwards of 2000 students. Debreczyn has also a Piarist college, a Roman Catholic gymnasium and other schools. The manufactures are considerable, including tobacco pipes, shoes, leather, coarse woollen cloth, soap, combs, cutlery, furs, and coopers' and turned wares. Pop. 63,000, mostly Magyars and Calvinists. An extensive fair for agricultural and other produce is held here every three months.

DEBRUIZED, in *Heraldry*, an epithet denoting the restraint imposed on an animal by any of the ordinaries being placed over it. It is also applied to charges over which another charge is borne.

DEBT, NATIONAL. See ENGLAND, and FUNDING SYSTEM.

DECADE (Fr. *décade*, from Lat. *decas*, Gk. δεκα), the sum or number of ten. *Decades*, an enumeration by tens, as *a decade of years*. Livy's great work is divided into decades.

DECAGON, in *Geometry*, a plane figure with ten sides and ten angles.

DECALITRE, a French measure equivalent to 10 litres. See LITRE.

DECALOGUE, the ten commandments delivered by God to Moses.

DECANDOLLE. See CANDOLLE, DE.

DECANTATION, the act of pouring a liquor gently from its lees or sediment, by inclining the lip or *canthus* of the vessel; and hence the name.

DECANUS, in *Roman Antiquity*, a petty officer who presided over the ten soldiers of his contubernium, or those living in the same tent.

DECAPOLIS, in *Ancient Geography*, a name given collectively to the ten cities of Damascus, Philadelphia, Raphana, Scythopolis, Gadara, Hippos, Dion, Pella, Gadasa, and Canatha. It gradually, however, came to include other cities besides these.

DECAPROTI, DECEMPRIMI, in *Roman Antiquity*, the ten chief aldermen in the municipia and colonies.

DECASTYLE, a portico with ten columns in front. See glossary to ARCHITECTURE.

DECCAN, or the Country of the South, in Hindustan, includes, according to Hindu geographers, the whole of the

Deccan. territories situate to the south of the Nerbuddah. In its more modern acceptation, however, it is sometimes understood as comprising only the country lying between that river and the Krishna, the latter having for a long period formed the southern boundary of the Mohammedan empire of Delhi. Assigning it the more extended of these limits, it comprehends the whole of the Indian peninsula, and in this view the mountainous system, consisting of the Eastern and Western Ghauts, constitutes the most striking feature of the Deccan. These two mountain ranges unite at their northern extremities with the Vindhya chain of mountains, and thus is formed a vast triangle supporting at a considerable elevation the expanse of table-land which stretches from Cape Comorin to the valley of the Nerbuddah. The surface of this table-land slopes from W. to E. as indicated by the direction of the drainage of the country; the great rivers the Cauvery, Godavery, Krishna, and Pennaur, though deriving their sources from the base of the Western Ghauts, all finding their way into the Bay of Bengal through fissures in the Eastern Ghauts.

In early times this country embraced that possessed by the five Hindu princes of Telingana, Maharashta, the Tamul country, Orissa, and Carnata or Bijayanagar. It was first invaded by the Mohammedans in 1294, who stormed Deogiri, the capital of Maharashta, and abandoned the city to pillage. In the year 1325 the Mohammedans made further progress in its conquest; and having extirpated the Hindu dynasties, annexed the provinces as far south as the Krishna to the empire of Delhi. The imperial sway was however of brief duration. Telingana and Carnata speedily reverted to their former masters; and this defection on the part of the Hindu states was followed by a general revolt, resulting in the establishment in 1347 of the independent Mohammedan dynasty of Bahmani, and the consequent withdrawal of the power of Delhi from the territory south of the Nerbuddah. In the struggles which ensued, the Hindu kingdom of Telingana fell to the Mussulmans, who at a later period formed a league against the remaining Hindu prince, and at the battle of Talikote in 1565 destroyed the monarchy of Bijayanagar or Carnata. On the dissolution of the Bahmani empire, its dominions were distributed into the five Mohammedan states of Golconda, Beejapore, Ahmednuggur, Beder, and Berar. Of these the larger succeeded in subverting those of less importance; and in 1630, during the reign of Shah Jehan of Delhi, the greater proportion of the Deccan had been absorbed by the kingdoms of Golconda, Ahmednuggur, and Beejapore. During the reign of Aurungzebe (in the latter half of the seventeenth century) all those states were reduced, and the Deccan was again annexed to the empire of Delhi. In the subsequent reigns, when the great empire of Aurungzebe fell into decay, the Nizam threw off his allegiance and fixed his court at Hyderabad. At the same time the Mahrattas, emerging from obscurity, established a powerful monarchy, which was usurped by the Peishwa. The remainder of the imperial possessions in the peninsula were held by chieftains acknowledging the supremacy of one or the other of these two potentates. In the sequel, Mysore became the prize of the Mohammedan usurper Hyder Ali. During the contests for power which ensued about the middle of the last century between the native chiefs, the French and the English took opposite sides. After a brief course of triumph, the interests of France declined, and a new empire in India was established by the British. Mysore formed one of their earliest conquests in the Deccan. Tanjore and the Carnatic were shortly after annexed to their dominions. In 1818 the forfeited possessions of the Peishwa added to their extent; and these acquisitions, with others which have more recently fallen to the paramount power by cession, conquest, or failure of heirs, form a continuous territory stretching from the Nerbuddah to Cape Comorin. Its length is upwards of 1000 miles, and its extreme breadth exceeds 800. This vast tract comprehends the chief provinces now distributed between the presidencies of Madras and Bombay, together with the native states of Hyderabad, Mysore, and those of Colapore, Sawunt Warree, Travancore, Cochin, the kingdom of Rajah Tondiman, and the petty possessions of France and Portugal. (E. T.)

December ‖ Decemviri.

DECEMBER (Lat. *December*), the last month of the year, in which the sun enters the tropic of Capricorn and makes the winter solstice. December was the tenth month in Romulus's year, which commenced with March; and hence it was named from its number, *decem*, ten. The Romulian December contained 30 days; Numa reduced it to 29; and Julius Cæsar increased it to 31. See CALENDAR, vol. vi., p. 77.

DECEMPEDA, a rod ten feet in length, used by the ancients in measuring land, &c.

DECEMVIRI (i. e., *the Ten Men*) in *Antiquity*, ten magistrates of absolute authority among the Romans. The privileges of the patricians raised dissatisfaction among the plebeians, who, though freed from the power of the Tarquins, still saw that the administration of justice depended upon the will and caprice of the patricians, without any written statute to direct them, and convince the people that they were governed with equity and impartiality. The tribunes complained to the senate, and demanded that a code of laws might be framed for the use and benefit of the Roman people. The petition was complied with, and three commissioners were sent to Athens and all the other Grecian states, to collect the laws of Solon and of the other celebrated legislators of Greece. Upon the return of these commissioners, it was universally agreed that ten new magistrates, called *Decemviri*, should be elected from the senate, in order to carry the project into execution. Their power was absolute, all other offices ceased after their election, and they presided over the city with regal authority. They were invested, each in his turn, with the badges of the consulship, and the one so distinguished was preceded by the fasces, and had the power of assembling the senate and confirming its decrees. The first decemvirs were Appius Claudius, T. Genutius, P. Sextus, Sp. Veturius, C. Julius, A. Manlius, Ser. Sulpitius, Pluriatius, T. Romulus, and Sp. Posthumius, in the year of Rome 302 (B.C. 451). Under them the laws, which had been exposed to public view (in order that every citizen might speak his sentiments regarding them), were publicly approved as constitutional, and ratified by the priests and augurs with the most solemn religious rites. These laws were originally ten in number, and were engraved on tablets of brass; but when two were afterwards added, they were called the laws of the twelve tables, *leges duodecim tabularum*, and *leges decemvirales*. The decemviral power, which was beheld by all ranks of people with the greatest satisfaction, was continued; but in the third year after their creation the decemvirs became odious on account of their tyranny; and the attempt of Appius Claudius, one of their number, to ravish Virginia led to the total abolition of the office. The people were so exasperated that they demanded of the senate that the decemvirs should be burned alive. Consuls were again appointed, and tranquillity was re-established in the state.

There were other officers in Rome called decemvirs, who were originally appointed, in the absence of the prætor, to administer justice. Their appointment became afterwards necessary, and they generally assisted at sales, called *subhastationes*, because a spear, *hasta*, was fixed at the door of the place where the goods were exposed to sale. They were called *decemviri litibus judicandis*. The officers whom Tarquin appointed to guard the Sibylline books were also called *decemviri*. They were originally two in number, called *duumviri*, till the year of Rome 388, when their number was increased to ten, five of whom were chosen from the plebeians and five from the patricians. Sylla increased their number to fifteen, so that they were called *quindecimviri*.

DECENNALIA, or DECENNIA, in *Roman Antiquity*, a festival celebrated by the emperors, with sacrifices, games, and largesses to the people, every tenth year of their reign. This festival owed its institution to the circumstance that Augustus declined to assume the supreme power for life when it was offered to him by the people, and would only consent to accept of it for the limited period of ten years; at the end of which term he accepted it anew, and so on to the end of his life. In this manner he continued to retain the sovereign power without offence; for at the conclusion of each term he went through the form of surrendering his authority into the hands of the people, who were so charmed by his seeming disinterestedness, that they immediately requested him to resume it. In memory of this solemn farce, the subsequent emperors celebrated the Decennalia every tenth year of their reign.

DECHALES, CLAUDE FRANÇOIS MILLET (1611–1678), a French mathematician and astronomer, descended of a noble family, and born at Chambéry. He was successively professor of mathematics at Clermont, Marseilles, and Turin; and published an edition of Euclid, which was long the favourite text-book on the Continent. His works were collected in 3 vols. folio, under the title of *Mundus Mathematicus*.

DECIDUOUS (Lat. *deciduus*, from *de* and *cado*), falling; not perennial or permanent. In botany, a deciduous leaf is one that falls in autumn; a deciduous calyx, one that falls along with the flower-petals and stamens.

DECIL, in *Astronomy*, an aspect or position of two planets, when they are distant from each other a tenth part of the zodiac.

DECIMAL ARITHMETIC, the art of computing by decimal fractions. See ARITHMETIC.

Circulating DECIMALS, called also *recurring* or *repeating decimals*, are those in which a figure or several figures are continually repeated. They are distinguished into *single* and *multiple*, and these again into *pure* and *mixed*.

A *pure single* circulate is that in which one figure only is repeated; as ·222, &c. and is marked thus $\cdot\dot{2}$.

A *pure multiple* circulate is that in which several figures are continually repeated; as ·232323, &c. marked $\cdot\dot{2}\dot{3}$; and ·524524, &c. marked $\cdot\dot{5}2\dot{4}$.

A *mixed single* circulate is that which consists of a terminate part and a single repeating figure; as 4·222, &c. or $4\cdot2\dot{2}$. And

A *mixed multiple* circulate is that which contains a terminate part with several repeating figures; as $45\cdot\dot{5}2\dot{4}$.

That part of the circulate which repeats is called the *repetend;* and the whole repetend, supposed to be infinitely continued, is equal to a vulgar fraction whose numerator is the repeating number or figures, and its denominator the same number of nines; so $\cdot\dot{2}$ is $= \frac{2}{9}$; and $\cdot\dot{2}\dot{3}$ is $= \frac{23}{99}$; and $\cdot\dot{5}2\dot{4}$ is $= \frac{524}{999}$.

Dr Wallis of Oxford was the first who distinctly considered or treated of infinite circulating decimals, as he himself informs us in his Treatise of Infinities.

DECIMAL *Coinage*, a system of monetary calculation advancing to infinity from a fixed standard of value, and performing its multiplications by any increasing progression of tens, and its divisions by a decreasing progression which is also decimal.

This system, whose superiority to all others now in use is universally acknowledged, was first organized and established by the Constituent Assembly of France in 1790. It forms a part of that vast decimal metrical system of weights and measures, which, since the close of the last century, has obtained in France, and is slowly spreading thence into the other countries of Europe and America. The subject was so widely and keenly agitated throughout Great Britain in the opening months of 1853, that the House of Commons appointed a committee to investigate the whole matter. The report of this committee was laid before the house on the 1st of August of that year. This document was introduced with a strong recommendation of the decimal system of coinage, and proposed that the basis of that system when introduced should be the present pound sterling. By the retention of the pound, the decimal system might be introduced with the least possible change. Its tenth part already exists in the shape of the florin or two-shilling piece, while an alteration of four per cent. in the value of the present farthing will serve to convert that coin into the lowest step of the decimal scale, which it is necessary to represent by means of an actual coin, viz., the $\frac{1}{1000}$ part of a pound. To this lowest denomination it was proposed by the committee to give the name of *mil*, in order to mark its relation to the unit of value. The addition of a coin to be called a cent, of the value of ten mils, and equal to the hundredth part of a pound, or the tenth part of the florin, would serve to complete the list of coins necessary to represent the monies of account, which would accordingly be pounds, florins, cents, and mils. As to the coins by means of which the decimal system will be developed, it is proposed that some of those now in use be retained, and that new coins be substituted for others of them. The coins thus retained would be the present sovereign (1000 mils), the half-sovereign (500 mils), florin (100 mils), and shilling (50 mils, or 5 cents). The present sixpence, under the denomination of 25 mils, might be retained; and the crown piece, or a piece of 250 mils, of which few are in circulation, need not be withdrawn. On the other hand, it would be desirable to withdraw the half-crown, and the threepenny and fourpenny pieces, which are inconsistent with the decimal scale.

DECIMATION (Lat. *decimatio*), a tithing; a selection of every tenth person by lot.

The term *decimatio* was applied by the Romans to a punishment inflicted on such soldiers as quitted their posts, or had been guilty of any crime. The names of the guilty were put into an urn or helmet; and as many having been drawn out as made the tenth part of the whole number, these were punished. The Romans had also the *vicesimatio*, and even *centesimatio*, when only the twentieth or the hundredth man suffered by lot.

DECIPHERING, the art of finding the alphabet of a cipher, or discovering a method of reading an unknown character or tongue. See CIPHER.

DECIUS MUS, PUBLIUS, a Roman consul who liberated the Roman army under M. Valerius Corvus Arvina, when inclosed by the enemy in the mountain passes of Samnium (B.C. 343). In the Latin war (B.C. 340) he devoted himself as a sacrificial victim for the safety of his country. His son, after distinguishing himself in the wars with the Etruscans and Samnites, followed the example of his father, and fell in the same way at the battle of Sentinum (B.C. 295). His grandson also is said to have sacrificed his life in the same manner in the war with Pyrrhus and the Tarentines. This last incident is, however, generally believed to be fabulous.

DECIUS, Roman Emperor (A.D. 249-251). See ROMAN HISTORY.

DECK *of a* SHIP (Ger. *decken, to cover*), the planked floor, resting upon her beams.

Flush-DECK, is a floor continued on one line from stem to stern.

Half-DECK, the under part of the quarter-deck of a ship of war, contained between the foremost bulk-head of the steerage and the fore-part of the quarter-deck. It also denotes a partial deck in the fore-part of small vessels. See SHIP-BUILDING.

DECLAMATION, a speech made in public, in the tone and manner of an oration.

Declarator || Decurio.

DECLARATOR, in *Scots Law*, a form of action by which some right of property, or of servitude, is sought to be judicially declared.

DECLINATION or DECLENSION, in *Grammar*, the inflection of a noun through its various terminations; as nominative, genitive, dative, &c.

DECLINATION, in *Astronomy*, the distance of any celestial object from the equator, northward or southward. It is either true or apparent, according as the real or apparent place of the object is considered. See ASTRONOMY, vol. iv., p. 2.

DECLINATION of the Compass or *Needle*, is its variation from the true meridian of a place.

DECLINATION of a Plane or *Wall*, in *Dialling*, an arc of the horizon contained between the plane and the prime vertical circle, reckoning from east to west, or between the meridian and the plane, reckoning from north to south. See DIALLING.

DECLINATOR, or DECLINATORY, an instrument chiefly used in practical dialling, for taking the declinations, inclinations, or reclinations of the planes on which the dials are to be delineated. See DIALLING.

DECOCTION (Lat. *decoquo, decoctum*), the act of boiling a substance in water, to extract its virtues; or the liquor itself in which the substance has been boiled.

DECOLLATION, the act of beheading; a term used frequently with reference to St John the Baptist, to denote a painting representing the decapitation of that saint.

DECOMPOSITION, in *Chemistry*, analysis; the separation of the constituent parts of any body which are chemically combined. See CHEMISTRY.

DECORATION, in *Architecture*, anything that adorns and enriches an edifice; as figures, vases, festoons, &c.

DÉCOUPLÉ, or UNCOUPLED, in *Heraldry*, parted or severed; as a *chevron découplé*.

DECREMENT, decrease; the state of becoming gradually less. In *Heraldry*, it signifies the wane of the moon, which in this state is said to be *decrescent*, or in *decours*. In *Mathematics*, decrements are the small parts by which a variable and decreasing quantity becomes gradually less.

DECREPITATION, the crackling noise which attends the separation of the parts of a body when heated, occasioned by the unequal sudden expansion of their substance.

DECRETAL, in the canon law, is a letter of a pope, determining some point or question in ecclesiastical law. The decretals compose the second part of the canon law. See CANON LAW, vol. vi., p. 189.

DECUMATES AGRI, tithe lands, or fields granted on a tithe, as appears from Tacitus, to the rabble of Gauls who succeeded the Marcomanni. This people had till then proved a check to the Roman conquests on the Rhine; and hence probably their name, which signifies people living on the marches or limits of the empire. In Cicero we meet with *Ager Decumanus*, which is of the same import with the *Ager Decumanus* of Tacitus.

DECUPLE (Lat. *decuplus*), tenfold; containing ten times as many. Hence *decuple proportion* is that of ten to one.

DECURIA. See DECURIO, and ARMY.

DECURIO, an officer in the Roman cavalry, who commanded a decuria, which was a body consisting of ten men.

There were certain provincial magistrates called *decuriones municipales*, who represented the Roman senate in free and corporate towns. As the name implies, they consisted of ten; and their duty was to watch over the interests of their fellow-citizens, and to increase the revenues of the commonwealth. Their court was called *curia decurionum*, and *minor senatus*; and their decrees, called *decreta decurionum*, were marked with two Ds at the top. They generally styled themselves *civitatum patres curiales*, and *honorati municipiorum senatorum*. They were elected with the same ceremonies as the Roman senators; they required to be at least twenty-five years of age, and to be possessed of a certain fixed income. The election took place in the kalends of March.

Decussation || Dee.

DECUSSATION, a term in geometry, optics, and anatomy, signifying the crossing of two lines, rays, or nerves, which meet in a point and then diverge.

DEDICATION, the act of consecrating a temple, altar, statue, palace, or other work, to a divine being or to a sacred purpose.

The custom of dedication is very ancient, both amongst the worshippers of the true God and amongst the heathens. In the Scripture we meet with dedications of the tabernacle, of altars, of the first and second temple, and even of the houses of private persons. There were also dedications of vessels and garments of the priests and Levites, and even of the men themselves. The heathens had likewise dedications of temples, altars, and images of their gods. Nebuchadnezzar made a solemn dedication of his statue: Pilate at Jerusalem dedicated gilt bucklers to Tiberius: in like manner Petronius would have dedicated a statue to the emperor in the same city; and Tacitus mentions the dedication of the capitol, upon its being rebuilt by Vespasian.

When the celebrated temple of Apollo on the Palatine Hill was built by Augustus, the poet Horace wrote on the occasion his beautiful ode beginning—

> "Quid dedicatum poscit Apollinem
> Vates?"

This had reference to a superstition prevalent at Rome, that whoever first appeared at the shrine of any deity, early on the day on which a new temple was dedicated to him, that person would obtain from the god whatever request he preferred.—*Hor.*, B. I., Ode 13.

The Jews every year celebrated the anniversary of the dedication of their temple for eight days. This was first enjoined by Judas Maccabeus, and the whole synagogue, in the year 148 of the Syro-Macedonian era, or 164 years before Christ. The heathens had similar anniversaries, as that of the dedication of the temple of Parthenope, mentioned by Lycophron.

The Christians finding themselves in possession of liberty under Constantine, began to replace their ruinous churches by new ones, which they dedicated with much solemnity. The dedication was usually performed in a synod; at least a number of bishops assembled to assist at the service. The description of such of the churches at Jerusalem and Tyre as were thus rebuilt may be found in Eusebius, while many others are noticed in later writers.

DEDITICII, the name given to that class of *libertini* which consisted of persons who had surrendered in war, and had thus lost entirely their political existence. By the law *Delia Sentia*, slaves who had been branded or whipt for any crime, but afterwards freed by their masters, were included amongst the Dediticii, and thus rendered incapable of aspiring to the privileges of Roman citizenship.

DEE, a river of England, rising in Bala lake, Merionethshire. In the first part of its course, which lies through the beautiful valley of Llangollen, its current is exceedingly rapid. After passing Wynnestay it turns northwards, and forms the boundary line which separates Denbighshire from Flintshire and Cheshire. In its after course it runs wholly within Cheshire. After nearly encircling the city of Chester, it is continued by an artificial channel for about nine miles until it falls into a spacious tidal estuary, which at its communication with the sea is nearly six miles wide. Its principal tributary is the Alwyn, which joins it at Holt. Its whole course is upwards of 70 miles in length.

DEE, a river of Scotland, rising in the Cairngorm hills, about 25 miles above Braemar. After an easterly course of 96 miles, chiefly through the beautiful valley of Deeside,

Dee. it falls into the German Ocean at Aberdeen. Its salmon fishery is one of the most valuable in Scotland.

Dee, *John*, a mathematician and astrologer, was born in July 1527, at London, where his father was a wealthy vintner. In 1542 he was sent to St John's College, Cambridge. After five years' close application to mathematical studies, particularly astronomy, he went to Holland, in order to visit several eminent mathematicians on the Continent. Having remained abroad nearly a year, he returned to Cambridge, and was elected a fellow of Trinity College, then first erected by King Henry VIII. In 1548 he took the degree of master of arts; but in the same year he found it necessary to leave England on account of the suspicions then entertained of his being a conjuror. A piece of machinery in the *Irene* of Aristophanes, which he exhibited to the University, and in which he represented the scarabæus flying up to Jupiter, with a man and a basket of victuals on its back, had helped to give currency to these surmises, and his subsequent conduct was little fitted to allay the popular prejudice.

On leaving England he repaired to the University of Louvain, where he resided about two years. He then set out for France, where, in the college of Rheims, he read lectures on Euclid's Elements with great applause. In 1551 he returned to England, and was introduced by the Secretary Cecil to King Edward, who assigned him a pension of a hundred crowns, which he afterwards exchanged for the rectory of Upton-upon-Severn. Soon after the accession of Mary, he was accused of using enchantments against the queen's life; but after a tedious confinement, he obtained his liberty in 1555, by an order of council.

When Elizabeth ascended the throne, Dee was asked by Lord Dudley to name a propitious day for her majesty's coronation. On this occasion he was introduced to the queen, who took lessons in the mystical interpretation of his writings, and made him great promises, which, however, were never fulfilled. In 1564 he again visited the Continent, in order to present a book which he had dedicated to the Emperor Maximilian. He returned to England in the same year; but in 1571 we find him in Lorrain, where, being dangerously ill, two physicians were sent to his relief by the queen. Having once more returned to his native country, he settled at Mortlake, in Surrey, where he continued his studies with unremitting ardour, and made a collection of curious books and manuscripts, and a variety of instruments, most of which were destroyed by the mob during his absence, on account of Dee's supposed familiarity with the devil. In 1578 Dee was sent abroad to consult with German physicians and astrologers, in regard to the illness of the queen. But having returned to England, we find him employed in investigating the title of the crown to the countries recently discovered by British subjects, and in furnishing geographical descriptions. Two large rolls containing the desired information, which he presented to the queen, are still preserved in the Cottonian Library. A learned treatise on the reformation of the calendar, written by him about the same time, is still preserved in the Ashmolean Library at Oxford.

From this period the philosophical researches of Dee degenerated into mere necromantic vagaries. In 1581 he became acquainted with one Edward Kelly, by whose assistance he performed various incantations, and maintained a frequent imaginary intercourse with spirits. Shortly after, Kelly and Dee were both introduced to a Polish nobleman, Albert Laski, palatine of Siradia, who was addicted to the same ridiculous pursuits, and persuaded the two friends to accompany him to his native country. They embarked for Holland in September 1583, and travelling overland, arrived at the town of Laski in February following. Their patron, however, finding himself deceived by their idle pretensions, persuaded them to pay a visit to Rodolph, king of Bohemia, who, though a credulous man, soon became disgusted with their practices. They were afterwards introduced to the king of Poland, but with no better success. They were, however, invited by a rich Bohemian nobleman to his castle of Trebona, where they continued for some time in great affluence, owing, as they asserted, to their power of transmutation exerted by means of a powder in the possession of Kelly. Deeg Defend.

Dee, having at length quarrelled with his companion, quitted Bohemia and returned to England, where he was made warden of Manchester College in 1595. He afterwards returned to his house at Mortlake, where he died in 1608, aged eighty-one.

His principal works are *Propædumata Aphoristica*, Lond. 1558, 12mo; *Monas Hieroglyphica*, Antwerp, 1564; *Epistola ad Fredericum Commandinum*, Pisauri, 1570; Preface to the English Euclid, 1570; Divers Annotations and Inventions added to the tenth book of the English Euclid, 1570; *Epistola præfixa Ephemeridibus Joannis Feldi, a* 1557; *Parallaticæ Commentationis Praxeosque nucleus quidam*, London, 1573. The catalogue of his printed and published works is to be found in his *Compendious Rehearsal*, as well as in his letter to Archbishop Whitgift, to which the reader is referred.

DEEG, in Hindustan, a town in the native state of Bhurtpore, situate amidst numerous marshes and small lakes, fed by a stream called the Manas Nye. In 1760 this place was occupied and strongly fortified by Soorag Mull, the rajah of the Jauts. In 1776 it was taken from that tribe by Nujuff Khan, the powerful minister of Shah Alum, emperor of Delhi, after a siege of twelve months, but was soon afterwards restored to them. It was under the walls of this town that the Mahratta army, commanded by Holkar, sustained a defeat on the 13th November 1804 from a British force under the command of General Fraser. Upon this occasion the Jauts of Deeg having treacherously opened a fire of musketry and cannon on the victors, siege was laid to the fortress by Lord Lake on the 16th December following, and this celebrated stronghold, previously supposed to be impregnable, was carried by storm on the 23d of the same month. At the conclusion of peace, it was restored to the Rajah Runjeet Sing. After the capture of Bhurtpore by Lord Combermere in 1826, Deeg surrendered without resistance, and having been dismantled was delivered over to the new Rajah by the British who had placed him upon the throne of Bhurtpore. Lat. 27. 29.; Long. 77. 23. (E. T.)

DEEMSTERS, or Demsters (Saxon *dema*, judge of umpire), a judge in the Isle of Man and in Jersey. All controversies in the Isle of Man are decided without process, writings, or any charges, by certain judges, chosen yearly from among the people. These are called *deemsters*, and there are two of them for each division of the island. The deemsters sit as judges in all courts, either for life or property; and with the advice of twenty-four *keys*, declare what is law in uncommon emergencies.

DEER. See index to Mammalia.

DEFAMATION, the speaking slanderous words of another; for which the slanderer is punishable, according to the nature of his offence, either by action upon the case at common law, or by statute in the ecclesiastical court.

DEFAULT, in *Law*, non-appearance in court at a day assigned. It also imports any omission of that which we ought to do, for which judgment may be given against the defaulter.

DEFECTION (Lat. *deficio*, to fall off), the act of abandoning or relinquishing a party or interest in which one has been engaged.

DEFEND, to protect or ward off injuries.

Defend, in our ancient laws and statutes, signifies to prohibit or forbid; as *Usuarios* defendit *quoque rex Edwardus ne remanerent in regno.* L. L. Edw. Conf. cap. 38,

Defender

Defoe.

and 5th Rich. II. cap. 7. In this sense Chaucer also uses the following passage:

> Where can you say in any manner, age,
> That ever God *defended* marriage.

In 7th Edward I. there is a statute entitled "*Statutum de* defensione *portandi armi*," &c. And "it is *defended* by law to distrain on the highway."

DEFENDER OF THE FAITH (*Fidei Defensor*), a peculiar title belonging to the sovereign of England; in the same way that *Catholicus* belongs to the king of Spain, and *Christianissimus* to the king of France. These titles were given by the popes of Rome. That of *Fidei Defensor* was first conferred by Leo X. on Henry VIII. for writing against Martin Luther; and the bull bestowing it bears date *quinto idus Octob.* 1521. This title was afterwards confirmed by Clement VII. But when Henry suppressed the religious houses at the time of the Reformation, the pope not only deprived him of the title, but also deposed him from his crown; but, in the thirty-fifth year of his reign, the title of "Defender of the Faith" was confirmed by parliament, and has continued to be used by all his successors on the English throne. Chamberlayne says the title belonged to the king of England before that time; and, in proof of his assertion, appeals to several charters granted to the University of Oxford; so that Pope Leo's bull was only a renovation of an ancient right.

DEFENDERS were anciently notable dignitaries both in church and state, whose business it was to look to the preservation of the public weal, to protect the poor and helpless, and to maintain the interests and causes of churches and religious houses. (See PROTECTOR.) The council of Chalcedon (can. 2) calls the defender of a church Ἔκδικος. Codin (*De officiis aulæ Const.*) makes mention of defenders of the palace. There were also a defender of the kingdom, *defensor regni*; defenders of cities, *defensores civitatis*; defenders of the people, *defensores plebis*; defenders of the poor, fatherless, widows, &c.

About the year 420, each patriarchal church began to have its own defender; a custom which was afterwards introduced into other churches, and continued till later days under other names, as those of *Advocate* and *Advowee*. In the year 407, we find that the council of Carthage asked the emperor for defenders of the number of *Scholastici*, or advocates who were in office, and that it might be allowed them to enter and search the cabinets and papers of the judges and other civil magistrates, whenever it should be found necessary for the interest of the church.

DEFERENS, or DEFERENT, in the *Ancient Astronomy*, an imaginary circle, which sweeps round the body of a planet, and is the same with the eccentric, being invented to account for the eccentricity, perigee, and apogee of the planets.

DEFINITION, in general, a short description of a thing by its properties; or, in *Logic*, the explication of the essence of a thing by its kind and difference.

DEFINITIVE, a term applied to whatever terminates a process, question, or the like, in opposition to provisional and interlocutory.

DEFLAGRATION, in *Chemistry*, the kindling or setting fire to a salt or mineral, either alone, or mixed for the purpose with nitrate of potassa, to purify it.

DEFLECTION *of the Rays of Light*, a property which Dr Hook observed in 1675, and described before the Royal Society in March the same year. He says he found it different from both reflection and refraction, and that it was made perpendicularly towards the surface of the opaque body. This is the same property which Sir Isaac Newton calls inflecting.

DEFOE, DANIEL, a man of varied and original genius, who distinguished himself as a political writer, and, above all, immortalized his name by the incomparable romance of *Robinson Crusoe*, was born in London about the year 1663. He was the son of James Foe, butcher in the parish of St Giles, Cripplegate, and grandson of Daniel Foe, of Elton, in Northamptonshire, yeoman. How he came to take the name of *De* Foe or Defoe, we are not informed, but his enemies have asserted that he assumed the *De* in order to pass for a Frenchman. It appears, however, that in January 1688 he was, under the name of Daniel Foe, admitted to the freedom of the city by reason of his birth. The family of Defoe were Protestant dissenters; and Daniel, who had received his education in an academy belonging to that body at Newington Green, near London, became by reflection attached to those principles which he had inherited by his birth, and approved himself through life their able and zealous defender. Fortune seemed to have destined him to be merely an artisan, and, accordingly, he was bound apprentice to a hosier; but his naturally active mind, already expanded by his early studies, sought to exercise itself on other objects than the details of a mechanical profession, and he read assiduously the public papers, in which subjects of great interest were sometimes discussed. The unpopular government of James the Second had begun to agitate the minds of men on questions of religion and politics; and that of Defoe, who had not yet attained his twenty-first year, partook largely of the general excitement. His first publication, which appeared in 1683, was a *Treatise against the Turks*, written in order to combat the prevailing sentiment of the time in favour of the Ottomans, as opposed to the house of Austria. But Defoe soon showed that he could wield the sword as well as the pen, and that he was as ready to fight as to write in defence of freedom. In June 1683, when he had not yet completed his twenty-third year, he appeared in arms for the unfortunate Duke of Monmouth; an exploit of which he was accustomed to boast, in the latter period of his life, when it had ceased to be dangerous to avow participation in that imprudent and ill-fated enterprise: and he had the good fortune not merely to escape the hazards of the field, but the still more imminent perils of Judge Jefferies' sanguinary "western campaign." In 1687 he attacked the proclamation for the repeal of the penal laws, in a tract, in which he exposed the unconstitutional measures pursued by King James, and warned the dissenters against the insidious toleration with which the court had sought to delude them. In common with all the friends of liberty, Defoe warmly greeted the Revolution, which he had endeavoured to promote by his sword as well as his pen; and when King William and Queen Mary were entertained by the city of London, on the 29th of October 1689, he was one of the regiment of volunteers which, commanded by the celebrated Earl of Peterborough, attended their majesties on that occasion from Whitehall to the Mansion-house.

Defoe.

At this period Defoe is said to have acted as a hosier in Freeman's Court, Cornhill: but with the imprudence which is too frequently the concomitant of genius, he neglected business for pleasure; frequented companies, where the readiness and vivacity of his wit made him always a welcome guest; and spent those hours in social enjoyment or the cultivation of literature which ought to have been devoted to the cares and calculations of the counting-house. The consequence was, that in 1692 he fell into difficulties, and being obliged to abscond for a time, a commission of bankruptcy was issued against him; but this was afterwards superseded on the petition of his principal creditors, who, on his own personal bond, accepted a composition which, by efforts of unwearied diligence, he punctually and honourably paid. Nor did even this satisfy the scrupulous integrity of the author of *Robinson Crusoe*. For when, by the favour of King William, his circum-

Defoe. stances had been improved, he paid such of his creditors as had themselves fallen into distress, their full claims, and, exclusively of the composition already mentioned, at length reduced his whole debts from seventeen to less than five thousand pounds; an instance of probity admirable in itself, and, considering that it was exemplified by a man who had to struggle with a numerous family, without assistance excepting his own industry, often paralysed by misfortunes, deserving of unqualified commendation. As yet he had mortified no great man by his keen satire, and offended no party by his caustic pamphlets; whilst by his powers of pleasing, which never deserted him, he had acquired friends who evinced a desire to serve him. Their project was that he should settle as a factor at Cadiz, a place with which he had previously had some correspondence as a trader; but, as he himself remarks, Providence, which had other work for him to do, placed a secret aversion in his mind to quitting England.

Defoe now began to meditate a variety of schemes for the benefit of his country, and, in January 1697, published his *Essay upon Projects*, which shows an extensive range of knowledge; recommends the establishment of a society for encouraging learning, refining the English language, and preventing barbarisms in manners as well as in speech; and well deserves the commendation which both Prior and Swift afterwards bestowed upon it. In 1695 Defoe was appointed accountant to the commissioners for managing the duties on glass; but this situation he lost in 1699, when the tax on glass was repealed by act of parliament. In 1701 appeared *The True-born Englishman*, a poem in vindication of King William, who had been attacked by one Tutchen, in a scurrilous piece entitled *The Foreigners*. This was the first effort of his satirical muse, and it appears to have succeeded amazingly; for it had a prodigious sale, and the author was admitted to several personal interviews with the king, who certainly was not a frequent reader of poetry. After the peace of Ryswick, he published an argument to prove that a standing army, with consent of parliament, is not inconsistent with a free government; and afterwards, when the grand jury of Kent, in May 1701, presented a petition to the Commons, in which the honourable house were unceremoniously desired to mind the public business more and their private heats less, Defoe dictated a remonstrance, signed *Legion*, against the commitment of Culpepper, Polhill, Hamilton, and Champneys, who had avowed this intrepid paper, and he imitated the courage of those whose cause he espoused, by speaking plain truths in bold language. At this time also he published a treatise on the original power of the collective body of the people of England, which he dedicated to King William, in a strain of very vigorous eloquence, and which, whilst it vies with Mr Locke's celebrated tract in force of reasoning, greatly transcends it in the graces of style. Soon after this appeared his pamphlet "against stockjobbing elections of parliament men," which was a very seasonable production, and fully sustained his reputation. His *Reasons against a War with France*, which he next published, is one of the finest tracts in the English language, and replete throughout with eloquence and wisdom. He declares that he is not adverse to a war with France, provided it be undertaken on justifiable grounds; but he trusts that England will never become so inconsiderable a nation as to make use of dishonest pretences to bring about any of her designs; and he observes with striking truth, that he who desires that we should end the war honourably, ought also to desire that we should begin it fairly. King William could scarcely be supposed to relish a treatise which, however able, was diametrically opposed to his favourite line of policy; but he never evinced the smallest resentment against the author on this account; and his death, which happened soon afterwards, deprived Defoe of a patron and protector whom Defoe. he revered, and whose memory he could never patiently hear abused. In the midst of the furious party contests which took place on the accession of Queen Anne, he engaged in a controversy concerning the occasional conformity of dissenters; a subject which then led to frequent disputes between the two houses of parliament, but which is now probably at rest for ever. "During the first fury of high-flying," says Defoe, "I fell a sacrifice for writing against the madness of that high spirit, and in the service of the dissenters." This alludes to *The Shortest Way with the Dissenters*, which he published in 1702, and which is a piece of exquisite irony, although, in the excited state of men's minds at that time, it was pertinaciously interpreted *ad pedem literæ* both by churchmen and dissenters, and being voted a gross libel by the House of Commons, was ordered to be burned as such by the hands of the common hangman.

It has been well observed that Defoe had, during the previous twenty years of his life, been unconsciously charging a mine which now blew both himself and his family into the air. He had fought for the Duke of Monmouth; he had opposed King James; he had vindicated the revolution; he had done justice to the character and memory of King William; he had displeased Godolphin and offended Marlborough, by objecting to the war in Flanders; he had defended the rights of the collective body of the people; he had bantered Sir Edward Seymour and Sir Christopher Musgrave, the Tory leaders of the House of Commons; and he had ridiculed all the high-flyers in the kingdom;—in a word, by following a course of undeviating political rectitude, and by constantly directing the force of his great talents against every species of public delinquency or folly, he had incurred the hatred of all parties, and was at last obliged to seek shelter from their overpowering and resistless vengeance. A reward of fifty pounds was offered to any one who should discover his retreat; and although he immediately published an explanation of the alleged libel, yet, being apprehended, he was tried, convicted, and sentenced to the pillory, fine, and imprisonment. Thus was Defoe ruined a second time; for, by this prosecution, he asserts that he lost above L.3500. Whilst in Newgate he amused some of his dreary hours by writing a *Hymn to the Pillory*, in which generous sentiments are intermingled with pointed satire, and the most cutting sarcasms against his persecutors. Defoe continued, in the solitude of his captivity, to pursue his literary labours, and to write on various subjects. He corrected for the press a collection of his writings, beginning with *The True-born Englishman*, and ending with *The Shortest Way to Peace and Union;* and to this was prefixed a print of the author, with the too appropriate motto, *Laudatur et alget.* In his prison also he projected *The Review*, a periodical paper far superior to any thing of the kind that had yet appeared, and which formed the prototype of the Tatlers, Spectators, and Guardians, and contained many things which, in point of wit, elegance, and purity of diction, would have done honour to Steele or to Addison. In 1704 he published *The Storm*, being a collection of the most remarkable casualties which had occurred during the tempest of the 23d November 1703; a production which displays higher attainments in science and literature than Defoe had generally been supposed to possess, and which is altogether exceedingly interesting.

While the author lay in Newgate, with his family ruined, and his hopes of deliverance crushed, a verbal message was brought him from Harley, Speaker of the House of Commons, and afterwards Earl of Oxford, desiring to know what could be done for him. In a factious age, a political intriguer like Harley doubtless foresaw that a man of Defoe's genius and ability might be rendered service-

Defoe. able to the purposes of his ambition; whilst, on the other hand, the captive and ruined author was fain to intimate a wish for his release from durance. But this was by no means easily nor speedily accomplished. Harley became secretary of state in April 1704; yet four months elapsed before his representations to the queen and the treasurer Godolphin, in favour of Defoe, produced the desired effect. The queen, however, inquired into the circumstances of the distressed author; Godolphin sent a considerable sum to his wife, and a further sum to Defoe himself, to enable him to pay his fine and the expense of his discharge; and at length, in August 1704, he was released from Newgate. Defoe was exceedingly grateful for this deliverance, and ever afterwards, amidst all the vicissitudes of party and faction, remained sincerely attached to the queen and to Oxford. In 1705 he published *The Consolidator*, or Memoirs of sundry Transactions from the World in the Moon, in which he makes the lunar politicians discuss the policy of Charles the Twelfth in pursuing the Saxons and the Poles: he also engaged in a controversy respecting a project then brought forward for employing the poor; and he published a second volume of the "Writings of the Author of the *True-born Englishman*," containing eighteen pieces in prose and verse. The persecutions of party rendered this a year of disquiet to Defoe. For, when his affairs had led him to the west of England, a project was formed to send him perforce as a soldier to the army; but being a freeholder of England, and a liveryman of London, he knew that these characters could not be violated with impunity; and when the western justices had resolved to apprehend him as a rogue and vagabond, they were deterred from doing so by the courage with which he asserted his rights, and denounced the meditated attack on his personal liberty. In his absence, too, real suits were commenced against him for fictitious debts; but he manfully advertised, that whilst genuine claims would be fairly satisfied, such as were groundless and vexatious would be resisted to the last. All these circumstances were published in his *Review*.

Defoe commenced the year 1706 with *A Hymn to Peace*, occasioned by the two houses of parliament uniting in an address to the queen; in May he published an "Essay at removing national prejudices against an Union with Scotland;" and in July appeared his *Jure Divino*, in which he attacked the doctrines of passive obedience and divine right, respecting which the world then seemed to be running stark mad, from the sheer fanaticism of servility. About this time, Godolphin, who knew how to discriminate men, resolved to employ Defoe on a mission of importance; and he was accordingly sent to Scotland, where his knowledge of commerce and revenue, his powers of insinuation, and the aptitude of his pen, which was that of a ready writer, proved of no small utility in promoting the great measure of the union. He arrived in Edinburgh in October 1706; he attended the committees of parliament, which he furnished with calculations on the subject of trade and taxes; he endeavoured to confute all that was published against the project of the union; and, though exposed to considerable danger, he escaped the vengeance of the populace, by whom he was continually watched, and sometimes insulted. In the midst of this agitating scene of business and tumult, he collected those documents, which he afterwards published for the instruction of posterity, respecting one of the most critical and important transactions in our whole national annals. Towards the close of this year he published *Caledonia*, a poem in honour of the Scottish nation; and soon after the act of union had been passed by the parliament of Scotland, he returned to London. How he was rewarded by the ministers for the important services he performed on this difficult occasion, has not been ascertained; but Mr Chalmers is of opinion that a pension was settled on him. He published his *History of the Union* in 1709; but it attracted little notice on its first appearance, though it was republished in 1712, and again in 1786, when the project of a union with Ireland had become a topic of frequent discussion. In the year 1709 also appeared his *History of Addresses*, which, in 1711, was followed by a second volume, intended to abate the public ferment occasioned partly by the mad harangues of Sacheverel, and still more by the incredible folly which raised them into consequence by the parliamentary censure of their author. Defoe

Defoe now lived at Newington in comfortable circumstances, and employed himself chiefly in writing the *Review*, which, however, he at length relinquished in order to commence *A General History of Trade;* but this last production, although it exhibits all the ingenuity and strength of Defoe, extended only to two numbers; the author having been silenced by noise, obloquy, and insult, and forced to withdraw for a time to the borders of Lancashire. Here, observing the insolence of the Jacobite party, and incapable of remaining an indolent or passive spectator of events, he published several pamphlets, with ironical titles, which were much approved by the friends of the Protestant succession, and diligently dispersed throughout the country; yet, for writing these seasonable tracts, Defoe was arrested, held to bail in the enormous sum of L.800, and ultimately committed to Newgate in Easter term of 1713. But on making a proper submission, he was soon released, and the Earl of Oxford being still in power, interceded to procure him the queen's pardon. Still darker days were, however, at hand. "No sooner was the queen dead," says he, "but the rage of men increased upon me to that degree, that their threats were such as I am unable to express. Though I have written nothing since the queen's death, yet a great many things are called by my name, and I bear the answerers' insults. I have not seen or spoken with the Earl of Oxford since the king's landing but once; yet he bears the reproach of my writing for him, and I the rage of men for doing it." Stunned by factious clamour, and overborne though not silenced by unmerited obloquy, Defoe appears to have lost his original appointment on the final expulsion from power of the Earl of Oxford; and instead of meeting with any reward for his zealous services in support of the Protestant succession, he was, on the accession of George I. discountenanced even by those who had derived most benefit from his active exertions. This cruel treatment preyed on his mind, and brought him to the very verge of the grave. In 1715 he published an *Appeal to Honour and Justice*, containing an account of his conduct in public affairs; and in stating his motives for doing so, he affectingly says, "By the limits of mortality, and the infirmities of a life of sorrow and fatigue, I have reason to think that I am very near to the great ocean of eternity, and the time may not be long ere I embark on the last voyage; wherefore I think I should make even accounts with the world before I go, that no slanders may lie against my heirs, to disturb them in the peaceable possession of their father's inheritance, his character." But before he had finished his "appeal" he was struck with apoplexy; and as he languished for more than six weeks in a state which held out but little prospect of recovery, his friends judged it proper not to delay the publication any longer. The treatment which he here complains of was undoubtedly the cause of this calamity: when he reflected on what he had done and suffered, his heart yielded to despair, and he sunk under the agony of his own desponding feelings. But this shock, severe as it proved, was not altogether without its benefit on the mind of Defoe, which it served to wean from politics, and to estrange from pursuits productive of nothing but disappointment and sorrow. The death of

Defoe. Queen Anne, and the accession of George the First, convinced him of the vanity of party-writing; and from this period he appears to have studied, not how to mend the state, but how to improve the human heart and to regulate the practice of daily life. The only other production of Defoe's which appeared in 1715, was *The Family Instructor*, in three parts; but *Religious Courtship*, which may be considered as the third volume, was not published until 1722.

We have now reached that period in the life of Defoe when he gave to the world the most remarkable, and perhaps the most lasting, of all his works; we mean the *Life and surprising Adventures of Robinson Crusoe*, which appeared in 1719. This extraordinary production met with the most favourable reception, and immediately became so popular, that Taylor, who purchased the manuscript after every other bookseller had refused it, is said to have gained a thousand pounds by the transaction. Seldom, indeed, has any immediate decision of the public respecting a literary performance been so fully ratified by posterity. At the distance of more than a century it has lost none of its original attraction. There is an air of reality and truth about it which belongs to no other work of fiction; we cannot indeed persuade ourselves that it is the creation of fancy, nor divest ourselves of the conviction, which every circumstance conspires to rivet on the mind, that we are perusing real adventures, and conversing with actual personages. Hence, whilst it carries captive the affections of childhood, it fixes the admiration of mature years; it is the book of all countries, and of every age and class; it delights the illiterate, and amuses as well as instructs persons of the most cultivated minds; and it speaks in the resistless language of nature to all hearts. It also contains, if not a treatise, at least a practical exemplification of a system of natural education, detailed with matchless truth and simplicity. "Puisqu'il nous faut absolument des livres," says Rousseau in his *Emile*, "il en existe un qui fournit, à mon gré, le plus heureux traité d'éducation naturelle. Ce livre sera le premier que lira mon Emile; seul il composera long-temps toute sa bibliothèque, et il y tiendra toujours une place distinguée. Il sera le texte auquel tous nos entretiens sur les sciences naturelles ne serviront que de commentaires. Il servira d'épreuve durant nos progrès, à l'état de notre jugement; et tant que notre goût ne sera pas gâté, sa lecture nous plaira toujours. Quel est dont ce merveilleux livre? Est-ce Aristote? Est-ce Platon? Non, c'est *Robinson Crusoe*." In a word, had all Defoe's other writings perished, the history of the author of this extraordinary production would still have been an object of literary curiosity. As to the story that the author had surreptitiously obtained and unceremoniously appropriated the papers of Alexander Selkirk, a Scottish mariner, who, having suffered shipwreck, had lived for three or four years on the island of Juan Fernandez, it is scarcely deserving of serious notice, and is certainly as unworthy of refutation as the fable published by Mr James Stanier Clarke, that the first volume of *Robinson Crusoe* was written by the Earl of Oxford during his imprisonment in the Tower of London. Calumnies of this sort always track the footsteps of genius; and dull malignity, where it dares not condemn a work, often seeks to tarnish the fame of its author, by trying to fasten on him a charge of plagiarism. In the present case, all that is needful to repel the accusation has been amply supplied by Chalmers and Wilson, who have proved that Selkirk had in truth no papers to lose, and, moreover, shown that the internal evidence is decidedly in favour of the entire originality of Defoe's inimitable fiction. How, indeed, could the rude journal of a rough sailor ever be supposed to have entered into the composition of such a finished masterpiece? or even allowing that some hints had been derived from such a source, how can that be held as in any degree detracting from the genius of him who bade these dry bones live? Defoe.

The success of *Robinson Crusoe* induced Defoe to publish, in 1720, *The Life and Piracies of Captain Singleton*, a romance of the same description, but much inferior in all respects. In 1725, he brought out another fictitious narrative, entitled *A New Voyage round the World by a Course never sailed before*, a work which displays uncommon skill, and is highly interesting throughout. The *History of Duncan Campbell*, who was born deaf and dumb, and who taught others in the same unfortunate situation with himself, had appeared in 1720; and the *Fortunes and Misfortunes of Moll Flanders*, the morality of which cannot be commended, followed in 1721, when he also published the *Life of Colonel Jaque*, a work of a similar tendency. *The Adventures of Roxana*, which appeared in 1724, is likewise a production by which few will be made wiser, and none better. But the *Memoirs of a Cavalier* is a work of a very different description. This romance is so like truth that it has been mistaken for real history; and in fact it contains the best account extant of the civil wars, the narrative being drawn up with great simplicity, and enlivened with such just and natural reflections as at once to instruct the ignorant and entertain the instructed. The *Family Instructor* and *Religious Courtship* have been already noticed. But there are other performances of his possessing not inferior merit. In 1722, he published *A Journal of the Plague*, which, like his *Memoirs of a Cavalier*, is, in its frame-work, a pure fiction; *The great Law of Subordination* appeared in 1724; the *Political History of the Devil*, and a *System of Magic*, which may be regarded as a supplement thereto, came out in 1726, and the *Treatise on the Use and Abuse of the Marriage-bed*, an excellent book, with an absurd title, was given to the world in 1727. He also published a *Tour* through England in 1724 and 1725, and one through Scotland in 1727. But the reader must not be misled by this title; for Defoe was one of those travellers who seldom quit the banks of the Thames. His last works were the *Complete English Tradesman*, published in 1727, and a *Plan of the English Commerce*, which appeared in 1728. In these treatises are many directions for the conduct of business, and many lessons of prudence and economy, which cannot be too frequently and earnestly inculcated.

But the glass of the indefatigable Defoe was now nearly run. After a laborious and checkered life, he died in April 1731, in the parish of St Giles, Cripplegate, leaving a widow, who did not long survive him, and six sons and daughters. From several circumstances, it is more than probable that he died insolvent; and it is at least certain that he left no other inheritance to his children but his good name and high literary reputation. Defoe was a man of strong natural parts and of clear good sense; ingenious and lively in conversation; bold and enterprising in spirit, but scantily gifted with prudence; and withal possessed of good nature and of real honesty. As a writer he is distinguished for the fertility of his invention, the vivid distinctness of his conceptions, the transparent perspicuity of his style, the keenness of his wit, the justness and originality of his reflections, and the inimitable ease and simplicity which more or less characterize all his performances. But though his merits both as a man and as a writer were undoubtedly great, yet few men have experienced more unjust treatment at the hands of their contemporaries; and, notwithstanding the general integrity of his conduct, he was repeatedly represented as an unprincipled writer, who had no view but to his own advantage, and who would employ his pen for any party which

Defoliation.

chose to hire his services. These charges, however, are refuted by the whole tenor of his life; and, indeed, they are in all probability the offspring of political rancour, which, in fact, no man ever did more to provoke. His readiness and power as a political writer, and, above all, the unsparing use which he made of ridicule and sarcasm, weapons which in his hands were peculiarly formidable, must have raised him up a host of enemies; and those who might feel themselves unequal to contend with the gifted writer, could at least find no difficulty in traducing the man. It has often struck us as surprising that his political works, on which he employed the very best of his days and his talents, should, comparatively speaking, be so little known. They constitute a mine which none can explore without being enriched with much that is precious in wisdom, impressive in eloquence, and striking in truth. But still his fame must principally rest upon those works which were entirely the offspring of imagination; and amongst these, and indeed all others of the kind, whether we regard the felicity of the design, the truth of the incidents, the variety and minute discrimination of the details, the natural justness of the sentiments, or the beautiful simplicity of the whole narrative, *Robinson Crusoe* must ever occupy the first place. Defoe, indeed, was an essentially original writer; and hence all his productions possess a raciness and a freshness which add incalculably to their attraction. But if he had any model at all, it was Bunyan, an author whom he must have read in his youth, and from whose works he probably imbibed that taste for simplicity in writing for which he was throughout distinguished; and what renders this still more certain is, that in the second volume of *Robinson Crusoe* may be discovered obvious traces of the religious principles so beautifully unfolded in Bunyan's admirable allegory. It must be admitted, however, that Defoe borrowed from the *Pilgrim's Progress* little else than the love of natural simplicity; and that in all which essentially distinguishes him as a writer, he is remarkable for nothing so much as for inexhaustible fertility, allied to extraordinary freshness and originality. (J. B—E.)

DEFOLIATION (from *de*, and *folium*, a leaf), the fall of the leaves; a term opposed to *frondescentia*, the annual renovation of the leaves, produced by the unfolding of the buds in spring.

Most plants in cold and temperate climates shed their leaves every year. This happens in autumn, and is generally announced by the flowering of the common meadow saffron. The term is only applied to trees and shrubs; for herbs perish down to the roots every year, losing stem, leaves, and all. All plants do not drop their leaves at the same time. Amongst large trees, the ash and walnut, although the latest in unfolding, are soonest divested of their leaves; which, indeed, the latter seldom carries above five months. On the oak and hornbeam the leaves die and wither as soon as the cold commences; but they remain attached to the branches until they are pushed off by the new ones, which unfold themselves the following spring. These trees are doubtless a kind of evergreens. The leaves are probably destroyed only by cold; and perhaps would continue longer on the plant, but for the force of the spring sap joined to the moisture.

In mild and dry seasons the lilach, privet, yellow jessamine of the woods, and maple of Crete, preserve their leaves green until spring, and do not drop them till the new leaves are beginning to appear. The fig-tree, and many other trees that grow between the tropics, are of this particular class of evergreens. The trees in Egypt, as Hasselquist observes, cast their leaves in the latter end of December and beginning of January, having young leaves ready before all the old ones have fallen off; and, to forward this operation of nature, few of the trees have buds; the sycamore and willow, indeed, have some, but with few and quite loose *tipulæ* or scales. Buds seem to be less necessary in southern than in northern countries.

Deformity || Degeneration.

Lastly, some trees and shrubs preserve their leaves throughout the year, and are not in the least influenced by the clemency or inclemency of seasons. Such are the firs, juniper, yew, cedar, cypress, and many other trees, hence denominated "evergreens." These preserve their old leaves long after the formation of the new, and do not drop them at any determinate time. In general the leaves of evergreens are harder and less succulent than those which are renewed annually. The trees are generally natives of warm climates, as the *alaternus* or *rhamnus* of France and Italy, and the evergreen oak of Spain, Portugal, and Suabia.

Some herbaceous perennials, as the house-leeks and navelworts, enjoy the same privilege with the evergreen trees, and resist the severities of winter; some even can dispense with the earth for a time, being replete with juices, which the leaves imbibe from the humidity of the atmosphere, and which in such plants are of themselves sufficient for effecting the purposes of vegetation. It is for this reason that, unless in excessively hot weather, gardeners seldom water succulent plants, as the aloes, which rot when they are moistened, if the sun does not quickly dry them.

The leaves of all the evergreen shrubs and trees have a thin compact skin or cover over their surface, as is easily discovered by macerating them in water, in order to separate the parenchyma or pulp from the vessels of the leaves, which cannot be effected in any of these evergreens till a thin parchment-like cover is taken off. These trees and shrubs are found by experiment to perspire but little, when compared with others which shed their leaves; and it is, perhaps, principally owing to this close covering, as also to the small proportion of moisture contained in their vessels, that they retain their verdure, and continue through the winter on the trees. The nutritive juices of these plants always abound more or less with an oily quality, which secures them from being injured by severe frosts; so that many of these evergreen trees are adapted to grow in the coldest parts of the habitable world.

With respect to deciduous trees, the falling off of the leaves seems principally to depend on the temperature of the atmosphere, which likewise serves to hasten or retard the process in question. A hot sun contributes to hasten the dropping of the leaves; and hence in warm and very dry summers the leaves of the lime-tree and horse-chestnut turn yellow about the first of September, whilst in ordinary years the yellowness does not appear till the beginning of October. Nothing, however, contributes more to hasten the fall of the leaves than immoderate cold or moist weather in autumn; but moderate droughts serve to retard it. As a proof of this position, M. Adanson relates, that in the year 1759, the leaves of the elm-tree, which generally fall off about the 25th of November, continued in verdure and vigour at Paris, where the autumn was remarkably dry, till the tenth of the following month.

It deserves to be remarked, that an evergreen grafted upon a deciduous tree determines the latter to retain its leaves. This observation is confirmed by repeated experiments, particularly by grafting the laurel, or cherry-bay, an evergreen, on the common cherry; and the ilex, or evergreen oak, on the oak.

DEFORMITY (Lat. *deformitas*), the want of that regularity of form necessary to constitute the beauty or symmetry of an object.

DEGENERATION, or DEGENERATING, in general denotes the growing worse, or losing some valuable qualities of which a thing was formerly possessed. Some naturalists have been of opinion that things are capable of degenerating into quite a distinct species; but this is chimerical. All that happens in the degeneration of a plant, for instance, is the losing its usual beauty, colour, smell, or the like; a

Degerando. circumstance entirely owing to its being planted in an improper soil, climate, or situation.

DEGERANDO, Marie Joseph, one of the most distinguished ethical and metaphysical philosophers of France, was born at Lyons, February 29, 1772. When that city was besieged in 1793 by the armies of the republic, the young Degerando took up arms in defence of his native place, was made prisoner, and with difficulty escaped with his life. He first took refuge in Switzerland, whence he afterwards fled to Naples. In 1796, after an exile of three years, the establishment of the directory allowed him to return to France. Finding himself, at the age of twenty-five, without a profession, he resolved to embrace the career of arms, and enlisted as a private in a cavalry regiment. About this time the class of moral and political sciences had proposed as a subject for an essay this question,—"What is the influence of symbols on the faculty of thought?" Degerando gained the prize, and heard of his success after the battle of Zurich, in which he had distinguished himself. This literary triumph was the first step in his upward career. In 1799 he was attached to the ministry of the interior by Lucien Bonaparte; in 1804 he became general secretary under Champagny; in 1805 he accompanied Napoleon into Italy; was nominated maître des Requêtes; in 1811 received the title of councillor of state; and in the following year was appointed governor of Catalonia. On the overthrow of the empire, Degerando was allowed to retain this office; but having been sent during the hundred days into the department of the Moselle to organize the defence of that district, he was punished at the second Restoration by a few months of neglect. He was soon after, however, readmitted into the council of state, where he distinguished himself by the prudence and conciliatory tendency of his views. In 1819 he opened at the law-school of Paris a class of public and administrative law, which in 1822 was suppressed by government, but re-opened six years later under the Martignac ministry. In 1837 the government acknowledged the long and important services which Degerando had rendered to his country by raising him to the peerage. He died November 9, 1842, at the age of seventy.

Degerando's works are very numerous. That by which he is best known now, and which constitutes his chief title to posthumous fame, is his *Histoire Comparée des Systêmes de Philosophie rélativement aux principes des Connaissances Humaines*, of which the first edition appeared at Paris in 1804, in 3 vols. 8vo. The germ of this work had already appeared in the author's *Mémoire de la Génération des Connaissances Humaines*, published at Berlin in 1 vol. 8vo, 1802. In this work Degerando, after a rapid review of ancient and modern speculations on the origin of our ideas, singles out the theory of primary ideas, which he endeavours to combat under all its forms. The latter half of the work, devoted to the analysis of the intellectual faculties, is intended to show how all human knowledge is the result of experience; and reflection is assumed as the source of our ideas of substance, of unity, and identity.

Degerando's great work is divided into two parts, the first of which is purely historical, and devoted to an exposition of various philosophical systems; in the second, which comprises fourteen chapters of the entire work, the distinctive characters and value of these systems are compared and discussed. Great fault has been found with this plan, and justly, as it is impossible to separate advantageously the history and critical examination of any doctrine in the arbitrary manner which Degerando has chosen for himself. Despite these disadvantages, however, the work has great merits. It brought back the minds of men to a due veneration for the great names in philosophical science,—a point which had been utterly neglected by Condillac and his school. In correctness of detail and comprehensiveness of view it is greatly superior to every work of the same kind that has hitherto appeared in France, Deslandes' not excepted. During the Empire and the first years of the Restoration, Degerando found time, despite his many political avocations, to recast the first edition of his *Histoire Comparée*, of which a second edition appeared at Paris in 1823, in 4 vols. 8vo. The plan and method of this edition are the same as in the first; but it is enriched with so many additions that it may pass for an entirely new work. It is greatly to be regretted that the author did not live to bring down his great work to his own times. His last chapter ends with the revival of letters and the philosophy of the fifteenth century. Degradation.

The next valuable work of Degerando was his essay *Du Perfectionnement moral et l'éducation de soi-même*, rewarded by the French Academy in 1825. The fundamental idea of this work, in which the speculative and the practical mingle in nearly equal proportions, is, that human life is in reality only a great education of which perfection is the aim.

Besides the works already mentioned, Degerando left many others of which we may indicate the following:—*Considérations sur diverses méthodes d'observation des peuples sauvages*, 8vo, Paris, 1801; *Eloge de Damarsais; discours qui a remporté le prix proposé par la seconde classe de l'Institut National*, 8vo, Paris, 1805; *Le Visiteur du pauvre*, 8vo, Paris, 1820; *Institutes du Droit Administratif*, 4 vols. 8vo, Paris, 1830; *Cours normales des Instituteurs primaires ou Directions rélatives à l'éducation physique, morale, et intellectuelle dans les écoles primaires*, 8vo, Paris, 1832; *De l'éducation des Sourds-Muets*, 2 vols, Paris, 1832; *De la Bienfaisance publique*, 4 vols. 8vo, 1838 A detailed analysis of the *Histoire Comparée des Systèmes* will be found in the *Fragmens Philosophiques* of M. Cousin.

DEGRADATION, in our law books called *disgradation* and *deposition*, the act of depriving or stripping a person of a dignity or degree of honour, and taking away the title, badge, and privileges thereof.

The degradation of a peer, a priest, a knight, a gentleman, an officer, or such like person, is performed with different ceremonies. That which anciently obtained in degrading a person from his nobility is very curious. It was practised in the time of Francis I. upon Captain Fangel, who had in a cowardly manner given up Fontarabia, of which he was governor. On this occasion, twenty or thirty cavaliers, *sans peur et sans reproche*, were assembled; before whom Fangel was accused of treason and breach of faith by a king-at-arms. Two scaffolds were erected; the one for the judges, heralds, and pursuivants, and the other for the guilty cavalier, who was armed at all points, and his shield placed on a stake before him, reversed with the point upwards. There also assisted twelve priests in surplices, who sung the vigils of the dead. At the close of each psalm they made a pause, during which the officers of arms stripped the condemned of some piece of his armour, beginning with the helmet, and proceeding thus till he was quite disarmed; which being done, they broke his shield in three pieces with a hammer. Then the king-at-arms emptied a basin of hot water on the criminal's head; and the judges, putting on mourning habits, went to the church. This being performed, the degraded was drawn from off the scaffold with a rope tied under his arm-pits, laid on a bier, and covered with mortuary clothes, the priest singing some of the prayers for the dead; and then he was delivered to the civil judge and the executioner of justice.

A more domestic instance is that of Sir Andrew Harcla, earl of Carlisle, who, on being attainted and convicted of treason, by the 18th Edward II. *coram rege*, after judgment had been pronounced on him, his sword was broken over his head, and his spurs hewn off his heels, was thus addressed by Sir Anthony Lucy, the judge, "Andrew, now thou art no knight, but a knave." By statute 13th Car. II., William Lord Monson, Sir Henry Mildmay, and others, were degraded from all titles of honour, dignities, and pre-eminences, and prohibited to bear or use the title of lord, knight, esquire, or

Degree. gentleman, or any coat of arms, for ever afterwards. It has been maintained that the king may degrade a peer; but it appears from modern authorities that a peer cannot be degraded but by act of parliament.

As to ecclesiastics, we have an instance of degradation before condemnation to death, in the eighth century, at Constantinople. It is in the person of the patriarch Constantine, whom Constantine Copronymus caused to be executed. He was made to ascend the ambo, when the patriarch Nicetas sent some of his bishops to strip him of the pallium, and to anathematize him; after which, they made him go out of the church backwards.

But we have a much later instance in our own history. When Cranmer, archbishop of Canterbury, was degraded by order of Queen Mary, he was dressed in episcopal robes made of canvas, invested with the mitre, the pastoral staff was placed in his hand, and in this attire he was shown to the people. When this was done he was stripped of his mock attire piece by piece. Subsequently it was not deemed necessary to go through the ceremony of degradation before putting a priest to death, on account of the delays and difficulties which sometimes occurred. Pope Boniface pronounced that six bishops were required to degrade a priest; but the difficulty of assembling so many bishops rendered the punishment frequently impracticable. In England, a priest, after being delivered to his ordinary, if he could not purge himself of the crime with which he was charged, underwent the disgrace of having his gown and other robes stripped over his ears by the common hangman; after which he was declared divested of his orders.

It has been decided, however, that degradation does not efface the priestly character. Degradation seems only to differ from deposition by the addition of a few ignominious ceremonies which custom has sanctioned. Accordingly, in the affair of Arnoul, archbishop of Rheims, sentenced in the council of Orleans in 991, it was deliberated what form they should follow in the deposition; whether that of the canons, that is, simple deposition; or that of custom, namely, degradation. It was decided that he should surrender the ring, pastoral staff, and pallium, but that his robes should not be torn off. In effect, the canons prescribe no more than a mere reading of the sentence. Degradation, therefore, properly consists in those ceremonies that have been added by custom, namely, the stripping off the ornaments and the tearing the pontifical vestments.

DEGREE, in *Geometry*, a division of a circle, being a three hundred and sixtieth part of its circumference.

Degree of Latitude. See LATITUDE.

Degree of Longitude. See LONGITUDE.

A degree of the meridian on the surface of the globe has been variously determined by different observers. M. Picart measured a degree in the latitude of 49. 21., and found it equal to 57,060 French toises. But the French mathematicians who examined Picart's operations found, that the degree in that latitude is 57,183 toises. Mr Norwood measured the distance between London and York, and found it 905,751 English feet; and finding the difference of latitudes 2. 28., determined the quantity of one degree to be 367,196 English feet, or 69 English miles and 288 yards. Maupertuis measured a degree in Lapland, in the latitude of 66. 20., and found it 57,438 toises. A degree was measured at the equator by other French mathematicians, and found to contain 56,767·8 toises. From these measurements it appears that the earth is not a sphere, but an oblate spheroid.

DEGREE, in the civil and canon law, denotes an interval in kinship, by which proximity and remoteness of blood are computed.

DEGREE, in *Music*, the difference of position or of elevation found between two notes placed on one and the same part, for a voice or an instrument. See MUSIC.

DEGREES, *Academical.* See UNIVERSITIES.

Degrees || Deiscal.

DEHISCENT (Lat. *dehisco*, to *gape*), in *Botany*, opening, as the capsule of a plant.

DEIFICATION. See APOTHEOSIS.

DEINOCRATES, or, as his name is sometimes written, DINOCHARES or TYMOCHARES, a celebrated Macedonian architect, who flourished in the time of Alexander the Great. He furnished the designs for the second temple of Diana at Ephesus; drew plans, which he submitted to Alexander, for cutting Mount Athos into a statue of that hero; and, at the command of Ptolemy Philadelphus, prepared to build a temple at Alexandria in honour of that monarch's deceased wife Arsinoë, the roof of which was intended to be arched with load-stones, so that the iron statue of the late queen might seem to float in mid-air. The exact dates of Deinocrates's birth and death are unknown.

DEIOCES, the founder of the Median empire, flourished towards the close of the eighth century B.C. On the destruction of Sennacherib and his army under the walls of Jerusalem, the nations which till that time had owned allegiance to the Assyrians revolted, and among them the Medes. Deioces, whose love of justice had already made him distinguished in his own village, was appointed ruler of the new kingdom, and founded the Median dynasty, which lasted for 150 years. Deioces died after a peaceful reign of 35 years.

DEIOTARUS, a prince of Gallo-Græcia, or Galatia, who joined the Romans against Mithridates, and received as his reward portions of Armenia and Pontus, with the title of king. In the civil wars he took the side of Pompey and of his patrons, the senate, against Cæsar. His own grandson, Castor, accused him of an intended assassination of Cæsar, which produced the fine oration of Cicero "pro Rege Deiotaro," in which the orator defended successfully his former friend. On the death of Cæsar, Deiotarus sided with Brutus; but afterwards made his peace with Octavius Cæsar, and joined him in the war against Antony, by which policy he retained possession of his territories. After this period history is silent about Deiotarus.

DEIPNOSOPHISTS (δεῖπνον, a *feast*, σοφιστής, a *sophist*), an ancient sect of philosophers, famous for their learned conversation at meals. Athenæus has left a collection of *Ana* which bears the title of *Deipnosophistæ*. See ATHENÆUS.

DEISCAL, the name of a ceremony originally used in the druidical worship of Britain, and retained in many places down to a very late period, as a civil ceremony towards persons of distinction. The Druids, in performing the public offices of their religion, invariably made three turns round the altar, accompanied by all the worshippers. The memory of this practice was preserved in some places for many ages after the Druids and their religion had disappeared; as in the custom in the Scottish isles of walking three times round the ancient cairns, from east to west, according to the course of the sun. This custom was called *deiscal* from *deas* or *dess*, the right hand, and *soil* or *sul*, the sun; the right hand being ever next the heap or cairn. In the same isles it was customary for the people to testify their respect for their chieftains by performing the deiscal around their persons in the same manner. The ceremony is described by a proprietor who experienced this mark of respect as follows:—"One of the natives would needs express his high esteem for my person, by making a turn round about me, sun-ways, and at the same time blessing me, and wishing me all happiness. But I bid him let alone that piece of homage, telling him I was sensible of his good meaning towards me. But this poor man was very much disappointed, as were also his neighbours; for they doubted not but this ancient ceremony would have been very acceptable to me; and one of them told me that this was a thing due to my character from them as to their chief and

Deism ‖ Deist.

patron, and that they could not, and would not, fail to perform it."

DEISM, the doctrine or belief of the deists. Deism or Theism, from *Deus*, or Θεός, *God*, is properly used to denote natural religion, as comprehending those truths which have a real foundation in reason and nature; and in this sense it is so far from being opposed to Christianity, that it is one great design of the gospel to illustrate and enforce it. Thus some of the deistical writers have affected to use it. But deism more commonly signifies that system of religion, relating both to doctrine and practice, which every man may discover for himself by the mere force of natural reason, independently of all revelation, and exclusive of it.

DEIST, one who acknowledges the existence of a God, but denies revealed religion; one who professes no form of religion, but follows the light of nature and reason as his guides in doctrine and practice. Deists are sometimes otherwise denominated Free-thinkers.

The name of Deist seems to have been first assumed as the denomination of a party about the middle of the sixteenth century, by some persons in France and Italy, who were desirous of thus disguising their opposition to Christianity by a more honourable appellation than that of atheists. Virot, an eminent reformer, mentions certain persons, in his epistle dedicatory prefixed to the second volume of his *Instruction Chrétienne*, published in 1563, who called themselves by a new name, that of *Deists*. These, he says, professed to believe in God, but showed no regard to Jesus Christ, and considered the doctrines of the apostles and evangelists as fables and dreams. He adds, that they scoffed at all religion, though they outwardly conformed to the religion of those with whom they lived, or whom they wished to please, or feared to offend. Some, he observes, professed to believe the immortality of the soul, but others denied both this doctrine and that of a providence.

The deists hold that, considering the multiplicity of religions, the numerous pretences to revelation, and the precarious arguments generally advanced in proof of them, the surest way is to return to the simplicity of nature and the belief of one God, which is the only truth agreed to by all nations. They complain, that the freedom of thinking and reasoning is oppressed under the yoke of religion; and maintain, that nothing should be required to be believed but what reason clearly comprehends.

The distinguishing character of modern deists is, that they reject all revealed religion, and discard all pretences to it, as the effects of imposture or enthusiasm. They profess a great regard for natural religion, though they are not agreed in their notions concerning it. They are classed by some of their own writers as mortal and immortal deists; the latter acknowledging a future state, and the former denying it, or representing it as very uncertain.

Dr Clarke distinguishes four sorts of deists. 1. Those who pretend to believe the existence of an eternal, infinite, independent, intelligible Being, who made the world, without concerning himself in the government of it. 2. Those who believe the being and natural providence of God, but deny the difference of actions, as morally good or evil, resolving it into the arbitrary constitution of human laws, and who therefore suppose that God takes no notice of them. With respect to both these classes he observes, that their opinions can consistently terminate in nothing but downright atheism. 3. Those who have right apprehensions concerning the nature, attributes, and all-governing providence of God, and seem also to have some notion of his moral perfections, though they consider them as transcendental, and such in nature and degree that we can form no true judgment, nor argue with any certainty, concerning them; but who deny the immortality of the human soul, alleging that men perish at death, and that the present life is the whole of human existence. 4. Those who believe the existence, perfections, and providence of God, the obligation of natural religion, and a state of future retribution, on the evidence of the light of nature, without a divine revelation. These, he says, are the only true deists; but their principles, he apprehends, should lead them to embrace Christianity; and therefore he concludes that there is no consistent scheme of deism in the world.

Deity ‖ Delambre.

The first deistical writer of any note who appeared in this country was Lord Herbert. He lived and wrote in the seventeenth century; and his book, *De Veritate*, was first published at Paris in 1624. This, together with his book *De Causis Errorum*, and his treatise *De Religione Laici*, were afterwards published in London. His celebrated work *De Religione Gentilium* was published at Amsterdam in 1663, in 4to, and in 1700, in 8vo; and an English translation of it appeared at London in 1705. As he was one of the first who formed deism into a system, and asserted the sufficiency, universality, and absolute perfection of natural religion, with a view to discard all extraordinary revelation as useless and needless, we shall subjoin the five fundamental articles of this universal religion. These are,—1. That there is one supreme God; 2. That he is chiefly to be worshipped; 3. That piety and virtue are the principal part of his worship; 4. That we must repent of our sins, and if we do so God will pardon them; 5. That there are rewards for good men, and punishments for bad men, both here and hereafter.

DEITY, Godhead; an appellation given to God, and also applied by the poets of antiquity to the heathen gods and goddesses.

DEJANIRA, in *Grecian Mythology*, daughter of Œneus, king of Ætolia, and wife of Hercules. The centaur Nessus endeavoured to ravish her, and was slain by Hercules with a poisoned arrow. Nessus, when dying, gave his bloody tunic to Dejanira, assuring her that it was a sovereign remedy to cure her husband if he ever proved unfaithful. Some time afterwards Dejanira, suspecting his fidelity, sent Hercules the tunic, which he had no sooner put on than he was seized with the most excruciating torments. Being unable to support his pains, he retired to Mount Œta, where he kindled a funeral pyre and perished in the flames. Dejanira killed herself in despair.

DELAGOA BAY, an inlet on the S.E. coast of Africa, lying between 25. and 27. S. Lat. It is about 60 miles in length from north to south, and 20 in breadth; and contains several islands. It is frequented by South Sea whalers. The Portuguese, who have a small fort on the coast, carry on some trade in ivory, gums, gold dust, and slaves.

DELAMBRE, JEAN BAPTISTE JOSEPH, an eminent mathematician and astronomer, born at Amiens, Sept. 19, 1749. He studied in the gymnasium of that town under the celebrated poet Delille, with whom he maintained an intimate friendship till his death.

Fortunately for Delambre, his family had formerly founded a gratuitous place for a limited time in one of the great colleges of the University of Paris, and placed it at the disposal of the town of Amiens; and this enabled him to carry on his studies, thus auspiciously begun. The expiry of this privilege, however, left him to struggle with great privations. During the interval in which he was awaiting permanent employment he devoted himself to historical and literary studies. He undertook extensive translations from Latin, Greek, Italian, and English; and at the same time entered on the study of the mathematical sciences.

By the advice of his friends, he resolved to devote his attention to the instruction of youth, and with this view he went to Compiègne; but he soon returned to Paris, where he pursued the same career, with the additional advantages, however, of competent and independent subsistence.

He now yielded to the natural bias of his mind towards the study of physics and astronomy. When he presented

Delambre. himself at the College of France to attend the lectures of Lalande, he had already read the works of that astronomer, and had made a complete commentary on them. This was first remarked when, in the course of instruction, an occasion offered to him of citing from memory a passage of Aratus. Lalande immediately foresaw the advantages his pupil was likely to confer on science, and from that moment regarded Delambre as a fellow-labourer. He entrusted to him the most complicated astronomical calculations, and prevailed on M. Dassy (whose son had received lessons from Delambre) to establish an observatory at his house, where Delambre applied himself to astronomical observations. Delambre at the same time undertook the most extensive researches; he formed the design of completing the astronomical tables; and he dedicated his life to the study and the description of the heavens, a resolution he had previously entertained during his stay at Compiègne.

In 1781 the discovery of the planet Uranus by Herschel excited general attention among astronomers; and the Academy of Sciences proposed the determination of its orbit as the subject of one of its annual prizes. Delambre undertook the formation of tables of its motion, and the prize was awarded to him for his labour. His next effort was the construction of solar tables, and tables of the motions of Jupiter and Saturn; he likewise undertook the construction of ecliptical tables of the satellites of Jupiter; and in a few years he completed that laborious and extensive work. He took a part in the sitting of the Academy of Sciences when Laplace communicated his important discoveries on the inequalities of Jupiter and Saturn; and he formed the design of applying the result of that profound analysis to the completion of tables of the two planets. Delambre turned his attention more especially to the satellites of Jupiter—an undertaking of great difficulty and extent. In this he was sustained by two powerful motives—public utility, and the dignity of the subject. He had been engaged for several years in the composition of his ecliptical tables, when the Academy of Sciences proposed the same question as the subject of a prize. This was awarded to Delambre; and soon afterwards (viz. in 1792) he was elected a member of the academy.

The great diversity of weights and measures, and the consequent inconvenience to commerce, engaged the attention of the French nation about the time of the first revolution; and in the year 1790, Talleyrand, then minister of foreign affairs, brought the subject before the constituent assembly, where it was resolved that the king should be requested to apply to his Britannic Majesty, with the view of getting the English parliament to concur with the national assembly in fixing on some natural unit as a standard. It was proposed that commissioners from the Academy of Sciences should meet an equal number of members of the Royal Society of London, in order to ascertain the length of a pendulum in some determinate latitude, and thence to deduce an invariable model for all weights and measures; and a commission—composed of Borda, Lagrange, Laplace, Monge, and Condorcet—was appointed to consider this grand project. Besides the length of the pendulum, two other units were suggested, namely, a quadrant of the elliptic meridian, and a fourth part of the earth's circumference at the equator. Of the three, the commission adopted the quadrant of the meridian, and its execution was begun by appointing Delambre and Méchain to measure an arc from Dunkirk to Barcelona. This undertaking, in itself laborious, was, by circumstances which arose out of the revolution, rendered highly dangerous to the personal safety of those engaged in it. Méchain died whilst the work was proceeding; and its successful termination was at last accomplished by the zeal, the talents, the perseverance, and the prudence of Delambre. The details of this grand labour have been consigned to posterity in his work entitled *Base du Système Métrique Décimal*, the first volume of which bears the date of 1806, and the third and last that of 1810. Delambre. The labours of Delambre and Méchain were followed up by those of Biot and Arago; who have added as a supplement to the *Base du Système Métrique* their *Recueil d'Observations Géodésiques, Astronomiques, et Physiques*, published in 1820, in which the operations are detailed by which the measurement of the meridian was prolonged from Barcelona to Formentera in the Mediterranean. Altogether this work does honour to the nation which produced such mathematicians, astronomers, and artists as were united in the execution of the labours detailed in it, but particularly to Delambre, the great directing mind that in the course of eight years brought them to a successful termination. The opinion of the National Institute of France was solemnly expressed when, having considered what had been the most important application of the mathematical and physical sciences during the preceding ten years, the universal suffrages of the members decreed the prize to the author of the *Base du Système Métrique*.

Delambre, who had been chosen as an associate of almost every scientific body in Europe, and a member of the French Board of Longitude, was appointed perpetual secretary for the mathematical sciences in the Institute. He had succeeded Lalande in the chair of astronomy of the College of France, and he was appointed one of the principal directors (*titulaires*) of the university. For twenty years he performed the duties of his office in one of the classes of the Institute, and, in doing so, he enjoyed the reputation of being impartial, faithful, and just. His annual reports, his historical éloges, which have been published, and his exposition of the progress of science, are eminently distinguished by profound erudition, a talent for writing formed on the best models, and, above all, by a disposition of mind which inclined him to place in the most favourable light the works of others, as far as was consistent with historical truth. His literary and scientific labours were very numerous, and, in respect of excellence, of the highest order. His *History of Astronomy* (6 vols. 4to) is a work of prodigious research. It puts the modern astronomer in possession of all that had been done, and of the methods employed by those who have gone before him.

His *Méthodes Analytiques pour la Détermination d'un Arc du Méridien*, his numerous memoirs in the additions to the *Connaissances des Temps*, and his *Astronomie Théorique et Pratique*, exhibit the finest applications of modern analysis to astronomy and geography; in fact, they have given a new direction to these sciences. Astronomers have now laid aside the purely geometrical methods, which, however elegant, always required at last numerical calculations; and, instead of these, have expressed everything to be determined in astronomy by compact analytical formulæ, of which a great number are due to Delambre.

It is a remarkable fact in the life of Delambre, that he did not apply himself to astronomical observations until he was about thirty-five years of age; whereas, in general, the particular subject in which a man is destined to excel attracts his attention in early youth. Delambre was appointed a member of the Royal Council of Public Instruction in 1814; a place, however, which he lost in 1815. He was in Paris when it was taken by the allied armies; and, in a letter written at that time to a friend and pupil, he says that on the day of the siege, in the hearing of the cannonade, he laboured with tranquillity in his study from eight in the morning till midnight. He had a happier fate than Archimedes in a like position, for he was not molested by the victors, and no one was billeted on him, probably from respect to his high reputation. At the creation of the Legion of Honour Delambre was made a member of that order. He was appointed chevalier of St Michael in 1817, an officer in the Legion of Honour in 1821; but a long time

Delaware. previous, he had been created a hereditary chevalier, with an endowment, which was decreed as a national reward.

The life of continued and hard study which Delambre led, at last affected his health. The disease by which he was cut off became apparent in the month of July 1822. His total loss of strength, with frequent and long-continued fainting-fits, gave warning of a fatal result. He foresaw what was about to happen, and preserved to the last moment the unalterable mildness of his character and the serenity of his mind. At last, Aug. 19, 1822, at the age of seventy-two, he sunk under his disease, not without having suffered, but without having complained, or betrayed any symptoms of impatience.

The following is a list of his works which appeared separately: *Tables de Jupiter et de Saturn*, 1789; *Tables du Soleil, de Jupiter, de Saturn, d'Uranus, et des Satellites de Jupiter, pour servir à la 3me edition l'Astronomie de Lalande*, 1792; *Méthodes Analytiques pour la Détermination d'un Arc du Méridien*, 1799; *Tables Trigonométriques Décimales, par Borda, revues, augmentées, et publiées par M. Delambre*, 1801; *Tables du Soleil (publiées par le Bureau des Longitudes)*, 1806; *Base du Système Métrique Décimal*, &c., 3 vols. in 4to, 1806–1810; *Rapport Historique sur les Progrès des Sciences Mathématiques depuis* 1789, &c., 1810; *Abrégé d'Astronomie, ou Leçons Elémentaires d'Astronomie Théorique et Pratique*, in 8vo; *Astronomie Théorique et Pratique*, 3 vols. in 4to, 1814; *Tables Eclyptiques des Satellites de Jupiter*, 1817; *Histoire de l'Astronomie Ancienne*, 2 vols. in 4to; *Histoire de l'Astronomie du Moyen Age*, 1819, 1 vol. in 4to; *Histoire de l'Astronomie Moderne*, 1821, 2 vols. in 4to; *Histoire de l'Astronomie au Dixhuitième Siècle*, 1 vol. 4to, 1827.

In addition to these, he furnished a very considerable number of memoirs (about 28) on various points of astronomy, to the *Connaissances de Temps*, beginning with the year 1788. He also contributed to the Memoirs of the Academies of Stockholm, Petersburg, Berlin, and Turin, and to those of the first class of the French Institute; and he composed éloges on many of his contemporaries at their death, among which may be noticed one on our highly distinguished countryman Dr Maskelyne, the astronomer-royal of England. Delambre has also rendered essential service by dispelling the delusion propagated by his friend Bailly regarding the antiquity of the Indian astronomical tables, which he held to be only about 700 years old.

DELAWARE, one of the United States of North America, and, after Rhode Island, the smallest in the Union, having an area of only 2120 square miles. It occupies the north-eastern portion of that peninsula lying between the bays of Chesapeake and Delaware, and extends from Lat. 38. 28. to 39. 47. N., and from Long. 74. 56. to 75. 46. W. It is bounded on the north by Pennsylvania, on the west and south by Maryland, and on the east by Delaware Bay and the Atlantic Ocean. Its length from north to south is about 92 miles, and its breadth varies from 36 miles in the south to less than 10 in the north. The general character of the surface is plain, with a general slope towards the Delaware and the ocean. The northern part as far as Christiana Creek is hilly, and somewhat rugged, but none of its eminences exceeds 500 feet above the level of the ocean. A table-land or low sandy ridge, nowhere more than 60 or 70 feet in height, passes through the state near its western boundary, and divides the waters that fall into the Chesapeake from those that fall into Delaware Bay. This table-land abounds with swamps in which most of the rivers and streams have their sources. At the southern extremity of the state is the Cyprus swamp, a morass 12 miles in length and 6 in width, including an area of 50,000 acres, the whole of which is a high level basin, containing a great variety of trees and plants, and infested by wild animals and reptiles. The rivers are all small, generally rising within the state and flowing into the Delaware. The Brandywine, however, rises in Pennsylvania. It is 40 miles in length, and uniting with the Christiana creek, forms the harbour of Wilmington one mile below that town, and two miles west of the Delaware River. The other principal streams are the Appoquinnimink, Duck Creek, Jones' Creek, Mispilion Creek, and Indian River. The eastern shore is washed by the Delaware Bay, but contains no good harbours, having generally long sandy beaches. To remedy this inconvenience, the government of the United States has constructed the Delaware breakwater opposite the village of Lewestown, above Cape Henlopen. It consists of two piers, the one forming a shelter from the fury of the waves, which roll in here with great violence, and the other affording protection from the masses of floating ice brought down by ebb tide. The former is 2743 feet long at the bottom, or 2030 at high water mark, 75 feet wide at low water mark, and raised 15 feet above low, or 3 feet above high water mark; the ice-breaker is 1700 feet long at the bottom, and 1378 at the top, of the same breadth as the other, but only 9 feet in height. The only arms of the sea extending inland, are Rehoboth Bay, and the estuary called Indian River, which are spacious but shallow basins, not admitting vessels of more than six feet draft. Delaware.

The soil of Delaware is in many places excellent, but is generally thin and sandy. In the northern parts of the state along the Delaware River and Bay, and for 8 or 10 miles inland, the soils are generally rich clays; thence to the swamps, the soil is light and sandy, and of an inferior quality; while the central and southern parts have also a sandy soil, which gradually becomes less productive the farther south. Bog iron-ore is found in the swampy tracts in the south, and has long been used for economical purposes; shell-marl, extensively used in agriculture, occurs in considerable quantities; and in the north is found porcelain clay, which is sent to supply the Philadelphia porcelain works. Agriculture is the principal occupation of the inhabitants; but in the north, where there is an abundance of water power, manufactures have long been in existence, and are in a very flourishing condition. Commerce and trade are also extensive, and the whale fisheries have been prosecuted with success from Wilmington. The principal agricultural productions are wheat, rye, Indian corn, oats, barley, buckwheat, potatoes, and flax. In the southern part of the state there is some fine grazing land. In 1850 there were 513 manufacturing establishments, producing to the value of $500 and upwards; and of these 12 were cotton factories, employing 413 males and 425 females, 8 woollen mills, employing 122 males and 18 females, 15 establishments engaged in manufacturing iron, viz. 13 in manufacturing castings, employing 250 hands, and 2 wrought-iron, employing 50 hands; and 16 tanneries, employing 108 hands. The other establishments are chiefly grist, flour, saw, gunpowder, and paper mills, smitheries, &c., and in the north are several machine shops. Some salt is made from sea water at Lewes and Rehoboth, and ship building is carried on to a considerable extent at Wilmington. The foreign trade of Delaware is effected chiefly through Baltimore, New York, and Philadelphia, especially the last; so that its direct foreign commerce is very inconsiderable (the exports in 1849 amounting to only $38,229, and the imports to $1400); the coasting trade, however, is extensive and active. The total amount of shipping owned within the state at 30th June 1850 was 16,719 tons, of which 1651 tons were of the class "registered," 14,639 tons of the class "licensed and enrolled," and 447 tons small licensed craft under 20 tons. The steam shipping amounted to 2774 tons. During 1850 16 vessels were built, of an aggregate burden of 1848 tons, viz., 12 schooners, 3 sloops, and 1 steamer. The Chesapeake and Delaware Canal is an important work connecting these two bays by a channel navigable for sea-going vessels. It extends from Delaware city to Buck Creek, a navigable branch of the Elk River, and is 13½ miles in length, 66 feet wide at the top, and 10 feet deep. The Newcastle and Frenchtown railway, extending also across the peninsula, is 16¼ miles in length, and, in connection with steam-boats at each terminus, forms a line of communication between Philadelphia and Baltimore. The Phila-

Delaware.

delphia, Wilmington, and Baltimore Railway crosses Delaware farther north, and being the nearest land line between those cities, it is the usual route taken by travellers between the northern and southern states.

This state is divided into 3 counties (Newcastle in the north, Kent in the middle, and Sussex in the south) and 25 hundreds. The population in the different decennial periods since 1810 was as follows:—

	Whites.	Free Coloured.	Slaves.	Total.
1810	55,361	13,136	4177	72,674
1820	55,282	12,958	4509	72,749
1830	57,601	15,855	3292	76,748
1840	58,561	16,919	2605	78,085
1850	71,289	17,957	2289	91,535

Of the entire population in 1850 there were 58 deaf and dumb, 46 blind, 70 insane, and 101 idiotic.

The legislature meets at Dover, the capital, on the first Monday of January biennally, and consists of a senate and house of representatives, styled the General Assembly. Senators, of whom three are sent from each county, must be at least 27 years of age, possessed of 200 acres of freehold land in the county, or an estate therein worth $1000, citizens and inhabitants of the state for three years, and of the county for the last year previous to election. Their term of office is four years. The representatives, of which there are seven for each county, must be at least twenty-four years of age, and are elected for two years. The elective is vested in all free white male citizens twenty-one years of age, who have resided in the state for one year, and in the county in which the vote is given one month previous to the election. The governor is elected for four years, and must be at least thirty years of age, a citizen of the state for the last twelve, and an inhabitant for the last six years previous to the first meeting of the legislature after his election. Delaware sends one representative to the federal congress. The judiciary consists of a superior court, court of chancery, orphan's court, &c. There are five judges in the state, one of whom is chancellor and president of the orphan's court, one chief justice of the state, and the remaining three are associate justices, one residing in each county. The chief justice and two of the associate justices form the superior court, and court of general session; and all the judges except the chancellor form the court of oyer and terminer. The orphan's court consists of the chancellor and the associate judge of the county. The government of Delaware is one of the least expensive in the Union, the income in 1850 amounting to only $31,863, and the expenditure to only $26,792. In 1850 there were in the state 209 free schools, with 13,288 scholars. Besides these there are about 40 academies and grammar-schools. The Delaware college at Newark was founded in 1838, and in 1850 had a president, 5 professors, and 30 students, and a library of 7000 volumes. St Mary's college at Wilmington, a Roman Catholic seminary, had, in 1850, a president, 3 professors, and 107 students. The most numerous religious body in the state is the Presbyterian, and after that the Methodist. There are also many Episcopalians, Roman Catholics, Baptists, and Quakers. This state derives its name from Lord De la War, governor of Virginia, who (in 1610) was the first to enter the bay, which took its name from him. It was first settled by the Swedes and Finns, under the patronage of Gustavus Adolphus, in 1627, and took the name of New Sweden. In 1630 the colonists built a fort at Lewestown, and a year after, another near Wilmington. They were, however, too weak, and too far removed from the protection of the mother country, to defend themselves against the Dutch, who claimed the country; and accordingly, in 1655, Delaware came into their power. In 1664 this colony, with other parts of New Amsterdam, fell into the hands of the English, and was granted by Charles II. to his brother James Duke of York, who in 1682 conveyed it to William Penn. In 1704, Delaware, though still under the same proprietor, became a separate colonial establishment, and remained such till the revolution. The people of Delaware, by a unanimous vote in convention, adopted the constitution of the United States 3d December 1787.

Delaware || Delfico.

Delaware, a river of the United States, which rises on the west side of the Catskill Mountains, state of New York, and after separating Pennsylvania from New York and New Jersey, falls into the Delaware Bay five miles below Newcastle. It is formed by the union of two streams. The Mohawks, or western and main branch, rises from a small lake in Lat. 42. 45. N., at an elevation of 1886 feet above the sea, and flows S.W. for nearly 50 miles, when it turns suddenly to the S.E., flowing in that direction for five miles to the Pennsylvania boundary line in Lat. 42. N. Eight miles below this spot it is joined by the Popaeton branch, which has a previous S.W. course of about 50 miles. After the union of these two streams, the river pursues a winding S.E. course between New York and Pennsylvania for 60 miles to the N.W. corner of New Jersey, where it receives the Neversink River. It then turns S.W. along the base of the Kittaning range for 35 miles, in passing through which it forms what is called the "Water Gap," a great natural curiosity. The banks here rise precipitously from the water's edge to the height of 1600 feet, overhung by immense masses of rock, and at the S.E. entrance leaving scarcely room for a road. The passage, however, widens towards the N.W. Its entire length is about 2 miles. From this point it pursues a S.E. and then a S.W. course to Easton, where it receives the Lehigh, a large tributary, from the west. A little below this the river passes through South Mountain, and has a S.E. course to Trenton, 60 miles below Easton; having in that distance 25 rapids, with a total fall of 165 feet. These falls are navigable at high water. The river below Trenton turns to the S.W. until near the bay, which it enters in a S.E. direction, after an entire course of 309 miles. It is navigable for vessels of the largest class to Philadelphia, 40 miles, and for sloops 35 miles farther, to Trenton. Above the falls at Trenton it is navigable for boats of 8 or 9 tons for 100 miles. The Delaware is connected with the Hudson river and the bays of New York by the Delaware and Hudson Canal, the Morris Canal, and the Delaware and Raritan Canal.

Delaware Bay, at the mouth of the Delaware River, is a large arm of the sea, 75 miles long, 20 miles wide between Cape May on the N. and Cape Henlopen on the S., and 30 miles wide in the middle. The navigation is difficult and dangerous, being interrupted by many shoals. Its low and sandy shores were without harbours until the construction of the breakwater within Cape Henlopen, noticed under the State of Delaware.

DELETERIOUS (Lat. *deleo*, to blot out or destroy), an appellation given to things of a destructive or poisonous nature.

DELFICO, Melchiore, an eminent Italian writer on political economy, was born at Teramo in the Abruzzi in 1744, and educated at Naples. His life and writings were dedicated to the improvement of the jurisprudence of his native country, and his labours were appreciated under all its dynasties. His first publication was rather moral than economic, being a curious and eloquent vindication of matrimony against the too prevalent customs of a loose age. It appeared in 1774. But from that time to 1795 his talents were devoted to the composition of several treatises, which being generally addressed to the king of Naples, and directed to the amelioration of the institutions of his country, were productive of great advantage to the state. This was especially the case with his *Memorie sul Tribunale della Grazia e sulle Legge Economiche nelle Provincie confinante del Regno.* To these *Memorie* the Neapolitans owe the abolition of the most vexatious and absurd restrictions on the sale and exportation of agricultural produce. A similar

Delft. effect followed his two *Memorie* on kindred topics, devoted like their predecessors to the advocacy of free measures whenever they might safely be allowed to come into operation, and followed, as had been anticipated, with the best effects. These were published in the years 1787–88. Equally beneficial was the adoption of the principles developed in his *Riflessioni sulla Vendita dei Feudi Devoluti*, in 1790, and his *Lettera al Duca di antalupo sui Feudi Devoluti*, in 1795, which were so powerfully reasoned that a law was promulgated for the sale of all feudalities reverting to the crown as free estates.

His merits were recognized by Joseph Bonaparte during his short reign at Naples; and Melchiore was made a councillor of state, and employed in the formation of the new judicial organization of Naples. He was employed in a similar manner under Murat; and when Ferdinand was restored in 1815, Delfico was made president of the commission of the archives; an office which he filled until 1823, when he tendered his resignation on account of his advanced age. His sovereign acknowledged his eminently patriotic services by the grant of a large pension for life. Soon after, he retired to his native town, where he died in 1835 at the advanced age of ninety-one.

Besides the works we have noticed, on which his Neapolitan fame may be said chiefly to rest, we owe to him several general works of no mean reputation, especially *Ricerche sul vero Carattere della Giurisprudenza Romana, e di sue Cultore*, 1790, and *Pensieri sulla Storia, e sull' Incertetza ed Inutilità della Medesima*, 1806. In this last he has anticipated the scepticism of Niebuhr on the early history of Rome, and disabused us on many of its fables; but he has fallen into the opposite extravagance, of denying to the Romans before the second Punic war all arts but that of agriculture, and making war on their neighbours. (T. S. T.)

DELFT, a large town of South Holland, on the Schie, nearly ten miles N.W. from Rotterdam, and in the line of the canal between Rotterdam and the Hague. It formerly possessed extensive potteries of "Delft ware," but the pottery of Holland is now almost entirely superseded by articles of English manufacture. There are still, however, a few manufactories of coarse earthenware and tobacco-pipes, besides coarse woollen stuffs, carpets, and soap. The new church contains the monuments of Grotius (born here in 1583) and William I. of Orange; the old church contains the tombs of Admiral Van Tromp and Leuwenhoeck the naturalist. The city itself is well built but gloomy, the streets being intersected by narrow stagnant canals lined with trees. Pop. 17,500.

DELFT *Ware*, a kind of pottery of baked earth, covered with an enamel or white glazing, which gives it the appearance and neatness of porcelain. Some kinds of this enamelled pottery differ from others, either in their sustaining sudden heat without breaking, or in the beauty and regularity of their forms, enamel, and the painting with which they are ornamented. In general, the fine and beautifully enamelled potteries, which approach the nearest to porcelain in external appearance, are, at the same time, those which least resist a brisk fire; whilst those which sustain a sudden heat are coarse, and resemble common pottery.

The basis of this pottery is clay, which, when too fat, is mixed with such a quantity of sand that the earth preserves enough of its ductility to be easily worked, moulded, and turned; and yet so that its fatness may be sufficiently counteracted, and that it may not crack or shrink too much in drying or in baking. Vessels formed of this earth must be dried very gently to avoid cracking. They are then placed in a furnace to receive a slight baking, which is only meant to give them a certain consistence or hardness. And, lastly, they are covered with an enamel or glazing, which is done by putting upon the vessels thus prepared the enamel, which has been ground very fine and diluted with water. Delft.

As vessels to which the enamel is applied are but slightly baked, they readily imbibe the water in which the enamel is suspended, and a layer of the enamel adheres to their surface. These vessels may then be painted with colours composed of metallic calces, mixed and ground with a fusible glass. When they have become perfectly dry, they are placed in the furnace, included in cases of baked earth called *seggers*, and exposed to a heat capable of fusing uniformly the enamel which covers them. The heat applied to fuse the enamel, being much stronger than that which was applied at first to give some consistence to the ware, is also the heat necessary to complete the baking process. The furnace and colours used for painting this ware are the same as those employed for porcelain. The glazing, which is nothing but white enamel, ought to be so opaque as not to show the ware under it. There are many receipts for making these enamels; but all of them are composed of sand or flints, vitrifying salts, calx of lead, and calx of tin; and the sand must be perfectly vitrified, so as to form a glass tolerably fusible. Somewhat less than an equal part of alkaline salt, or twice its weight of calx of lead, is requisite to effect such vitrifications of sand. The calx of tin is not intended to be vitrified, but to give a white opaque colour to the mass; and one part of it is added to three or four parts of all the other ingredients taken together. From these general principles various enamels may be made to suit the different kinds of earths. To make the enamel, lead and tin are calcined together with a strong fire; and the sand is also made into a frit with the salt or ashes. The whole is then well mixed and ground together, and the matter is placed under the furnace, where it is melted and vitrified during the baking of the ware. It is next ground in a mill, and applied as above directed.

The preparation of the white enamel is a very essential article in making delft ware, and one in which artists often fail. A French writer, in a memoir concerning this kind of ware, recommends the following proportions; namely, a hundred pounds of calx of lead to be mixed with about a seventh part of that quantity of calx of tin for common delft ware, or a fourth part of calx of tin for the finest kind, a hundred or a hundred and ten pounds of fine sand, and about twenty or thirty pounds of sea-salt. Concerning the earth of which the ware is made, he observes, that pure clay is not a proper material when used alone; and that different kinds of earth mixed together are found to succeed better. Pieces of ware made of clay alone are found to require too much time to dry; and besides this they crack, and lose their form, unless they are made exceedingly thick. An addition of marl diminishes the contraction of the clay, renders it less compact, and allows the water to escape, without altering the form of the ware in drying; and it also affords a better ground for the enamel, which appears more glossy and white than when laid upon clay alone. The kinds of clay which are chiefly used in the composition of delft ware are the blue and the green. A mixture of blue clay and marl would not be sufficiently solid, and would be apt to scale, unless it were exposed to a fire more intense than that which is commonly used for the burning of delft ware. But to give greater solidity, there is added some red clay, which, on account of its ferruginous matter, possesses the requisite binding quality. The proportions of these ingredients vary in different works, according to the different qualities of the earths employed. Three parts of blue clay, two parts of red clay, and five parts of marl, form the composition used in several manufactories. It has been said that the best delft ware might be made of equal parts of pure clay and pure calcareous earth; but this composition would require that the fire should be continued twice as long as it generally is.

Delhi.

DELHI, in Hindustan, a British district under the jurisdiction of the lieutenant-governor of the north-western provinces. Its boundaries are the district of Panneeput on the north; the River Jumna on the east, dividing it from the districts of Meerut and Boolundshuhur; the district of Goorgaon on the south, and the petty native states of Buhardoorgurh and Jhujur on the west. It has an area of 602 square miles, and lies between Lat. 28. 24. and 28. 54.; Long. 76. 49. and 77. 29. The climate is characterized by aridity, and the soil being for the most part sandy or stony, its successful cultivation depends in a great measure on artificial means of irrigation. The principal alimentary crops are wheat, barley, and pulse. Water is procured from wells, but these have to be dug to a great depth. Happily an abundant supply from a more accessible source has been rendered available to a considerable portion of the district. In 1356 a celebrated aqueduct, diverging from the Jumna at the very spot where that river issues from the mountains, was constructed by Feroz Shah, king of Delhi, and conducted in a westerly direction to the royal hunting grounds of Hansi and Hissar. At the distance of 80 miles from the commencement of this aqueduct, the canal of Ali Mardan Khan, a Persian nobleman of great eminence, parted from Feroz Shah's canal, and traversing the district in a southerly direction, rejoined the Jumna at the city of Delhi. It was a noble work, which gave fertility to a large district along its banks, and was the sole source of vegetation in the gardens of Delhi, besides furnishing the inhabitants with the only drinkable water within their reach. This aqueduct, which, from indolence, neglect, and the devastations of intestine war to which this province was long exposed, had been allowed to fall entirely into disrepair, was re-opened by the British government in 1820, to the great joy of the inhabitants of Delhi, who went out in jubilee to meet its stream, throwing flowers, ghee, and other things into the water, and calling down all manner of blessings on the British government. The supply of water derived from this aqueduct enables the inhabitants in a large tract of country to have recourse to irrigation, and thus to render the soil productive. According to the census taken in 1853 the population amounts to 435,744. Of this number 235,203 are males, and 200,541 females. The Hindu population greatly preponderates; its proportion, compared with that of all other classes, being about eight to three; but in the city of Delhi, long the seat of a Mohammedan monarchy, the proportion of Mussulmans nearly equals that of Hindus.

Delhi, the chief city of the above province, and for many years the capital of the Patan and Mogul empires, situated on the banks of a branch of the Jumna. During the era of its splendour it is said to have occupied a space of twenty miles round; and its great extent is still attested by the ruins, which cover a vast surface. The inhabited part of the town is about seven miles in circuit: it is seated on a range of rocky hills, and is surrounded by an embattled wall, which the English government have put into repair, and strengthened with bastions, a moat, and a regular glacis. The city has seven gates in addition to those on the river face, namely, the Lahore gate, Ajmeer gate, Turkoman gate, Delhi gate, Mohur gate, Cabul gate, and Cashmere gate; all built of freestone. The houses within the walls are many of them large and high. The streets are in general narrow, with the exception of two: the first leading from the palace to the Delhi gate, which has an aqueduct along its whole extent; and the second from the palace to the Lahore gate. These are really wide, handsome, and, for an Asiatic city, remarkably clean. The breadth of the first may be about equal to that of Pall-Mall in London, and is called Chandnee Chokee, or Silversmiths' Street, though few of the present residents belong to that craft. The city contains a great number of mosques, with high minarets and gilded domes, and the remains of many splendid palaces belonging to the great omrahs of the empire. They are all surrounded with high walls, and occupy a considerable space of ground, as they comprehend gardens, baths, stables for all sorts of animals, and music galleries. Above all is seen the imperial palace, a very high and extensive cluster of towers and battlements. It was built by Shah Jehan, on the west bank of the Jumna, and is surrounded on three sides by an embattled wall sixty feet high, built of red granite, with small round towers, and two noble gateways, each defended by an outer barbican of the same material, though of less height, and the whole surrounded by a wide moat. It is a place of no strength; but, "as a kingly residence," says Heber, "it is one of the noblest that I have seen. It far surpasses the Kremlin; but I do not think that, except in the durability of its materials, it equals Windsor." On the opposite bank of the river is the fortress of Selimghur, now in ruins. The gardens of Shalimar were made by the Emperor Shah Jehan, and are said to have cost one million sterling; but, like his other works, they are now in ruins. They were surrounded by a brick wall, and were about a mile in circumference.

Delhi.

There are many fine mosques in Delhi still in good repair, the chief of which are the Jumna Musjeed and the Kala Musjeed. The former is advantageously elevated on a small rocky eminence to the full height of the surrounding houses. It was begun by Shah Jehan in the fourth year of his reign, and was completed in the tenth. In front it has a large square court, surrounded by a cloister open on both sides. It is paved with granite inlaid with marble, and commands a view of the whole city. In the centre is a great marble reservoir of water, with some small fountains supplied by machinery from the canal. On its west side and rising at another flight of steps, is the mosque itself, which is entered by three noble Gothic arches, surmounted by three domes of white marble. It has at each end a very tall minaret. "The ornaments," says Heber, "are less florid, and the building less picturesque, than the splendid group of the Imambara and its accompaniments at Lucknow; but the situation is far more commanding. Bishop Heber was more impressed with the size, the solidity, and rich materials of this building, than with anything of the sort which he had seen in India. By the liberality of the British rulers, it is kept in excellent repair, a grant having been made for this purpose. The Kala Musjeed is small, and is chiefly worthy of notice from its plainness, solidity, and great antiquity, being a work of the first Patan conquerors in the times of primitive Mussulman simplicity. Not far from the palace is the pretty little mosque of Roshun ud Dowlah, with its three gilt domes, on the porch of which it is said that, in 1739, Nadir Shah sat to witness the massacre of the unfortunate inhabitants by his licentious soldiery; and a gate leading to a bazaar near it retains the name of "Coonia Durwazu," or the Slaughter Gate. There are besides about forty other mosques of inferior size. The tombs of the imperial family at Delhi have several of them the most splendid architectural ornaments. That of Humaioon, the second of the Mogul dynasty who reigned over Hindustan, is a noble building of granite, inlaid with marble, and in a very simple style of architecture. It is surrounded by a large garden with terraces and fountains; and the garden itself is surrounded by an embattled wall with towers, four gateways, and a cloister within all the way round. In the centre of the square is a platform of about twenty feet high and two hundred feet square, supported by cloisters, and ascended by four great flights of granite steps. Above rises the tomb, also a square, with a great dome of white marble in its centre. The apartments within consist of a circular room, in the centre of which lie, under a small raised slab, the mortal remains of the prince; and smaller chambers in the angles where other branches of his family are interred. About a mile westward is an-

Delhi. other burying-ground, or collection of tombs and small mosques, some of them very beautiful. The most remarkable is a little chapel in honour of a celebrated Mussulman saint Nizam ud Deen; and around his shrine most of the deceased members of the present imperial family lie buried, all in their own little inclosures, surrounded by very elegant latticework of white marble. From the gate of Agra to Humaioon's tomb is a very awful scene of desolation; "ruins after ruins," says Bishop Heber, "tombs after tombs, fragments of brick-work, freestone, granite, and marble, scattered everywhere over a soil naturally rocky and barren, without cultivation except in one or two small spots, and without a single tree." Amongst these ruins is to be seen one mass which is larger than the rest. This is the old Patan palace, which was a large and solid fortress, in a plain and unornamented style, and chiefly remarkable for a high black pillar of cast metal, called Feroz's Walking Stick, a Hindu emblem of Siva, as is supposed, concerning which there is a tradition, that whilst it stood the children of Brahma were to bear rule in Indraput, the name of the Hindu city which preceded Delhi. The vanity of the prediction appeared when the country was conquered. The pillar is covered with inscriptions, mostly in Persian and Arabic; but that portion of it which probably contains the prophecy is inscribed with characters obsolete and unknown —a sure mark of its high antiquity.

Delhi has fallen from its ancient splendour; the palaces of the nobles, which formerly gave an air of grandeur to the city, having been for the most part demolished. But as these memorials of the resources and magnificence of the Mohammedan dynasties of Hindustan disappear, their sites become occupied by structures of less pretension, but still possessing much elegance of architectural design, and, upon the whole, the city is represented as having greatly improved. Much attention has been paid to its cleanliness; it is amply supplied with water by means of the canal which diffuses constant streams throughout its streets; and the locality is considered healthy. From a series of observations continued over a period of three years, the mean temperature of the atmosphere in the daytime is estimated as follows: January 56°, February 61°, March 72°, April 83°, May 91°, June 92°, July 86°, August 83°, September 83°, October 77°, November 65°, December, 58°. During the cooler months, the frost of the night is sufficient to produce ice, which is carefully removed in the morning and deposited for preservation in deep pits.

Among the more modern buildings of Delhi is the Government College. This institution was founded in 1792. It is divided into four departments—English, Arabic, Persian, and Sanscrit. The number of students, according to the latest returns, amounted to 333, of whom 206 were Mohammedans, 105 Hindus, and 22 Christians. There is also the palace of the British resident and a Protestant church built at the cost of L.10,000 by the munificence of the late Colonel Skinner, a military officer in the service of the East India Company. By a census taken on the 1st January 1853, the city is stated to contain 152,424 inhabitants, of whom 76,390 are represented as being Hindus, and 76,034 as Mohammedans.

The ruins which surround the present town mark the site of old Delhi, which was founded on the ruins of the still larger Hindu city of Indraput towards the west. This city was taken in 1193 by the Mohammedans under Cuttubbadeen Khan, who fixed his residence there, and, upon his succeeding to the throne, made it his capital. It was increased and improved, until, under the Afghan monarchs, Agra was made the capital, which continued to be the seat of empire till the return of Humaioon from Persia in 1554. During the reigns of Akbar and Jehangire, Delhi was deserted, but was restored to its ancient splendour by the Emperor Shah Jehan, who founded the present city in 1631, and removed to it many of its inhabitants; others soon followed, to be near the palace and the principal markets; and as, during the disorders of the Mahratta government, it was unsafe to remain without the walls, the old city was soon entirely abandoned. After the defeat of the Mogul army at Kurnaul in 1739, Delhi was occupied by Nadir Shah, the sovereign of Persia. During his stay in the city the Persian troops were rashly attacked by the populace; and Nadir, vainly attempting to restore order, gave directions for a general military execution, which were acted upon with terrible fidelity. From this period the dismemberment of the empire of Delhi rapidly proceeded. Ahmed Shah, the great Mogul, who had succeeded to the shattered sovereignty in 1748, was deposed in 1754, and blinded; and upon the accession of his successor nothing remained to the house of Baber but the decayed metropolis, which itself was taken in 1756 by Ahmed Shah Dooranee, and again in 1758 by the Mahrattas. The emperor Shah Alum succeeded to the titular sovereignty in 1759, and having thrown himself into the hands of the Mahrattas, long suffered neglect and abject poverty. Upon the discomfiture of the Mahratta army by Lord Lake in 1803, Delhi admitted the conquering forces without resistance, and the Mogul emperor was taken under the protection of the East India Company. He was honourably treated by the English, who assigned him an annual pension of ten, twelve, and ultimately of fifteen lacs of rupees for his subsistence, and who rendered him all the outward homage of royalty, acknowledging him as the sovereign of the country, and themselves as his tributaries. But the altered position of the British in India at length rendered it expedient to discountenance the further assumption of regal dignity on the part of the Mogul dynasty; and an arrangement has been made with the heir apparent to the titular sovereignty under which upon the reigning emperor's death the palace is to be given up to the British, the members of the royal family removing to other residences. The royal allowances will be continued, but the position of the head of the family will have subsided into that of a subject. Delhi was besieged in 1804 by the Mahratta chief Holkar, commanding an army of 70,000 men, but it maintained a gallant and successful defence under the command of Lieutenant-Colonel Burn. The city has an elevation of 800 feet above the level of the sea. Lat. 28. 39.; Long. 77. 18. (E. T.)

Delia ‖ Delille.

DELIA, in *Antiquity*, a festival celebrated every fifth year in the island of Delos, in honour of Apollo. It was first instituted by Theseus, who on his return from Crete placed at Delos a statue which he had received from Ariadne. At the celebration they crowned the statue of the god with garlands, appointed a choir of music, and exhibited horse-races. They afterwards led a dance, in which they imitated by their motions the various windings of the Cretan labyrinth, from which Theseus had extricated himself with Ariadne's assistance. There was another festival of the same name yearly celebrated by the Athenians at Delos, and also instituted by Theseus, who, when going to Crete, made a vow that if he returned victorious, he would yearly visit in a solemn manner the temple of Delos. The persons employed in this annual procession were called *Deliastæ* and *Theori;* and the ship which had carried Theseus, and had been carefully preserved by the Athenians, was called *Theoria* and *Delias*. During this festival it was unlawful to put any one to death; and hence it was that the life of Socrates was prolonged for thirty days.

DELIA, a surname of the goddess Diana; from Delos the place of her birth. Hence also Apollo is called Delius.

DELIACAL PROBLEM, a celebrated problem among the ancients, concerning the duplication of the cube.

DELILLE, JACQUES, early acquired deserved celebrity as the founder of a new school in French poetry, but unfortunately his ambition extended with his fame, till he left

Delille. behind him as many didactic poems as Sir Richard Blackmore has epics, and we suspect the greater number of them are already almost as little known. The author of the *Jardins*, indeed, will always hold his rank among poets; but it would have been no great misfortune to his memory if he had written little more.

He was born on the 22d of June 1738, in the neighbourhood of Clermont, in Auvergne. His father was a man of neither fortune nor family; but he was connected by his mother with that of the Chancellor de l'Hôpital. With very slender means of support, he was educated at Paris, and made such progress in his studies as augured well for his future distinction. When his education was completed, he was forced to accept of a very humble situation as teacher in the College of Beauvais; but this was soon exchanged for the more honourable station of professor of humanity at Amiens. After returning to Paris, where he likewise obtained a professorship, he speedily acquired a considerable poetical name, and was encouraged, by the younger Racine, to give to the world a translation of the *Georgics* of Virgil, which he had begun at Amiens. Voltaire was greatly struck with the enterprise and the success of Delille; and without any personal acquaintance with the poet, he, of his own accord, recommended him and his work to the good graces of the Academy. It was not, however, till some years afterwards that Delille became a member of that celebrated body. He now aimed at a higher distinction than even a finished translation of the most finished poem in the world could confer upon him; and in the *Jardins*, which he published a few years after his reception into the Academy, he made good his pretensions as an original poet.

Before he had gone far in the composition of his next poem, which was not, indeed, published till after many of his other works, he made a voyage to Constantinople in the train of the ambassador M. de Choiseul Gouffier. On his return to Paris he lectured, in his capacity of professor, on the Latin poets, and was attended by a numerous audience, who were delighted, not only with his critical observations, but with his beautiful recitation. Delille continued to advance in fame and fortune, though without hazarding any more publications, till the period of the Revolution, when he was reduced to poverty, and sheltered himself in retreat from the disasters which surrounded him. He quitted Paris, and retired to St Dièz, the native place of Madame Delille; and here he completed, in deep solitude, his translation of the *Æneid*, which he had begun many years before. A residence in France, however, soon became very undesirable, and he emigrated first to Bâle and then to Glairesse in Switzerland, a charming village on the lake of Bienne, opposite Rousseau's island of St Pierre. Much delighted with this enchanting country, and with the reception which he met from its inhabitants, he occupied himself constantly in the composition of poetry, and here finished his *Homme des Champs*, and his poem on the *Trois Règnes de la Nature*. His next place of refuge was in Germany, where he composed his *La Pitié;* and finally, he passed two years in London, chiefly employed in translating *Paradise Lost*. In 1801, finding that he might return safely to Paris, he did so, carrying with him his immense *Poetical Encyclopædia*, and from that time he sent poem after poem into the world, till at last he himself quitted it on the 1st of May 1813, at the age of seventy-five.

Delille appears to have been a person of a very amiable and simple character; his conversation was full of a child-like gaiety, and his writings are always moral and pious; but with all his beauty of versification, and occasional felicity of expression, he yet shows, in his latter works especially, a great ignorance of the line of distinction between prose and poetry.

Delille has left behind him little prose. His preface to the translation of the *Georgics* is an able essay, and contains many excellent hints on the art and the difficulties of translation. He wrote the article *La Bruyère* in the *Biographie Universelle*. The following is the list of his poetical works: *Les Géorgiques de Virgile, traduites en vers Français*, Paris, 1769, 1782, 1785, 1809. *Les Jardins*, en quatre chants, 1780; nouvelle edition, Londres, 1800; Paris, 1802. *L'Hommes des Champs, ou les Géorgiques Françaises*, 1800. *Poésies Fugitives*, 1802. A collection given under the title of *Poésies Diverses*, 1801, was disavowed by Delille. *Dithyrambe sur l'Immortalité de l'Ame, suivi du passage du Saint Gothard;* poème traduit de l'Anglais de Madame la Duchesse de Devonshire, 1802. *La Pitié;* poème en quatre chants. Londres et Paris, 1803. *L'Enéide de Virgile, traduite en vers Français*, 1805. *L'Imagination*, poème en huit chants, 1806. *Les Trois Règnes de la Nature*, 1809. *La Conversation*, 1812.

Deliquescence ‖ Delos.

DELIQUESCENCE (Lat. *deliquesco*, to dissolve), spontaneous liquefaction; a property of certain bodies by which they attract moisture from the air, and thereby become liquid.

DELIQUIUM, in *Chemistry*, is the dissolution or melting of a salt by suspending it in a moist cellar. Salt of tartar, or any fixed alkali, placed in a cool and moist situation, and in an open vessel, resolves or runs into a kind of liquor called by the older chemists oil of tartar *per deliquium*.

DELIRIUM (from *delirare*, to rave), a state in which the ideas excited in the mind do not correspond with external objects, but are produced by the change induced on the sensorium, either by fever or some other cause.

DELLAMCOTTA, a fortress of Northern Hindustan, in the province of Bootan. It is situated on a range of lofty mountains, which rises about a mile and a half above the plains of Bengal, and commands the principal pass into Bootan. It was stormed by the British troops in 1773, which so alarmed the Booteans that they petitioned for peace. The fortress was then restored to them. Distant 27 miles E. from Durjeeling. Lat. 26. 59.; Long. 88. 44.

DELOS, in *Ancient Geography*, an islet in the Ægean Sea, the most famous of the Cyclades, and the central spot round which that group was believed by the ancients to cluster in a nearly circular form. It was known by the ancients under many names, such as Asteria, Chlamydia, Cynthus, Ostygia, Pyrpile, &c. Delos is the smallest of the Cyclades, being only about 5 miles in circumference, and lies at nearly equal distances between Myconos and Rheneia, though somewhat nearer the latter, in N. Lat. 37. 23. and E. Long. 25. 17. Many traditions were current in ancient times regarding the origin of Delos, the most popular of which, recorded with some variations by the different poets of antiquity, describes it as having been called forth from the bottom of the sea by a stroke of Neptune's trident, and as having floated through the Ægean till Jupiter moored it as a place of refuge for the persecuted Latona. Here it was that Apollo and Diana were soon after born; and from this circumstance the island was ever after deemed peculiarly sacred to these deities. The early history of Delos is involved in much obscurity. The best authorities describe the island as originally colonized by Ionian settlers, and as being the seat of a great Pan-Ionic festival, which was celebrated with musical as well as with gymnastic contests. So sacred was the island believed to be, that in the time of Pisistratus all the tombs within sight of the temple were removed as being displeasing to the god; a purification which was repeated even more strictly in the course of the Peloponnesian war by the Athenians, who removed every tomb that was there, and ordained that no one should henceforth either die or be born on the island. Invalids and pregnant women were accordingly always removed from Delos to some of the adjacent islands. The purification was a few years afterwards completed by the final removal of all the inhabitants from the island. A full account of this second

Delphi. purification and all the ceremonies consequent upon it will be found in the third book of Thucydides' History. It was just about this time that the great festival already mentioned began to lose its national character and assume a local one. It still however afforded great facilities for commerce, of which, after the overthrow of Corinth, Delos became the great emporium in the Ægean. The fame and importance of the island, however, had by this time been long on the wane; and in the Mithridatic war it received a shock from which it never afterwards fully recovered. In the time of Pausanias it was little better than a barren uninhabited rock. The town in which the temple of Apollo was situated lay on the western side of the island, at the foot of Mount Cynthus. In the middle ages the greater portion of these magnificent ruins were carried off by the Turks and Venetians to Constantinople and Venice; and nothing now remains but a few broken pillars and architraves to mark the site of one of the most sacred and sumptuous edifices of the ancient world. The only inhabitants of Delos now are a few shepherds who cross over with their flocks during the summer months from the neighbouring islands. (See Leake's *Northern Greece;* Sallier, *Histouré de l'Ile de Delos;* Thucydides, Book III.; and Smith's *Dictionary of Ancient Geography.*

DELPHI, in *Ancient Geography*, a town of Phocis, situated on the south-western extremity of Mount Parnassus. It was famous for the temple and oracle of Apollo, the origin of which is ascribed to an accidental discovery. A number of goats which were feeding on Mount Parnassus happened, it is said, to approach a place in which there was a long and deep perforation. The vapour which issued from the cavity seemed to inspire the goats, and they played and frisked about in such an uncommon manner, that the goatherd was tempted to lean over the aperture, in order to see what mysteries the place contained. But he was immediately seized with a fit of enthusiasm; his expressions were wild and extravagant, and passed for prophecies. This circumstance soon became known throughout the country, and many experienced the same enthusiastic inspiration. The place was revered; a temple was soon afterwards erected in honour of Apollo; and a city was built, which became the most illustrious in Phocis. The influence of this oracle afterwards controlled the councils of states, directed the course of armies, and decided the fate of kingdoms. The ancient history of Greece is full of its energy, and an early register of its authority. The circumjacent cities were the stewards and guardians of the god; and their deputies composed the famous Amphictyonic assembly which once guided all Greece.

The temple of Apollo was at first a kind of cottage covered with boughs of laurel; which, however, was early replaced by a more sumptuous structure. An edifice of stone was erected by Trophonius and Agamedes, and subsisted about seven hundred years, but was burned in the year 636 after the taking of Troy, and 548 before Christ. It is mentioned in the hymn to Apollo ascribed to Homer. The opulent and illustrious family, of the Alcmæonidæ, having fled from Athens and the tyrant Hippias, contracted with the deputies for the building of a new temple, and far exceeded their agreement. The front was raised with Parian marble, instead of the stone called *porus*, which resembled it in whiteness, but was not so heavy; the pediments were adorned with representations of Latona, Diana, and Apollo, and the Muses, with the setting of Phœbus or the sun, Bacchus, and the women called Thyades; and the architraves were decorated with golden armour, with bucklers suspended by the Athenians after the battle of Marathon, and with shields taken from the Gauls under Brennus. In the portico were inscribed the celebrated maxims of the seven sages of Greece. There was also an image of Homer; and in the cell was an altar of Neptune, with statues of the Fates, and of Jupiter and Apollo, who were surnamed Leaders of the Fates. Near the hearth, before the altar at which Neoptolemus, the son of Achilles, was slain by a priest, stood the iron chair of Pindar. In the sanctuary stood an image of Apollo. The inclosure was of great extent, and filled with treasures—many cities having consecrated tenths of the spoil taken in war—and with the public donations of renowned states in various ages. It was the grand repository of ancient Greece, in which, by the labours of the sculptor and statuary, gods, heroes, and illustrious persons, were seen collected and arranged; the inequalities of the area of acclivity contributing to give a full display of the noble assemblage. Delphi.

The oracles were delivered by a priestess called the Pythoness, who received the prophetic influence in the following manner. A lofty tripod, decked with laurel, was placed over the aperture whence the sacred vapour issued. The priestess, after washing her body, and especially her hair, in the cold water of Castalia, mounted on the stool to receive the divine effluvia. She wore a crown of laurel on her head, and shook a sacred tree which grew near the aperture. Sometimes she chewed the leaves; and the frenzy which followed may probably be attributed to this usage, and the gentler or more violent symptoms to the quantity taken. In one instance the paroxysm was so terrible that the priests and suppliants ran away, and left her alone to expire, as was believed, of the god. Her part was an unpleasant one; but if she declined to undertake it, she was dragged by force to the tripod. The habit of her order was that of virgins. The rules enjoined temperance and chastity, and prohibited luxury in apparel. The season of inquiry was in the spring; after which Apollo was supposed to visit the altars of the Hyperboreans.

The city of Delphi arose in the form of an amphitheatre, upon the winding declivity of Parnassus, the picturesque tops of which overshadowed it like a canopy on the north, whilst two immense rocks rendered it inaccessible on the east and west, and the rugged and shapeless Mount Cirphis defended it on the south. The foot of the last-named mountain was washed by the rapid Plistus, which discharged itself into the sea at the distance of only a few leagues from the sacred city. This inaccessible and romantic situation, from which the place derived the name of Delphi (a word signifying *solitary*), was rendered still more striking by the innumerable echoes which multiplied every sound, and increased the ignorant veneration of visitants for the divinity of the oracle. The artful ministers of Apollo also collected such objects in the groves and temple as were fitted to astonish the senses of the admiring multitude. The splendour of marble, the magic of painting, and invaluable statues of gold and silver, had not, to use the language of antiquity, the resemblance of an earthly habitation, but rather expressed the image of Olympus, adorned and enlightened by the actual presence of the gods.

The protection and superintendence of this precious depository of riches and superstition belonged to the Amphictyons. But the inhabitants of Delphi, who, if we may use the expression, were the original proprietors of the oracle, always continued to direct the religious ceremonies, and to conduct the important business of prophecy. It was their province alone to determine at what time, and on what occasion, the Pythia should mount the sacred tripod, in order to receive the prophetic exhalations by which she communicated with Apollo. When overflowing with the heavenly inspiration, she uttered the confused words, or rather frantic sounds, irregularly suggested by the impulse of the god; and these sounds the Delphians collected, reduced them into order, animated them with sense, and adorned them with harmony. The Pythia, being appointed and dismissed at pleasure, was a mere instrument in the hands of those artful ministers, whose character became so venerable and

Delphi || Deluge.

sacred, that they were finally regarded, not merely as attendants and worshippers, but as the peculiar family of the divinity. Their number, though never exactly ascertained, must have been considerable, since all the principal inhabitants of Delphi, claiming an immediate relationship with Apollo, were entitled to officiate in the rites of his sanctuary; and even the inferior ranks belonging to that sacred city were continually employed in dances, festivals, and processions, and in displaying all the gay pageantry of an airy and elegant superstition.

Delphi was conveniently situated for the resort of votaries, being in the centre of Greece, and, as was then imagined, also in that of the universe. It was customary for those who consulted the oracle to make rich presents to the god. His servants and priests feasted upon the numerous victims which were sacrificed to him; and the rich magnificence of his temple had become proverbial even in the age of Homer. In after times, Crœsus, the wealthiest of monarchs, was particularly munificent in his donations. This sacred repository of opulence, therefore, often became the object of plunder. Neoptolemus was slain while sacrificing, on suspicion of a design of this kind. Xerxes divided his army at Panopeus, and proceeded with the main body through Bœotia into Attica, whilst a party, keeping Parnassus on the right, advanced along Schiste to Delphi; but it was seized with a panic when near Ilium, and fled. This monarch, it is related, was as well apprised of the contents of the temple, and the sumptuous offerings of Halyattes and Crœsus, as of the effects which he had left behind him in his own palace. The divine hoard was seized by the Phocensians under Philomelus, and dissipated in a long war with the Amphictyons. The Gauls experienced a reception similar to that of the Persians, and manifested similar dismay and superstition. Sylla, wanting money to pay his army, sent to borrow from the holy treasury; and when his messenger would have frightened him, by reporting a prodigy, namely, that the sound of a harp had been heard from within the sanctuary, the Roman replied, it was a sign that the god was happy to oblige him.

The city of Delphi became free under the Romans. In the time of Pausanias, who has particularly described it, there still remained an invaluable treasure of offerings within the court of the temple. The number, variety, and beauty of these gifts were prodigious; the store appeared inexhaustible; and the robbery of Nero, who removed no less than five hundred brazen images, was rather regretted than perceived. The holy treasuries, though empty, served as memorials of the piety and glory of the cities which had erected them. The Athenian portico preserved the beaks of ships and the brazen shields, trophies won in the Persian wars; and a multitude of curiosities remained untouched in other parts of the temple.

Constantine the Great, however, proved a more fatal enemy to Apollo and to Delphi than either Sylla or Nero. He removed the sacred tripods to adorn the hippodrome of his new city, where these, with the Apollo, the statues of the Heliconian muses, and the celebrated Pan, dedicated by the Greek cities after the conclusion of the war with the Medes, were extant when Sozomen wrote his history. Julian afterwards sent Oribasius to restore the temple; but he was admonished by an oracle to represent to the emperor the deplorable condition of the place. "Tell him the well-built court is fallen to the ground. Phœbus has not a cottage, nor the prophetic laurel, nor the speaking fountain Cassotis; and even the beautiful water is extinct." Delphi has been identified with the modern Kastri.

Delphin || Deluge.

DELPHIN, in *Literary History*, a name given to an edition of the Latin classics prepared and commented on by thirty-nine of the ablest scholars of the time, by command of Louis XIV., for the use of the dauphin (*in usum Delphini*) under the care and direction of his governor M. de Montausier, and his preceptors Bossuet and Huet.

DELPHINIA, in *Antiquity*, feasts which the inhabitants of Ægina celebrated in honour of Apollo, surnamed *Delphinius*, as is pretended, because he assumed the form of a dolphin, in order to conduct Castilius and his colony from the isle of Crete to the *Sinus Crissæus Delphinium*, one of the courts of judicature of the Athenians.

DELPHINUS, the Dolphin, a constellation of the northern hemisphere, the stars of which are ten in Ptolemy's catalogue, in Tycho's the same number, in Hevelius's fourteen, and in Flamsteed's eighteen.

DELPHOS, or CASTRI as it is most frequently named by the inhabitants, a wretched village in the province of Livadia, consisting of about seventy houses, which occupy the site of the ancient city of Delphi. The remains of the gymnasium, stadium, and other buildings, are still extant in its vicinity; but except these, and the stories connected with them, it has now little to recommend it to the notice of travellers beyond the splendid prospect which it commands of the surrounding country.

DELTA, a part of Lower Egypt, included in the space between the branches of the Nile and the Mediterranean Sea. The ancients called it the Isle of Delta, because its triangular form resembled the Greek letter of that name. It extends about a hundred and thirty miles along the coast from Damietta to Alexandria, and seventy on the sides from the place where the Nile begins to divide itself. It is the most fruitful country in all Egypt, but the fertility is chiefly owing to the periodical inundations of the river Nile. The principal towns on the coast are Damietta, Rosetta, and Alexandria. The same name has since been extended to similar alluvial tracts, formed in a similar manner at the mouths of other great rivers.

DELTOID, in the form of the Greek letter Δ; a term applied in anatomy to a muscle of the shoulder which moves the arm forward, upward, and backward; and in botany, to a leaf of a triangular form.

DELUGE.

A DELUGE is an inundation or overflowing of the earth, either wholly or in part, by water.

We have several deluges recorded in history; as that of Ogyges, which overflowed almost all Attica, and that of Deucalion, which drowned Thessaly, in Greece: but the most memorable was that called the *Universal Deluge*, or *Noah's Flood*, which overflowed and destroyed the whole earth, and from which only Noah, and those with him in the ark, escaped. This flood forms one of the most considerable epochs in chronology. Its history is given by Moses, in the book of Genesis; and its date is fixed, by the best chronologers, at the year from the creation 1656, which answers to the year before Christ 2293. From this flood, the state of the world is divided into *diluvian* and *antediluvian*.

Amongst the many testimonies to the truth of this part of the Mosaic history, may be mentioned the general voice of mankind at all times, and in all parts of the world. The objections of the free-thinkers have indeed principally turned upon three points: the want of any direct history of that event by the profane writers of antiquity; the apparent impossibility of accounting for the quantity of wa-

Deluge. ter necessary to overflow the whole earth; and the absence of any apparent necessity for an universal deluge, as the same result might have been accomplished by a partial one.

The first of these objections has given rise to several very elaborate treatises; though all that has yet been done in this way has scarcely been able to silence the objectors. Mr Bryant, in his system of mythology, has with great learning and considerable success endeavoured to show, that the deluge was the principal, if not the only, foundation of the Gentile worship; that the first of their deities was Noah; that all nations of the world looked up to him as their founder; and that he, his sons, and the first patriarchs, are alluded to in most, if not in all of the religious ceremonies, not only of the ancient, but of the modern heathens. In short, according to this author, the deluge, so far from being forgotten or obscurely mentioned by the heathen world, is in reality conspicuous throughout every act of religious worship performed by them.

The Egyptian Osiris, according to him, was the same with Ham the son of Noah, though the name was sometimes bestowed on Noah himself. That this is the case is evident, he thinks, from its being said that he was exposed in the ark, and afterwards restored to day; that he planted the vine, taught mankind agriculture, and inculcated upon them the maxims of religion and of justice. Something of the same kind is related of Perseus. He is represented by some ancient historians as a great astronomer, and as well versed in other sciences. After being conceived in a shower of gold, he was exposed in an ark upon the waters, and is said to have had his life renewed. Further, the history of Myrina the Amazon affords a kind of abridgment and mixture of the histories of Osiris and Perseus; and similar to these is the history of Hercules himself. But our author observes, that under the titles of Osiris, Perseus, Myrina, and the like, the ancients spoke of the exploits of a whole nation, who were no other than the Cuthites or Cushites, the descendants of Cush the son of Ham and father of Nimrod. These people spread themselves into the most remote corners of the globe; and hence the heroes whom they represented are always described as conquering the whole world. According to Diodorus Siculus, the Egyptian Osiris was the same with the Dionysus of the Greeks. He is said to have been twice born, and to have had two fathers and two mothers; to have been wonderfully preserved in an ark; and to have travelled all over the earth, and taught men the use of the vine, building, planting, and the like. The Indians also claim him as a native of their country, though some allow that he came from the west. Of Kronus and Astarte, it is said that they travelled over the whole earth, disposing of the countries as they pleased, and doing good wherever they went. The same thing is related of Ouranus, Themis, Apollo, and others; though all their exploits are said to have been the effects of conquest, and their benevolence was enforced by the sword. In a similar manner does he explain the stories of other heroes of antiquity; and having thus, in the characters and histories of the most celebrated personages, found traces of the history of Noah and his family, he proceeds to inquire into the memorials of the deluge itself which are to be met with in the history or religious rites of the different nations of antiquity.

"We may reasonably suppose," says he, "that the particulars of this extraordinary event would be gratefully commemorated by the patriarch himself, and transmitted to every branch of his family; that they were made the subject of domestic converse, where the history was often renewed, and ever attended with a reverential awe and horror, especially in those who had been witnesses to the calamity, and had experienced the hand of Providence in their favour. In process of time, when there was a falling off from the truth, we might farther expect, that a person of so high a character as Noah, so particularly distinguished by the Deity, could not fail of being reverenced by his posterity, and, when idolatry prevailed, that he would be one of the first among the sons of men to whom divine honours would be paid. Lastly, we might conclude, that these memorials would be interwoven in the mythology of the Gentile world; and that there would be continual allusions to these ancient occurrences in the rites and mysteries as they were practised by the nations of the earth. In conformity to these suppositions, I shall endeavour to show that these things did happen; that the history of the deluge was religiously preserved in the first ages; that every circumstance of it is to be met with among the historians and mythologists of different countries; and traces of it are to be found, particularly in the sacred rites of Egypt and of Greece. Deluge.

"It will appear from many circumstances in the more ancient writers, that the great patriarch was highly reverenced by his posterity. They looked up to him as a person highly favoured by heaven, and honoured him with many titles, each of which had a reference to some particular part of his history. They styled him Prometheus, Deucalion, Atlas, Theuth, Zuth, Xuthus, Inachus, Osiris. When there began to be a tendency towards idolatry, and the adoration of the sun was introduced by the posterity of Ham, the title of *Helius*, among others, was conferred upon him. They called him also Μην and Μαν, which is the moon. When colonies went abroad, many took to themselves the title of *Minyadæ* and *Minyæ* from him; just as others were denominated *Achæmenidæ*, *Auritæ*, *Heliadæ*, from the sun. People of the former name are to be found in Arabia and in other parts of the world. The natives at Orchomenos were styled Minyæ, as were some of the inhabitants of Thessaly. Noah was the original Zeus and Dios. He was the planter of the vine, and inventor of fermented liquors; whence he was denominated *Zeuth*, which signifies ferment, rendered *Zeus* by the Greeks. He was also called *Dionusus*, interpreted by the Latins *Bacchus*, but very improperly. Bacchus was Chus, the grandson of Noah; as Ammon may in general be esteemed Ham, so much reverenced by the Egyptians.

"Among the people of the East the true name of the patriarch was preserved; they called him *Noas*, *Naus*, and sometimes contracted *Nous*; and many places of sanctity, as well as rivers, were denominated from him. Anaxagoras of Clazomene had obtained some knowledge of him in Egypt. By him the patriarch was denominated Noas or Nous; and both he and his disciples were sensible that this was a foreign appellation; notwithstanding which, he has acted as if it had been a term of the Greek language. Eusebius informs us that the disciples of Anaxagoras say 'that Nous is, by interpretation, the deity, Dis or Dios; and they likewise esteem Nous the same as Prometheus, because he was the renewer of mankind, and was said to have fashioned them again,' after they had been in a manner extinct. After this, however, he gives a solution of the story, upon the supposition that Nous is the same with the Greek word νους, *the mind*; that 'the mind was *Prometheia*; and Prometheus was said to renew mankind, from new forming their minds, and leading them, by cultivation, from ignorance.'

"Suidas has preserved, from some ancient author, a curious memorial of this wonderful personage, whom he affects to distinguish from Deucalion, and styles *Nannacus*. According to him, this Nannacus was a person of great antiquity, and prior to the time of Deucalion. He is said to have been a king, who, foreseeing the approaching deluge, collected every body together, and led them to a

Deluge. temple, where he offered up his prayers for them, accompanied with many tears. There is likewise a proverbial expression about Nannacus applied to people of great antiquity.

" Stephanus gives great light to this history, and supplies many deficiencies. ' The tradition is,' says he, ' that there was one formerly named *Annacus*, the extent of whose life was above three hundred years. The people who were of his neighbourhood and acquaintance had inquired of an oracle how long he was to live; and there was an answer given, that when Annacus died, all mankind would be destroyed. The Phrygians, upon this account, made great lamentations, from whence arose the proverb το επι Αννακου κλαυσειν, *the lamentation of Annacus*, made use of for people in circumstances highly calamitous. When the flood of Deucalion came, all mankind were destroyed, according as the oracle had foretold. Afterwards, when the surface of the earth began to be again dry, Zeus ordered Prometheus and Minerva to make images of clay in the form of men; and, when they were finished, he called the winds, and made them breathe into each, and render them vital.' "

From these histories Mr Bryant concludes, that however the story may have been varied, the principal outlines plainly point out the person who is alluded to in these histories. It is manifest, he thinks, that Annacus, and Nannacus, and even Inachus, relate to Noachus or Noah. And not only these, but the histories of Deucalion and Prometheus, have a like reference to the patriarch; in the six hundredth year, and not the three hundredth, of whose life the waters prevailed upon the earth. He was the father of mankind, who were renewed in him. Hence he is represented by another author, under the character of Prometheus, as a great artist, by whom men were formed anew, and were instructed in all that was good.

" Noah was the original Kronus and Zeus, though the latter is a title conferred sometimes upon his son Ham. There is a very particular expression recorded by Clemens of Alexandria, and attributed to Pythagoras, who is said to have called the sea the *Tear of Kronus;* and there was a further tradition concerning this person, that he drank or swallowed up all his children. The tears of Isis are represented as very mysterious. They are said to have flowed whenever the Nile began to rise, and to flood the country. The overflowing of that river was the great source of affluence to the people, and they looked upon it as their chief blessing; yet it was ever attended with mystical tears and lamentations. This was particularly observed at Coptos, where the principal deity was Isis. An ancient writer imagines that the tears and lamentations of the people were to implore an inundation, and the tears of Isis were supposed to make the river swell. But all this was certainly said and done in memorial of a former flood, of which they made the overflowing of the Nile a type.

" As the patriarch was by some represented as a king called *Naachus* or *Nauchus;* so by others he was styled *Inachus*, and supposed to have reigned at Argos. Hence Inachus was made a king of Greece, and Phoroneus and Apis brought in succession after him. But Inachus was not a name of Grecian original; it is mentioned by Eusebius, in his account of the first ages, that there reigned in Egypt Telegonus, a prince of foreign extraction, who was the son of Ones the shepherd, and the seventh in descent from Inachus. And in the same author we read that a colony went forth from that country into Syria, where they founded the ancient city of Antioch; and that they were conducted by Casus and Belus, who were sons of Inachus. By Inachus is certainly meant Noah; and the history relates to some of the more early descendants of the patriarch. His name has been rendered very unlike itself, by having been lengthened with terminations, and Deluge. likewise fashioned according to the idiom of different languages; but the circumstances of the history are so precise and particular that we cannot miss of the truth.

" He seems in the East to have been called *Noas*, *Noasis*, *Nusus*, and *Nus;* and by the Greeks his name was compounded *Dionusus*. The Ammonians, wherever they came, founded cities to his honour; hence places called *Nusa* will often occur, and indeed a great many of them are mentioned by ancient authors. These, though widely distant, being situated in countries far removed, yet retained the same original histories, and were generally famous for the plantation of the vine. Misled by this similarity of traditions, people in after times imagined that Dionusus must necessarily have been where his history occurred; and as it was the turn of the Greeks to place every thing to the account of conquest, they made him a great conqueror, who went over the face of the whole earth, and taught mankind the plantation of the vine. We are informed that Dionusus went with an army over the face of the whole earth, and taught mankind, as he passed along, the method of planting the vine, and how to press out the juice and receive it in proper vessels. Though the patriarch is represented under various titles, and even these not always uniformly appropriated, yet there will continually occur such peculiar circumstances of his history, as will plainly point out the person referred to. The person preserved is always mentioned as preserved in an ark. He is described as being in a state of darkness, which is represented allegorically as a state of death. He then obtained a new life, which is called a second birth; and is said to have his youth renewed. He is, on this account, looked upon as the first-born of mankind; and both his antediluvian and postdiluvian states are commemorated; and sometimes the intermediate state is also spoken of. Diodorus calls him *Deucalion*, but describes the deluge as in a manner universal. ' In the deluge which happened in the time of Deucalion, almost all flesh died.' Apollodorus having mentioned Deucalion εν λαρναχι, *consigned to the ark*, takes notice, upon his quitting it, of his offering up an immediate sacrifice to the God who delivered him. As he was the father of all mankind, the ancients have made him a person of very extensive rule, and supposed him to have been a king. Sometimes he is described as a monarch of the whole earth, at other times he is reduced to a petty king of Thessaly. He is mentioned by Helladias in this latter capacity, who speaks of the deluge in his time, and of his building altars to the gods. Apollonius Rhodius supposes him to have been a native of Greece, according to the common notions; but notwithstanding his prejudices, he gives so particular a character of him, that the true history cannot be mistaken. He makes him indeed the son of Prometheus, the son of Japetus; but in these ancient mythological accounts all genealogy must be entirely disregarded. Though this character be not precisely true, yet we may learn that the person represented was the first of men, through whom religious rites were renewed, cities built, and civil polity established in the world; none of which circumstances are applicable to any king of Greece. We are assured by Philo that Deucalion was Noah; and the Chaldeans likewise mentioned him by the name of Xisuthrus, as we are informed by Cedrenus.

" That Deucalion was unduly adjudged by the people of Thessaly to their country solely, may be proved from his name occurring in different parts of the world, and always accompanied with some history of the deluge. The natives of Syria laid the same claim to him. He was supposed to have founded the temple at Hierapolis, where was a chasm through which the waters after the deluge

Deluge. were said to have retreated. He was likewise reported to have built the temple of Jupiter at Athens, where there was a cavity of the same nature, and a like tradition, that the waters of the flood passed off through this aperture. However groundless the notions may be of the waters having retreated through these passages, yet they show what impressions of this event were retained by the Ammonians, who introduced some history of it wherever they came. As different nations succeeded one another in these parts, and time produced a mixture of generations, they varied the history, and modelled it according to their notions and traditions; yet the groundwork was always true, and the event for a long time universally commemorated. Josephus, who seems to have been a person of extensive knowledge, and versed in the histories of nations, says that this great occurrence was to be met with in the writings of all persons who treated of the first ages. He mentions Berosus of Chaldea, Hieronymus of Egypt, who wrote concerning the antiquities of Phœnicia; also Alnaseas, Abydenus, Melon, and Nicholaus Damascenus, as writers by whom it was recorded; and adds, that it was taken notice of by many others.

"Among the eastern nations, the traces of this event are more vivid and determinate than those of Greece, and more conformable to the accounts of Moses. Eusebius has preserved a most valuable extract to this purpose from Abydenus, which was taken from the archives of the Medes and Babylonians. This writer speaks of Noah, whom he names Seisithrus, as a king, and says that the flood began upon the 15th day of the month Desius; that during the prevalence of the waters, Seisithrus sent out birds, that he might judge if the flood had remained; but that the birds, not finding any resting-place, returned to him again. This was repeated three times; when the birds were found to return with their feet stained with soil, by which he knew the flood was abated. Upon this he quitted the ark, and was never more seen of men, being taken away by the gods from the earth. Abydenus concludes with a particular, in which the eastern writers are unanimous, that the place of descent from the ark was in Armenia, and speaks of its remains being preserved for a long time. Plutarch mentions the Noachic dove, and its being sent out of the ark. But the most particular history of the deluge, and the nearest of any to the account given by Moses, is to be found in Lucian. He was a native of Samosata, a city of Comagene, upon the Euphrates, part of the world where memorials of the deluge were particularly preserved, and where a reference to that history was continually kept up in the rites and worship of the country. His knowledge, therefore, was obtained from the Asiatic nations among whom he was born, and not from his kinsmen the Helladians, who were far inferior in the knowledge of ancient times. He describes Noah under the name of Deucalion, and says, 'that the present race of mankind are different from those who first existed; for those of the antediluvian world were all destroyed. The present world is peopled from the sons of Deucalion, having increased to so great a number from one person. In respect to the former brood, they were men of violence, and lawless in their dealings. They regarded not oaths, nor observed the rights of hospitality, nor showed mercy to those who sued for it. On this account they were doomed to destruction; and for this purpose there was a mighty eruption of waters from the earth, attended with heavy showers from above, so that the rivers swelled and the sea overflowed, till the whole earth was covered with a flood, and all flesh drowned. Deucalion alone was preserved to re-people the world. This mercy was shown to him on account of his piety and justice. His preservation was effected in this manner. He put all his family, both his sons and their wives, into a vast ark which he had provided, and he went into it himself. At the same time animals of every species, boars, horses, lions, serpents, whatever lived upon the face of the earth, followed him by pairs; all which he received into the ark, and experienced no evil from them; for there prevailed a wonderful harmony throughout, by the immediate influence of the Deity. Thus were they wafted with him as long as the flood endured.' After this he proceeds to mention, that upon the disappearing of the waters, Deucalion went forth from the ark and raised an altar to God; but he transposes the scene to Hierapolis in Syria, where the natives pretended, as has been already mentioned, to have very particular memorials of the deluge. Deluge.

"Most of the authors who have transmitted to us these accounts at the same time inform us that the remains of the ark were to be seen in their days on one of the mountains of Armenia. Abydenus particularly says, in confirmation of this opinion, that the people of the country used to get small pieces of the wood, which they carried about by way of amulet. And Berosus mentions that they scraped off the asphaltus with which it was covered, and used it as a charm. Some of the fathers seem to insist on the certainty of the ark being still remaining in their time. Theophilus says expressly that the remains were to be seen upon the mountains of Ararat or Armenia. And Chrysostom appeals to it as to a thing well known. 'Do not,' says he, 'those mountains of Armenia bear witness to the truth? those mountains where the ark first rested? And are not the remains of it preserved there even unto this day?'

"There was a custom among the priests of Ammon of carrying a boat in procession at particular seasons, in which was an oracular shrine held in great veneration. They were said to have been eighty in number, and to have carried the sacred vessel about just as they were directed by the impulse of the deity. This custom was likewise in use among the Egyptians; and Bishop Pocock has preserved three specimens of ancient sculpture, wherein this ceremony is displayed. They are of wonderful antiquity, and were found by him in Upper Egypt.

"Part of the ceremony in most of the ancient mysteries consisted in carrying about a ship or boat, which custom, upon due examination, will be found to relate to nothing else but Noah and the deluge. The ship of Isis is well known, and the festivity among the Egyptians whenever it was carried in public. The name of this, and of all the navicular shrines, was Baris, which is remarkable; for it was the very name of the mountain, according to Nicolaus Damascenus, on which the ark of Noah rested, the same as Ararat in Armenia. He mentions that there is a large mountain in Armenia, which stands above the country of the Minyæ, called Baris; to this it was said that many people betook themselves in the time of the deluge, and were saved; and there is a tradition of one person in particular floating, in an ark, and arriving at the summit of the mountain. We may be assured, then, that the ship of Isis was a sacred emblem, in honour of which there was among the Egyptians an annual festival. It was in after times admitted among the Romans, and set down in their calendar for the month of March. The former, in their description of the primary deities, have continually some reference to a ship or float. Hence we frequently read of θεοι ναυπλλωντες, *sailing gods*. They oftentimes, says Porphyry, describe the sun in the character of a man sailing upon a float. And Plutarch observes to the same purpose, that they did not represent the sun and moon in chariots, *but wafted about upon floating machines*. In doing which, they did not refer to the luminaries, but to a person represented under those titles. The sun, or Orus, is likewise

Deluge. described by Jamblichus as sitting upon the lotus, and sailing in a vessel.

"It is said of Sesostris that he constructed a ship which was two hundred and eighty cubits in length. It was of cedar, plated without with gold, and inlaid with silver; and it was, when finished, dedicated to Osiris at Thebes. It is not credible that there should have been a ship of this size, especially in an inland district, the most remote of any in Egypt. It was certainly a temple and a shrine. The former was framed upon this large scale; and it was the latter on which the gold and silver were so lavishly expended. There is a remarkable circumstance relating to the Argonautic expedition, that the dragon slain by Jason was of the size of a trireme; by which must be meant that it was of the shape of a ship in general, for there were no triremes at the time alluded to. And I have moreover shown, that all these dragons, as they have been represented by the poets, were in reality temples, *Draconta*, where, among other rites, the worship of the serpent was instituted. There is another reason to think that this temple, as well as that of Sesostris, was fashioned, in respect to its superficial contents, after the model of a ship; and as to the latter, it was probably intended in its outlines to be the exact representation of the ark, in commemoration of which it was certainly built. It was a temple sacred to Osiris at Theba, or, to say the truth, it was itself called Theba; and both the city, said to be one of the most ancient in Egypt, as well as the province, were undoubtedly denominated from it. Now Theba was the name of the ark. It is the very word made use of by the sacred writer; so that we may, I think, be assured of the prototype after which this temple was fashioned. It is said indeed to have been only two hundred and eighty cubits in length, whereas the ark of Noah was three hundred; but this is a variation of only one fifteenth in the whole; and as the ancient cubit was not in all countries the same, we may suppose that this disparity arose rather from the manner of measuring, than from any real difference in the extent of the building. It was an idolatrous temple, said to have been built by Sesostris in honour of Osiris. I have been repeatedly obliged to take notice of the ignorance of the Greeks in respect to ancient titles, and have shown their misapplication of terms in many instances, especially in their supposing temples to have been erected by persons to whom they were in reality sacred. Sesostris was Osiris; the same as Dionusus, Menes, and Noah. He is called Seisithrus by Abydenus, Xixouthros by Borosus and Apollodorus, and is represented by them as a prince in whose time the deluge happened. He was called Zuth, Xuth, and Zeus, and had certainly divine honours paid to him.

"Pausanias gives a remarkable account of a temple of Hercules, at Eruthra in Ionia, which he mentions as of the highest antiquity, and very like those of Egypt. The deity was represented upon a float, and was supposed to have come thither in this manner from Phœnicia. Aristides mentions that at Smyrna, upon the feast called Dionysia, a ship used to be carried in procession. The same custom prevailed among the Athenians at the Panathenæa, when what was termed the sacred ship was borne with great reverence through the city to the temple of Dameter at Eleusis. At Phalerus, near Athens, there were honours paid to an unknown hero, who was represented in the stern of a ship At Olympia, the most sacred place in Greece, was a representation of the like nature. It was a building like the forepart of a ship, which stood facing the end of the hippodromus; and towards the middle of it was an altar, upon which, at the renewal of each Olympiad, certain rites were performed.

"I think it is pretty plain that all these emblematical representations, of which I have given so many instances, related to the history of the deluge, and the conservation of one family in the ark. This history was pretty recent when these works were executed in Egypt, and when the rites were first established; and there is reason to think, that in early times most shrines of the Mizraim were formed under the resemblance of a ship, in memory of this great event. Nay, further, both ships and temples received their names from thence, being styled by the Greeks, who borrowed largely from Egypt, Ναυς, and Ναος, and mariners Ναυτα, *Nautæ*, in reference to the patriarch, who was variously styled Noas, Nous, and Noah. Deluge.

"However the Greeks may in their mysteries have sometimes introduced a ship as a symbol, yet in their reference to the deluge itself, and to the persons preserved, they always speak of an ark. And though they were apt to mention the same person under various titles, and by these means different people seem to be made principals in the same history; yet they were so far uniform in their account of this particular event, that they made each of them to be exposed in an ark. Thus it is said of Deucalion, Perseus, and Dionusus, that they were exposed upon the waters in a machine of this fabric. Adonis was hid in an ark by Venus, and was supposed to have been in a state of death for a year. Theocritus introduces a pastoral personage named Comates, who was exposed in an ark for the same term, and wonderfully preserved. Of Osiris being exposed in an ark we have a very remarkable account in Plutarch, who mentions that it was on account of Typhon, and that it happened on the 17th of the month Athyr, when the sun was in Scorpio. This, in my judgment, was the precise time when Noah entered the ark, and when the flood came, which, in the Egyptian mythology, was called Typhon.

"Typhon is one of those whose character has been greatly confounded. This has arisen from two different personages being included under one name, who undoubtedly were distinguished in the language of Egypt. Typhon was a compound of *Tuph* or *Tupha-On*, and signified a high altar of the deity. There were several such in Egypt, upon which they offered human sacrifices; and the cities which had these altars were styled Typhonian. But there was another Typhon, who was very different from the former, however by mistake blended with that character. By this was signified a mighty whirlwind and inundation, and it oftentimes denoted the ocean, and particularly the ocean in a ferment; for, as Plutarch observes, by Typhon was understood any thing violent and unruly. It was a derivative from *Tuph*, like the former name; which Tuph seems here to have been the same as the Suph of the Hebrews. By this they denoted a whirlwind; but among the Egyptians it was taken in a greater latitude, and signified any thing boisterous, particularly the sea. Plutarch speaks of it as denoting the sea, and says likewise that the salt of the sea was called the foam of Typhon. It signified also a whirlwind, as we learn from Euripides, who expresses it Tuphos; and the like is to be found in Hesychius, who calls it a violent wind.

"The history of Typhon was taken from hieroglyphical descriptions. In these the dove, *oinas*, was represented as hovering over the *mundane* egg, which was exposed to the fury of Typhon; for an egg, containing in it the elements of life, was thought no improper emblem of the ark, in which were preserved the rudiments of the future world. Hence, in the Dionusiaca, and in other mysteries, one part of the nocturnal ceremony consisted in the consecration of an egg. By this, we are informed by Porphyry, was signified the world. This world was Noah and his family, even all mankind, inclosed and preserved in the ark.

"In respect to Typhon, it must be confessed that the

Deluge. history given of him is attended with some obscurity. The Grecians have comprehended several characters under one term, which the Egyptians undoubtedly distinguished. The term was used for a title as well as a name, and several of those personages which had a relation to the deluge were styled Typhonian or Diluvian. All these the Grecians have included under one and the same name, Typhon. The real deity by whom the deluge was brought upon the earth had the appellation of Typhonian, by which was meant *Diluvii Deus*. It is well known that the ark was constructed by a divine commission, in which, when it was completed, God inclosed the patriarch and his family. Hence it is said that Typhon made an ark of curious workmanship, that he might dispose of the body of Osiris. Into this Osiris entered, and was shut up by Typhon. All this relates to the Typhonian deity who inclosed Noah, together with his family, within the limits of an ark. The patriarch also, who was thus interested in the event, had the title of Typhonian. I have shown that the ark by the mythologists was spoken of as the mother of mankind. The stay in the ark was looked upon as a state of death and of regeneration. The passage to life was through the door of the ark, which was formed in its side. Through this the patriarch made his descent, and at this point was the commencement of time. This history is obscurely alluded to in the account of Typhon, of whom it is said, that without any regard to time or place, he forced a passage and burst into light obliquely through the side of his mother. This return to light was described as a revival from the grave; and Plutarch accordingly mentions the return of Osiris from Hades, after he had been for a long season inclosed in an ark and in a state of death. This renewal of life was by the Egyptians esteemed a second state of childhood. They accordingly, in their hieroglyphics, described him as a boy, whom they placed upon the lotus or water-lily, and called him Orus. He was the supposed son of Isis; but it has been shown that Isis, Rhea, Atargatis, were all emblems of the ark, that receptacle which was styled the mother of mankind. Orus is represented as undergoing from the Titans all that Osiris suffered from Typhon, and the history at bottom is the same. Hence it is said of Isis, that she had the power of making people immortal, and that when she found her son Orus, in the midst of the waters, dead through the malice of the Titans, she not only gave him a renewal of life, but also conferred upon him immortality."

In this manner does Bryant interpret almost all the ancient fables, of which no satisfactory solution was ever before given. He shows that the primitive gods of Egypt, who were eight in number, were no other than the eight persons saved in the ark; and that almost all the heathen deities had one way or other a reference to Noah. He proves that Noah was characterized under the titles of Janus, Nereus, Proteus, Oannes, Dagon; and, in short, that the deluge, so far from being unknown to the heathens, or forgotten by them, was in a manner the basis of their whole worship. He traces the history of the raven and dove sent forth by Noah in the customs of various nations, not only in the East, but the West also. And, not content with these testimonies, he shows that the same mythology as that of the Egyptians, and the same hieroglyphics, were carried as far as China and Japan. The Indians have a person whom they call Buto or Budo, or Buddha. This is the same as Boutas of Egypt, Battus of Cyrene, and Bœotus of Greece: and the account given of him is similar to that of Typhon; for it is said that he did not come to life in the usual way, but made himself a passage through the side of his mother, who is represented as a virgin. This history, though now current among the Indians, is of great antiquity, as we learn from the account given by Clemens Alexandrinus. "There Deluge. is a caste of Indians," says he, "who are disciples of Boutas. This person, on account of his extraordinary sanctity, they look up to as a god." The name of Boutas, Battus, and Bœotus, though apparently conferred upon the patriarch, yet related originally to the machine in which he was preserved. Of this some traces may be found among the Greeks. One of the Ammonian names for the ark was Aren or Arene, and Bœotus is said by Diodorus Siculus to have been the son of Neptune and Arne, which is a contraction of *arene*, the ark. The chief city, Boutus, in Egypt, where was the floating temple, signified properly the city of the float or ark. The Bœotians, who in the Dionusiaca so particularly commemorated the ark, were supposed to be descended from an imaginary personage, Bœotus; and from him likewise their country was thought to have received its name. But Bœotus was merely a variation from Boutus, and Butus, the ark; which in ancient times was indifferently styled Theba, Argus, Aren, Butus, and Bœotus. The term Cibotus is a compound of the same import, and signifies both the temple of the ark and also a place for shipping.

"All the mysteries of the Gentile world seem to have been memorials of the deluge, and of the event which immediately succeeded. They consisted for the most part of a melancholy process, and were celebrated by night, in commemoration of the state of darkness in which the patriarch and his family had been involved. The first thing at those awful meetings was to offer an oath of secrecy to all who were to be initiated, after which they proceeded to the ceremonies: these began with a description of chaos, by which was signified some memorial of the deluge. Chaos was certainly the same as *Βυθος, the great abyss*. Who, says Epiphanius, is so ignorant as not to know that Chaos, and Buthos, the abyss, are of the same purport?

"The names of the deities in Japan and China, and the form of them, as well as the mythology with which they are attended, point out the country from whence they originally came. In China the deity upon the lotus in the midst of waters has been long a favourite emblem, and was imported from the West; the insigne of the dragon was from the same quarter. The Cuthites worshipped Cham, the sun, whose name they variously compounded. In China most things which have any reference to splendour and magnificence seem to be denominated from the same object. Cham is said, in the language of that country, to signify any thing supreme. Cum is a fine building or palace, similar to Coma of the Ammonians. Cum is a lord or master, Cham a sceptre. Lastly, by Cham is signified a priest, analogous to the Chamanim and Chamenim of Cutha and Babylonia. The country itself is by the Tartars called Ham. The cities Cham-ju, Campion, Compition, Cumdan, Chamul, and many others of the same form, are manifestly compounded of the sacred term Cham. Cambalu, the name of the ancient metropolis, is the city of Cham-bal; and Milton styles it very properly 'Cambalu, seat of Cathaian Chan.' By this is meant the chief city of the Cuthean monarch; for Chan is a derivative of Cahen, a prince. It seems sometimes in China and Japan to have been expressed Quan and Quano.

"Two temples are taken notice of by Hamilton, near Syrian, in Pegu, which he represents as so like in structure that they seemed to be built on the same model. One of these was *Kiakiack*, or the *God of Gods' temple*. The other is called *the temple of Dagun;* and the doors and windows of it are perpetually shut, so that none can enter but the priests. They will not tell of what shape the idol is, but only say that it is not of human form. The former deity, Kiakiack, is represented as asleep, of a human shape, and sixty feet long, and when he awakes the

Deluge. world is to be destroyed. As soon as Kiakiack has dissolved the frame and being of this world, Dagun will gather up the fragments and make a new one. I make no doubt but the true name of the temple was *Iach Iach*, and dedicated to the same god as the Jachusi in Japan. Mr Wise takes notice of the Grecian exclamation to Dionusus, when the terms *Iacche, O Iacche*, were repeated; and he supposes, with great probability, that the Peguan name had a reference to the same deity. It is certain that the worship of Dionusus prevailed very early among the nations in the East. The Indians used to maintain that his rites first began among them. Professor Bayer has shown that traces of his worship are still to be observed among the Tamuli of Tranquebar. 'They have a tradition,' says he, 'that there was once a gigantic person named Maidashuren, who was born of Nisadabura, near the mountain Meru. He had the horns of a bull, and drank wine, and made war upon the gods. He was attended by eight *Pudam*, who were gigantic and mischievous dæmons, of the family of those Indian shepherds called *Kobaler*.' In this account we have a manifest reference to the history of Dionusus, as well as that of the Dionusians, by whom his rites were introduced. And we may perceive that it bears a great resemblance to the accounts transmitted by the Grecians. What are these Kobaler, who were descended from the shepherds, but the same as the Cobali of Greece, the uniform attendants upon Dionusus? a set of priests whose cruelty and chicanery rendered them infamous. 'The Cobali,' says an ancient author, 'were a set of cruel dæmons, who followed in the retinue of Dionusus. It is a term made use of for knaves and cheats.'

"As the deity, in the second temple of Syrian, to which strangers were not admitted, was not of a human form, and was called *Dagun*, we may easily conceive the hidden character under which he was described. We may conclude that it was no other than that mixed figure of a man and a fish, under which he was of old worshipped both in Palestine and Syria. He is expressed under this symbolical representation in many parts of India, and by the Brahmins is called *Wistnu* or *Vishnu*. Dagon and Vishnu have a like reference; they equally represent the man of the sea, called by Berosus *Oannes*, whose history has been reversed by the Indians. They suppose that he will restore the world when it shall be destroyed by the chief God. But by Dagon is signified the very person through whom the earth has been already restored when it was in a state of ruin, and by whom mankind was renewed. Dagon and Noah I have shown to be the same. Vishnu is represented, like Dagon, under the mixed figure of a man and a fish, or rather of a man, a princely figure, proceeding from a fish. The name of this district, near which the temples above stand, we find to be called *Syrian*, just as was named the region where stood the temples of Atargatis and Dagon. Syrus, Syria, and Syrian are all of the same purport, and signify Cœlestis and Solaris, from *Sehor*, the sun."

He next proceeds to describe some of the Indian temples or pagodas, particularly those of Salsette, Elephanta, and another called Elora, near Aurungabad, in the province of Balagate.

"Many of these ancient structures," continues Mr Bryant, "have been attributed to Ramscander, or Alexander the Great; but there is nothing among these stately edifices that in the least savours of Grecian workmanship, nor had that monarch, nor any of the princes after him, opportunity to perform works of this nature. We have not the least reason to think that they ever possessed the country, for they were called off from their attention this way by feuds and engagements nearer home. There is no tradition of this country having been ever conquered except by the fabulous armies of Hercules and Dionusus. What has led people to think that those works were the operation of Alexander, is the similitude of the name *Ramtxander*. To this person they have sometimes been attributed; but Ramtxander was a deity, the supposed son of Bal, and he is introduced among the personages who were concerned in the incarnations of Vishnu. Deluge.

"The temple of Elora, and all the pagodas of which I have made mention, must be of great antiquity, as the natives cannot reach their era. They were undoubtedly the work of the Indo-Cuthites, who came so early into these parts. And that these structures were formed by them, will appear from many circumstances; but especially from works of the same magnificence which were performed by them in other places. For scarce any people could have effected such great works, but a branch of that family which erected the tower in Babylonia, the walls of Baalbec, and the pyramids of Egypt."

Having then described a number of Indian idols of surprising magnitude, "the Babylonians and Egyptians," says he, "and all of the same great family, used to take a pleasure in forming gigantic figures, and exhibiting other representations equally stupendous. Such were the colossal statues at Thebes, and the sphinx in the plains of Coume. The statue erected by Nebuchadnezzar in the plains of Dura was in height threescore Babylonish cubits. It was probably raised in honour of Cham, the sun; and perhaps it was also dedicated to the head of the Chaldaic family, who was deified and reverenced under that title. Marcellinus takes notice of a statue of Apollo named Comeus, which, in the time of the Emperor Verus, was brought from Seleucia to Rome. This related to the same deity as the preceding. We may also infer that the temple at Kamju was erected to Cham, the sun, whom the people worshipped under the title of *Samonifu*."

It is remarkable that in Japan the priests and nobility have the title of Cami. The Emperor Quebacondono, in a letter to the Portuguese viceroy in 1585, tells him that Japan is the kingdom of Chamis; whom, says he, we hold to be the same as Scin, the origin of all things. By Scin is probably meant *San*, the sun, who was the same as Cham, rendered here Chamis. The laws of the country are spoken of as the laws of Chamis; and we are told by Kæmpfer that all the gods were styled either Sin or Cami. The founder of the empire is said to have been Tensio Dai Sin, or Tensio the god of light. Near his temple was a cavern religiously visited, upon account of his having been once hid, when no sun nor stars appeared. He was esteemed the fountain of day, and his temple was called the Temple of Naiku. Near this cavern was another temple, in which the canusi or priests showed an image of the deity sitting upon a cow. It was called Dainits No Ray, the great representation of the sun. One of their principal gods is Jakusi, similar to the Iacchus of the West. Kæmpfer says that he is the Apollo of the Japanese, and they describe him as the Egyptians did Horus. His temple stands in a town called Minnoki; and Jakusi is here represented upon a gilt tarate flower, which is said to be the *nymphæa palustris maxima*, or *faba Egyptiaca* of Prosper Alpinus. One half of a large scallop shell is like a canopy placed over him; and his head is surrounded with a crown of rays. They have also an idol named Menippe, much reverenced in different parts. Both these, continues Bryant, relate to the same person, namely, Noah. Kæmpfer, an author of great credit, saw the temple of Dabys, which he truly renders Daibod, at Jedo, in Japan. By Daibod was meant the god Buddha, whose religion was styled the Budso, and prevailed greatly upon the Indus and Ganges. Kæmpfer, from whom Mr Bryant takes this account, says that the people of Siam represent him

Deluge. under the form of a Moor, in a sitting posture, and of a prodigious size. His skin is black, his hair curled, and the images about him are of the same complexion. "This god," says Mr Bryant, "was supposed to have neither father nor mother. By Budha we are certainly to understand the idolatrous symbol called by some nations Buddo; the same as Argus and Theba, names for the ark. In the mythology concerning it we may see a reference both to the machine itself and to the persons preserved in it; in consequence of which we find this person also styled Bod, Budha, and Buddo; and in the west Butus, Battus, and Bœotus. He was said by the Indians not to have been born in the ordinary way, but to have come to light indirectly through the side of his mother. By Clemens of Alexandria he is called *Bouta;* and in the history of this person, however varied, we may perceive a relation to the arkite deity of the sea, called Poseidon or Neptune; also to Arculus and Dionusus, styled Bœotus and Thebanus. Kæmpfer has a curious history of a deity of this sort called Abutto, whose temple stood in the province of Bungo, upon the sea-shore, near the village of Toma. About a quarter of a German mile before you come to this village, stands a famous temple of the god Abutto, which is said to be very eminent for miraculously curing many inveterate distempers, as also for procuring a favourable wind and a good passage. For this reason sailors and passengers always tie some farthings to a piece of wood, and throw it into the sea, as an offering to Abutto, to obtain a propitious wind. The same deity, but under a different name, was worshipped in China. The Apis, Mnevis, and Anubis of Egypt, have often been mentioned and explained, as well as the Minotaur of Crete. The same hieroglyphics occur in Japan: and we are informed by Marco Polo that the inhabitants worship idols of different shapes. Some have the head of an ox, some of a swine, and others the head of a dog. The most common representation in this country is that of *Godso Ten Oo*, or 'the ox-headed prince of heaven.'

"It has already been noticed, that the ark was represented under the symbol of an egg, called the *mundane egg*, which was exposed to the rage of Typhon. It was also described under the figure of a lunette, and called Selene, or the moon. The person by whom it was framed, and who through its means was providentially preserved, occurs under the character of a steer, and the machine itself under the semblance of a cow or heifer. We have moreover been told that it was called Cibotus, which Clemens of Alexandria calls Thebotha. Epiphanius mentions it by the name of *Idaal Baoth;* and says that, according to an eastern tradition, a person named Nun was preserved in it. The horse of Neptune was another emblem, as was also the hippopotamus or river-horse. The people of Elis made use of the tortoise for the same purpose, and represented Venus as resting upon its back. Some traces of these hieroglyphics are to be found in Japan, which were certainly carried thither by the Indic Ethiopians.

"From an account of a temple of Daiboth, probably the same with Daibod, at Meaco, in Japan, we may perceive that the people there speak of the renewal of the world at the deluge as the real creation, which I have shown to be a common mistake in the histories of the event. And though the story is told with some variation, yet in all the circumstances of consequence it accords very happily with the mythology of Egypt, Syria, and Greece. It matters not how the emblems have by length of time been misinterpreted. We have the mundane egg upon the waters, and the concomitant symbol of the moon; and the egg at last opened by the assistance of the sacred steer, upon which the world issues forth to this day." The author proceeds afterwards to mention the great veneration paid in these parts to the ox and cow, and says that nobody dares injure them. One deity of the Japanese was Canon, the reputed lord of the ocean. He was represented in an erect posture, crowned with a flower, and coming out of the mouth of a fish. He is represented in the same manner by the natives of India, and named *Vishnu* and *Macauter;* and he is to be found in other parts of the East. Father Boushet mentions a tradition among the Indians concerning a flood in the days of Vishnu, which covered the whole earth. It is moreover reported of him, that seeing the prevalence of the waters, he made a float, and being turned into a fish, he steered it with his tail. This person, in the account of the Banians by Lord, is called Menow; which certainly should be expressed Men-Now. It is said, that in the Shaster of this people, a like history is given of the earth being overwhelmed by a deluge, in which mankind perished; but the world was afterwards renewed by two persons called Menou and Ceteroupa. Vishnu is described under many characters, which he is said at times to have assumed. One of these, according to the Brahmins of Tanjour, was that of Rama Sami. This undoubtedly is the same as Sama Rama of Babylonia, only reversed; and it relates to that great phenomenon the Iris, which was generally accompanied with the dove, and held in veneration by the Semarim. Deluge.

"As the history of China is supposed to extend upwards to an amazing height, it may be worth while to consider the first eras in the Chinese annals, as they are represented in the writings of Japan (for the Japanese have preserved histories of China); and by such a collation, I believe no small light may be obtained towards the discovery of some important truths. Hitherto it has not been observed that such a collation could be made.

"In the histories of this country, the first monarch of China is named Foki, the same whom the Chinese call Fohi, and place at the head of their list. This prince had, according to some the body, according to others the head, of a serpent. If we may believe the Japanese historians, he began his reign above 21,000 years before Christ. The second Chinese emperor was Sin-Noo, by the people of China called Sin-Num; and many begin the chronology of the country with him. He is supposed to have lived about 3000 years before Christ, consequently there is an interval of near 18,000 years between the first emperor and the second, a circumstance not to be credited. The third, who immediately succeeded Sin-Noo, was Hoam-Ti. In this account we may, I think, perceive, that the Chinese have acted like the people of Greece and other regions. The histories which were imported they have prefixed to the annals of the nation; and adopted the first personages of antiquity, and made them monarchs in their own country. Whom can we suppose Fohi, with the head of a serpent, to have been, but the great founder of all kingdoms, the father of mankind? They have placed him at an immense distance, not knowing his true era. And I think we may be assured, that under the character of Sin-Num and Sin-Noo we have the history of Noah; and Hoam-Ti was no other than Ham. According to Kæmpfer, Sin-Noo was exactly the same character as Serapis of Egypt. 'He was a husbandman, and taught mankind agriculture, and those arts which relate to the immediate support of life. He also discovered the virtues of many plants; and he was represented with the head of an ox, and sometimes only with two horns. His picture is held in high estimation by the Chinese.' Well indeed might Kæmpfer think that in Sin-Noo he saw the character of Serapis, for this personage was no other than Sar-Apis, the great father of mankind, the same as Men-Neuas of Egypt, the same also as Dionusus and Osiris. By Du Halde he is called Chin-Nong, and made the first mo-

Deluge. narch after Fohi. The Chinese accounts afford the same history as has been given above.

"As the family of Noah consisted of eight persons inclusive, there have been writers who have placed some of them in succession, and supposed that there were three or four persons who reigned between Sin-Noo and Hoam. But Du Halde says, that in the true histories of the country, the three first monarchs were Fohi, Chin-Nong, and Hoam, whom he styles Hoang-Ti. To these, he says, the arts and sciences owe their invention and progress. Thus we find that those who were heads of families have been raised to be princes, and their names have been prefixed to the list of kings, and their history superadded to the annals of the country. It is further observable, in the accounts given of those supposed kings, that their term of life, for the first five or six generations, corresponds with that of the patriarchs after the flood, and decreases much in the same proportion.

"The history of Japan is divided into three eras, which consist of gods, demigods, and mortals. The person whom the natives look upon to be the real founder of their monarchy is named Synmu, in whose reign the Sintoo religion, the most ancient of the country, was introduced. It was called Sin-sju and Chami-mitsa, from Sin and Chami, the deities which were the objects of worship. At this time it is said that 600 foreign idols were brought into Japan. To the Sintoo religion was afterwards added the Budso, together with the worship of Amida. This deity they commonly represented with the head of a dog, and esteemed him the guardian of mankind. This religion was more complicated than the former, and abounded with hieroglyphical representations and mysterious rites. It is the same which I have termed the *Arkite Idolatry*, wherein the sacred steer and cow were venerated. The deity was represented upon the lotus and upon a tortoise, and oftentimes as proceeding from a fish. In this also, under the character of Buddha, we may trace innumerable memorials of the ark, and of the person preserved in it. The author above, having mentioned the eleventh emperor inclusive from Syn-Mu, tells us that in his time these rites began. 'In his reign Budo, otherwise called Kobotus, came over from the Indies to Japan, and brought with him, upon a white horse, his religion and doctrines.' We find here, that the object of worship is made the person who introduced it (a mistake almost universally prevalent), otherwise in this short account what a curious history is unfolded.

"The only people to whom we can have recourse for any written memorials concerning these things are the inhabitants of India Proper. They were, we find, the persons who introduced these hieroglyphics both in China and Japan. It will therefore be worth while to consider what they have transmitted concerning their religious opinions, as we may from hence obtain still greater light towards explaining this symbolical worship. Every manifestation of God's goodness to the world was in the first ages expressed by an hieroglyphic; and the Deity was accordingly described under various forms, and in different attitudes. These at length were mistaken for real transfigurations; and Vishnu was supposed to have appeared in different shapes, which were styled Incarnations. In one of these he is represented under the figure before mentioned, of a princely person coming out of a fish. In another he appears with the head of a boar, treading upon an evil dæmon, which seems to be the same as the Typhon of the Egyptians. On his head he supports a lunette, in which are seen cities, towers, in short, all that the world contains. In Baldæus we have a delineation and history of this incarnation. Kircher varies a little in his representation, yet gives him a similar figure of the Deity, and styles him *Vishnu Barachater*. By this I should think was signified Vishnu, "the offspring of the fish." The Brahmins say that there was a time when the serpent with a thousand heads withdrew itself, and would not support the world, it was so overburdened with sin. Upon this the earth sunk in the great abyss of waters, and mankind and all that breathed perished. But Vishnu took upon himself the form above described, and diving to the bottom of the sea, lifted up the earth out of the waters, and placed it, together with the serpent of a thousand heads, upon the back of a tortoise. Deluge.

"In the third volume of M. Perron's Zendavesta, there is an account given of the cosmogony of the Parsees; also of the subsequent great events that ensued. The supreme Deity, called by him Ormisda, is said to have accomplished the creation at six different intervals. He first formed the heavens, at the second the waters, at the third the earth. Next in order were produced the trees and vegetables; in the fifth place were formed birds and fishes, and the wild inhabitants of the woods; and in the sixth and last place he created man. The man thus produced is said to be an ox-like person, and is described as consisting of a purely divine and a mortal part. For some time after his creation he lived in great happiness; but at last the world was corrupted by a dæmon named Ahriman. This dæmon had the boldness to visit heaven, whence he came down to the earth in the form of a serpent, and introduced a set of wicked beings called karsesteis. By him the first ox-like personage, called Aboudad, was so infected that he died; after which Kaimorts, probably the divine part, of which the ox was the representative, died also. Out of the left arm of the deceased proceeded a being called Goschoraun, who is said to have raised a cry louder than the shout of 1000 men. After some conversation between the supreme Deity and Goschoraun, it was determined to put Ahriman to flight, and to destroy all those wicked persons he had introduced; for there now seemed to be an universal opposition to the supreme Deity Ormisda. At this season a second ox-like personage is introduced by the name of Taschter. He is spoken of both as a star and a sun. At the same time he is mentioned as a person upon earth under three forms. By Taschter is certainly signified De Ashter, the same person whom the Greeks and Syrians represented as a female, and called Astarte. She was described horned, and sometimes with the head of a bull; supposed to proceed from an egg; and they esteemed her the same as Juno and the moon. At last it was thought proper to bring an universal inundation over the face of the earth, that all impurity might be washed away; which being accomplished by Taschter, every living creature perished, and the earth was for some time entirely covered. At last, the waters retreating within their proper bounds, the mountains of Albordi in Ferakh-kand first appeared; which the author compares to a tree, and supposes that all other mountains proceeded from it. After this there was a renewal of the world, and the earth was restored to its pristine state. The particular place where Ormisda planted the germina from whence all things were to spring was Ferakh-kand, which seems to be the land of Arach, the country upon the Araxes, in Armenia."

Thus we have given ample specimens of this author's method of reasoning, and of discovering traces of the sacred history even in things which have been thought to have the least possible relation to it. That the Greeks and western nations had some knowledge of the flood, has never been disputed; and from what has been already related, it appears that the same has pervaded the remotest regions of the east. The knowledge which these people have of the fall of man, and the bitter consequences which ensued, can-

Deluge not, according to Bryant, have arisen from their intercourse with Christians; for their traditions afford no traces of any kind, either of Christianity or its founder. Whatever truths may be found in their writings, therefore, must be derived from a more ancient source. "There are," says he, "in every climate some shattered fragments of original history, some traces of a primitive and universal language; and these may be observed in the names of deities, terms of worship, and titles of honour, which prevail among nations widely separated, who for ages had no connection. The like may be found in the names of pagodas and temples, and of sundry other objects which will present themselves to the traveller."

The accounts hitherto met with in the American continent are far from being equally authentic and satisfactory with those already treated of. In Acosta's History of the Indies, however, we are informed that the Mexicans make particular mention of a deluge in their country, by which all men were drowned. According to them, one Viracocha came out of the great lake Titicaca in their country. This person dwelt in Tiaguanaco, where at this day are to be seen the ruins of some ancient and very strange buildings; and thence he proceeded to Cusco, where mankind began to multiply. They show also a small lake, where they say the sun hid himself; for which reason they sacrifice largely to him, both men and other animals. Hennepin informs us that some of the savages are of opinion that a certain spirit, called Otkon by the Iroquois, and Atahauta by those at the mouth of the river St Lawrence, is the creator of the world; and that Messou repaired it after the deluge. They say that this Messou or Otkon, being a-hunting one day, his dogs lost themselves in a great lake, which thereupon overflowing, covered the whole earth in a short time, and swallowed up the world. According to Herrera, the people of Cuba knew that the heavens and the earth had been created, and said they had much information concerning the flood, and that the world had been destroyed by water by three personages who came three several ways. Gabriel de Cabrera was told by a man of more than seventy years of age that an old man, knowing the deluge was to come, built a great ship, and went into it with his family and abundance of animals; that he sent out a crow, which did not at first return, staying to feed on the carcases of dead animals, but that she afterwards came back with a green branch. He is said to have added other particulars nearly consonant to the Mosaic account. The same author likewise informs us that it was reported by the inhabitants of Castilla del Oro, in Terra Firma, that when the universal deluge happened, one man with his wife and children escaped in a canoe, and that from them the world had been peopled. The Peruvians likewise affirmed that they had received by tradition from their ancestors, that, many years before there were any incas or kings, when the country was very populous, there happened a great flood; the sea breaking out beyond its bounds, so that the land was covered with water, and all the people perished. To this it is added by the Guancas, inhabiting the vale of Xausea, and the natives of Chiquito in the province of Callao, that some persons found shelter in the hollows and caves of the highest mountains, who again peopled the land. Others again affirm that all perished in a deluge, only six persons being saved in a float, from whom are descended all the inhabitants of that country. In Nieuhoff's voyages to Brazil we are informed that the most barbarous of the Brazilians, inhabiting the inland countries, scarcely knew any thing of religion or of an Almighty Being. But they had some knowledge remaining of a general deluge, it being their opinion that the whole race of mankind were extirpated by a general deluge, except one man and his sister, who being with child before, they by degrees repeopled the world. M. Thevet gives us the creed of the Brazilians in this matter more particularly. In the opinion of these savages the deluge was universal. They say that Summay, a Caribbee of great dignity, had two children named Tamendonare and Ariconte. Being of contrary dispositions, one delighting in peace and the other in war and rapine, they mortally hated each other. One day Ariconte, the warrior, brought an arm of an enemy whom he had encountered to his brother, reproaching him at the same time with cowardice. But the other retorted by telling, that if he had been possessed of the valour which he boasted, he would have brought his enemy entire. On this Ariconte threw the arm against the door of his brother's house. At that instant the whole village was carried up into the sky; and Tamendonare striking the ground with violence, a vast stream of water issued out from it, and continued to flow in such quantity, that in a short time it seemed to rise above the clouds, and the earth was entirely covered. The two brothers seeing this, ascended the highest mountains of the country, and with their wives ascended the trees which grew upon them. By this deluge all mankind, as well as all other animals, were drowned, excepting the two brothers above mentioned and their wives, who having descended when the flood abated, became the heads of two different nations. Deluge.

To these American testimonies we may add another from the remote and uncivilized island of Otaheite. Dr Watson, in his discourse to the clergy, informs us, that one of the navigators to the southern hemisphere having asked some of the inhabitants of that island concerning their origin, was answered, that their supreme God, a long time ago, being angry, dragged the earth through the sea, and their island, being broken off, was preserved. In the East Indies, we are informed by Dr Watson that Sir William Jones, by whom a society for the advancement of Asiatic literature was instituted at Calcutta, discovered in the oldest mythological books of that country such an account of the deluge as corresponds sufficiently with that of Moses.

The fact being thus established by the universal consent of mankind, that there was a general deluge which overflowed the whole world, it remains next to inquire by what means it may reasonably be supposed to have been accomplished. There have been many speculations on the instruments employed in bringing about this grand cataclysm; and a great division of opinion has existed as to the effects which it might be expected to have produced on the surface of the earth.

It has been asserted that a quantity of water was created on purpose, and at a proper time annihilated, by divine power. This, however, besides its being absolutely without evidence, is directly contrary to the words of the sacred writer whom the supporters of this hypothesis mean to defend. He expressly derives the waters of the flood from two sources; first, the fountains of the great deep, which he tells us were all broken open; and secondly, the windows of heaven, which he says were opened: and speaking of the decrease of the waters, he says, the fountains of the deep and the windows of heaven were stopped, and the waters returned continually from off the face of the earth. Here it is obvious that Moses was so far from having any difficulty about the quantity of water, that he thought the sources whence it came were not exhausted; since both of them required to be stopped by the same almighty hand which had opened them, lest the flood should increase more than it actually did.

Dr Burnet, in his *Telluris Theoria Sacra*, endeavours to show that all the waters in the ocean were not sufficient to cover the earth to the depth assigned by Moses. Supposing the sea drained quite dry, and all the clouds of the

Deluge. atmosphere dissolved into rain, we should still, according to him, want much the greater part of the water of a deluge. To get rid of this difficulty, Dr Burnet and others have adopted Descartes' theory. That philosopher supposes the antediluvian world to have been perfectly round and equal, without mountains or valleys. He accounts for its formation on mechanical principles, by supposing it at first in the condition of a thick turbid fluid, replete with divers heterogeneous matters, which, subsiding by slow degrees, formed themselves into different concentric strata or beds, in obedience to the law of gravity. Dr Burnet improves on this theory by supposing the primitive earth to have been no more than a shell or crust investing the surface of the water contained in the ocean, and in the central abyss which he and others suppose to exist in the bowels of the earth. At the time of the flood, this outward crust, according to him, broke in a thousand pieces; and consequently sunk down among the water, which thus spouted up in vast cataracts, and overflowed the whole surface. He supposes also, that before the flood there was a perfect coincidence of the equator with the ecliptic, and consequently that the antediluvian world enjoyed a perpetual spring; but that the violence of the shock by which the outer crust was broken shifted also the position of the earth, and produced the present obliquity of the ecliptic. This theory, it will be observed, is equally arbitrary with the former. But it is, besides, directly contrary to the words of Moses, who assures us, that all the high hills were covered; whilst, in opposition to this, Dr Burnet affirms that there were then no hills in existence.

Other authors, supposing a sufficient fund of water in the abyss or sea, are only concerned for an expedient to bring it forth. Accordingly some have recourse to a shifting of the earth's centre of gravity, by which, the water being drawn out of its channel, the several parts of the earth were successively overwhelmed.

Mr Whiston, in his *New Theory of the Earth*, shows, from several remarkable coincidences, that a comet descending in the plane of the ecliptic, towards its perihelion, must have passed just before the earth on the first day of the deluge; the consequences of which would be, first, that this comet, when it came below the moon, would raise a vast and strong tide, both in the small seas, which according to his hypothesis existed in the antediluvian earth (for he allows no great ocean there, as in ours), and also in the abyss which was under the upper crust of the earth; and this tide would rise and increase during all the time of the approach of the comet towards the earth, and would be at its greatest height when the comet was at its least distance from the earth. By the force of this tide, and also by the attraction of the comet, he judges that the abyss must have assumed an elliptical figure, the surface of which being considerably larger than the former spherical one, the outward crust of the earth, incumbent on the abyss, must accommodate itself to that figure, which it could not do whilst it remained solid and conjoined. He concludes, therefore, that it must of necessity have been extended, and at last broken, by the violence of the tides and attraction; and that the included water issuing thence was a great means of the deluge, according to what Moses says of the "fountains of the great deep being broken open." Again, the same comet, he maintains, in its descent towards the sun, passed so close by the body of the earth, as to involve the latter in its atmosphere and tail for a considerable time, and of consequence left a vast quantity of its vapours, both expanded and condensed, on its surface, a great part of which being rarefied by the solar heat, would be drawn up into the atmosphere, and afterwards return in violent rains. And this he takes to be what Moses intimates by "the windows of heaven being opened," and particularly Deluge. by the "forty days rain." Lastly, to remove this vast orb of waters again, he supposes a mighty wind to have arisen, which dried up some, and forced the rest into the abyss through the clefts by which it came up; only a great quantity remained in the alveus of the ocean, now first formed, and in lesser seas, lakes, and the like. This theory was at first only proposed as an hypothesis; but, on further consideration, Mr Whiston thought he could actually prove that a comet did at that time pass very near the earth, and that it was the same which afterwards appeared in 1688. But the uncertainty of the comet's return in 1758, and the absolute failure of that which ought to have appeared in 1788 or 1789, must certainly render Mr Whiston's calculations for such a length of time extremely dubious.

Mr Hutchinson and his followers present us with a theory of the deluge, which they pretend to derive from the word of God itself. This theory has been particularly enlarged upon and illustrated by Mr Catcot, who in 1768 published a volume on the subject. This gentleman asserts, that when the world was first created, at the time when it is said to have been "without form and void," the terrestrial matter was then entirely dissolved in the aqueous; so that the whole formed, as it were, a thick muddy water. The figure of this mass was spherical; and on the outside of this sphere lay the gross dark air. Within the sphere of earth and water was an immense cavity, called by Moses the *deep;* and this internal cavity was filled with air of a kind similar to that on the outside. On the creation of light, the internal air received elasticity sufficient to burst out through the external covering of earth and water. Upon this the water descended, filled up the void, and left the earth in a form similar to that which it has at present. Thus, according to him, the antediluvian world, as well as the present, consisted of a vast collection or nucleus of water, called the *great deep*, or the *abyss*. The breaking up of these fountains was occasioned by a miraculous pressure of the atmosphere, from the immediate action of the Deity himself; and so violent was this pressure, that the air descended to where it had originally been, occupied the space of the abyss, and drove out the waters over the whole surface of the dry land. But this account, so far from being infallibly certain, seems inconsistent with the most common observation. No pressure, however violent, will cause water to rise above its level, unless the pressure is unequal. If therefore the atmosphere entered into the supposed abyss by a vehement pressure on the surface of the ocean, that pressure must only have been on one place, or on a few places; and even though we suppose the atmosphere to have been the agent made use of, it is impossible that it could have remained for any time in the abyss, as the pressure of the water would immediately have forced it up again through those holes which had afforded it a passage downwards.

M. de Beaumont has indulged in the speculation that the sudden appearance of the Cordillera of the Andes may have caused the historical deluge; that the unfathomable ocean was suddenly upheaved, and converted into dry land, thereby displacing a great body of water, and producing a diluvial wave or regurgitation, which inundated the previously existing portion of the earth. An event of this kind, it cannot be disputed, would very probably have produced such an effect as he anticipates; but the sudden elevation of such a mountain-ridge as the Andes to the height of ten, fifteen, or twenty thousand feet, would displace a great volume of atmospheric air, not of water, and, if the velocity of the movement were sufficiently great, might occasion a tremendous hurricane.

It is not to be supposed that we can pretend to ascer-

Deluge. tain any thing more on the subject than others have done. The following conjectures, however, may be offered as to the manner in which the deluge might have happened, without any violence to the established laws of nature.

If we consider the quantity of water requisite for the purpose of the deluge, it will not appear so very extraordinary as has been commonly represented. The height of the highest hills is thought not to exceed four or five miles. It will therefore be deemed a sufficient allowance, when we suppose the waters of the deluge to have been four miles deep on the surface of the ground. Now it is certain that water, or any other matter, when spread out at large upon the ground, seems to occupy an immense space in comparison of that which it does when contained in a cubical vessel, or when packed together in a cubical form. A cube of ten miles of water would very nearly overflow two hundred and fifty-six square miles of plain ground to the height of four miles. But if we take into account the vast number of eminences with which the surface of the earth abounds, the above-mentioned quantity of water would cover a great deal more. If, therefore, we attempt to calculate the quantity of water sufficient to deluge the earth, we must make a very considerable allowance for the bulk of all the hills upon its surface. But, to consider this matter in its utmost latitude, the surface of the earth is supposed by the latest computations to contain about 199,512,595 square miles. In order to overflow this surface to the height of four miles, there is required a parallelopiped of water sixteen miles deep, and containing 49,878,148 square miles of surface. Now, considering the immense thickness of the globe of the earth, it is by no means improbable that this quantity of water might be contained in its bowels, without the necessity of any remarkable abyss or huge collection of water, such as most of our theorists suppose to exist in the centre. It is certain that, as far as the earth has been mined, it has been found, not dry, but moist; nor have we any reason to imagine that it is not at least equally moist to the centre. How moist it really is cannot be known, nor can the quantity of water requisite to impart to it the degree of moisture it has be ascertained; but we are certain that it must be immense. It was not, however, from the bowels of the earth alone that the waters were discharged, but also from the air; for we are assured by Moses that it rained forty days and forty nights. But this source of the diluvian waters has been considered as of small consequence by almost every one who has written on the subject.

With reference to this subject we must observe, however, that there is a very general mistake with regard to the air, similar to that above mentioned regarding the earth. Because the earth below our feet appears to our senses firm and compact, therefore the vast quantity of water contained even in the most solid parts of it, and which will readily appear on proper experiment, is overlooked. In like manner, because the air does not always deluge with excessive rains, it is also imagined that it contains but little water. Because the pressure of the air is able to raise only thirty-two feet of water on the surface of the earth, it is therefore supposed that we may ascertain to what depth the atmosphere could deluge the earth if it was to discharge the *whole* water contained in it. But we know that the pressure of the atmosphere has not the least connection with the quantity of water which it contains. Nay, if there is any connection, the air, as exhibited by the barometer, seems to be lightest when it contains most water. For these reasons we think that the quantity of water contained in the whole atmosphere ought to be considered as indefinite, especially as we know that by whatever agent it is suspended, that agent must counteract the force of gravity, otherwise the water would immediately descend.

The above considerations render it at least probable Deluge. that there is in nature a quantity of water sufficient to deluge the world, provided it were applied to the purpose. We must next consider, therefore, whether there be any natural agent powerful enough to effect this purpose; and we shall take the phrases used by Moses in their most obvious sense. The breaking up of the fountains of the deep we may reasonably suppose to have been the opening of all passages, whether great or small, through which the subterraneous waters could possibly discharge themselves on the surface of the earth. The opening of the windows of heaven we may also suppose to be the pouring out of the water contained in the atmosphere, through those invisible passages by which it enters in such a manner as totally to elude our senses, as when water is absorbed by the air in evaporation. As both these are said to have been opened at the same time, it seems therefore probable that one natural agent was employed to do both. Now it is certain that the industry of modern inquiry has discovered an agent unknown to former ages, the influence of which is so great, that with regard to this world, it may be said to possess a kind of omnipotence. The agent which we mean is electricity. It is certain, that by means of it immense quantities of water can be raised to a great height in the air. This is clearly proved by the phenomena of water-spouts. Mr Forster relates, that he happened to see one break very near him, and observed a flash of lightning to proceed from it at the moment of its breaking. The conclusion from all this is obvious. When the electric matter was discharged from the water, it could no longer be supported by the atmosphere, but immediately descended. Though water-spouts do not often appear in this country, yet every one must have made an observation somewhat similar to Mr Forster's. In a violent storm of thunder and rain, after every flash of lightning or discharge of electricity from the clouds, the rain pours down with increased violence; thus showing that the cloud having parted with so much of its electricity, cannot longer be supported in the form of vapour, but must descend in rain. It is not indeed yet discovered that electricity is the cause of the suspension of water in the atmosphere, but it is certain that evaporation is promoted by electrifying the fluid to be evaporated. It may therefore be admitted as a possibility, that the electric fluid contained in the air may be the agent by which it is enabled to suspend the water which rises in vapour. If therefore the air be deprived of the due proportion of this fluid, it is evident that rain must fall in prodigious quantities.

Again, we are assured, from the most undeniable observations, that electricity is able to swell up water on the surface of the earth. This we can make it do even in our trifling experiments; and much more must the whole force of the fluid be supposed capable of doing it, if applied to the waters of the ocean, or to any others. The agitation of the sea in earthquakes is a sufficient proof of this. It is certain that at these times there is a discharge of a vast quantity of electric matter from the earth into the air; and that, as soon as this happens, all becomes quiet on the surface of the earth.

From a multitude of observations, it also appears that there is at all times a passage of electric matter from the atmosphere into the earth, and, *vice versa*, from the earth into the atmosphere. There is therefore no absurdity in supposing the Deity to have influenced the action of the natural powers in such a manner, that for forty days and forty nights the electric matter contained in the atmosphere should descend into the bowels of the earth: if indeed there be occasion for supposing any such immediate influence at all; since it is not impossible that there might have been, from some natural cause, a descent of this matter

Deluge. from the atmosphere at that time. But by whatever cause the descent was occasioned, the consequence would be the breaking open of the fountains of the deep, and the opening of the windows of heaven. The water contained in the atmosphere being left without support, would descend in impetuous rains; whilst the waters of the ocean, those from which fountains originate, and those contained in the solid earth itself, would rise from the very centre, and meet the waters which descended from above. Thus the breaking up of the fountains of the deep, and the opening of the windows of heaven, would accompany each other, as Moses tells us they actually did; for, according to him, both happened at the same time.

In this manner the flood would come on gradually, without that violence to the globe which Burnet, Whiston, and other theorists, are obliged to suppose. The abatement of the waters would ensue on the ascent of the electric fluid; the atmosphere would then absorb the water as formerly; that which had ascended through the earth would again subside; and thus every thing would return to its former state.

Having thus shown in what manner an universal deluge might have been produced by means of those natural agents with which we are at present acquainted, we shall next consider some of those remarkable geological facts which place it beyond a doubt, not only that that event did happen, but that the deluge was universal. It has long been a question, even before the commencement of geological researches, whether the deluge mentioned in Scripture was universal in reference to the whole surface of the globe, or only so with respect to that portion of it which was then inhabited by man. Vossius was of opinion, that in the days of Noah, mankind had not extended themselves beyond the borders of Syria and Mesopotamia; and no reason, says he, "obliges us to extend the inundation of the deluge beyond those bounds which were inhabited; yea, it is altogether absurd to aver that the effect of a punishment inflicted upon mankind only, should extend to those places where no man lived. Although we should therefore believe that part of the earth only to have been overflowed by the waters which we have mentioned, and which is not the hundredth part of the terrestrial globe, the deluge will nevertheless be *universal* œcumenical, since the destruction was universal, and overwhelmed the whole habitable world."

If such an interpretation were admissible, there are two classes of phenomena in the configuration of the earth's surface, which, according to Professor Lyell, might enable us to account for such an event; *first*, extensive lakes elevated above the level of the ocean; and, *secondly*, large tracts of dry land depressed below that level. "When there is an immense lake, having its surface, like Lake Superior, raised six hundred feet above the level of the sea, the waters may be suddenly let loose by the rending or sinking down of the barrier during earthquakes; and hereby a region as extensive as the valley of the Mississippi, inhabited by a population of several millions, might be deluged. On the other hand, there may be a country placed beneath the mean level of the ocean, as is the case with certain parts of Asia; and such a region must be entirely laid under water, should the tract which separates it from the ocean be fissured or depressed to a certain depth. The great cavity of Western Asia is 18,000 square leagues in area, and is occupied by a considerable population. The lowest parts, surrounding the Caspian Sea, are three hundred feet below the level of the Euxine; here, therefore, the diluvial waters might overflow the summits of hills rising three hundred feet above the level of the plain; and if depressions still more profound existed at any former time in Asia, the tops of still loftier mountains may have been covered by a flood." Deluge.

Pallas, and some of the geologists of his day, denied that the summits of the hills had been covered by the deluge; for, according to his hypothesis, the mass of water required to surmount, or even to cover them all round the globe could not be disposed of within the earth, even were its interior wholly made up of caverns. Had the deluge been of this partial and transient description, we should have been led to look for its effects only in certain situations; in those countries, in particular, which we know were inhabited by antediluvian mortals. Such, however, is not the fact; the distinct traces of its action being visible under innumerable circumstances, and in almost every country on the face of the globe. To what, we would ask, do those immense tracts of gravel and loam, so frequent in Prussia, Denmark, and other parts of the European continent, and in situations to which no torrents nor rivers now in action could ever have drifted them, owe their existence? Whence came those vast collections of fossil bones and other animal remains so common in Siberia, in Behring's Strait, in the valley of the Arno in Tuscany, and in many districts of Germany and England? How were the beds of shells and other marine productions brought together in such profusion, and raised to elevations which the seabreeze never reached? By what means were those large erratic boulders so common among the sand in the north of Germany, and in numerous other places, removed from their original position, and conveyed sometimes hundreds of miles from any rock of a similar description?

Dr Buckland, in his *Reliquiæ Diluvianæ*, enumerates a great many English localities where remains of the elephant, rhinoceros, hyena, and the other larger animals have been met with. In Scotland and Ireland they have also been occasionally found. At the village of Theide, near Brunswick, a congeries of tusks, teeth, and bones, were discovered in 1816, some of the former upwards of fourteen feet in length. Within the last ten years, parts of the skeletons of at least a hundred hippopotami have been discovered in the valley of the Arno, and placed in the museum of Florence, along with numerous remains of the rhinoceros and elephant, horse, ox, several species of deer, hyena, bear, wolf, dog, tiger, tapir, hog, beaver, mastodon, and fox. Over the frozen regions of Russia and Siberia their dispersion is also nearly universal. There is not, says Pallas, in all Asiatic Russia, from the Don to the extremity of the promontory of Tchutchis, a stream or river in the banks of which are not to be found the remains of elephants and other animals, now strangers to that climate. These are washed out by the violent floods arising from the thaw of the snows, and have attracted universally the attention of the natives, who collect annually the elephants' tusks, in order to sell them as ivory. Humboldt has also noticed them in the plains of Mexico and in the province of Quito. How is it possible, says Buckland, to explain the general dispersion of all these remains, but by admitting that the elephants, as well as all the other creatures whose bones are buried with them, were the antediluvian inhabitants of the extensive tracts of country over which we have been tracing them, and that they were all destroyed together by the waters of the same inundation which produced the deposits of loam and gravel in which they are imbedded.

The *diluvium* of geologists is the name applied to those deposits of loam and gravel which were formed by the flood, in order to distinguish them from those which are in daily and gradual progress, and commonly called *alluvium*. The origin of the alluvial formations may be referred to the action of torrents, rivers, and lakes, whilst to the production of the diluvial deposits no cause at present in

Deluge. action is adequate; and they can therefore only be referred to the waters of a sudden and transient deluge.

Immense deposits of diluvium have taken place in Holland, Denmark, Holstein, Pomerania, and along the southern shores of the Baltic. The whole coast, from the Thames to the Tweed, consists of such deposits, being composed principally of a tough bluish clay, through which are dispersed irregularly pebbles of different sizes, and containing almost every description of rock. Much gravel is accumulated in the midland counties of England, composed of the wreck of rocks of the most distant ages, and which exist in their native state only in remote quarters of the island.

The immense boulders, or erratic blocks as they are termed by geologists, which are met with in many parts of Europe, frequently at the distance of several hundred miles from any similar rocks existing *in situ*, afford evidences of a stream having overflowed it, capable of overwhelming and disregarding objects, and by which the Nile or the Ganges would have been turned out of their course. In Great Britain we have instances of this in almost every county. Professor Sedgwick, for instance, has remarked, that the blocks of Shap granite, which cannot be confounded with other rocks in the north of England, are not only drifted over the hills near Appleby, but have been rolled over the great central chain of England into the plains of Yorkshire—imbedded into the transported detritus of the Tees, and even carried to the eastern coast. Blocks of granite and syenite of a very peculiar character have been drifted from the Criffle Hill, in Galloway, across the Solway Frith, to the base of the mountains in Cumberland. Large blocks of another kind of granite have been transported in still greater numbers from Ravenglass, on the coast of Cumberland, over the plains of Lancashire, Cheshire, and Staffordshire, and may be observed in masses of some tons weight to the west of the towns of Macclesfield and Stafford, and between Dudley and Bridgenorth. Numerous examples of a similar description might be cited; but the most remarkable circumstance attending these erratic blocks is, that they do not occur promiscuously throughout the country, but invariably to the *southward* of the rock whence they have been derived. From this it would appear, and indeed it is now pretty generally admitted by geologists, that the direction of the great flood was, in this part of the world at least, from north to south. The boulders on the east coast of England have, according to Mr Phillips, been derived both from Norway and from Scotland; and Dr Hibbert mentions boulders three or four feet in height on the northern coasts of Shetland, which do not correspond with any known rock of the country, and were probably derived from the northward. If the supposition that a mass of waters passed over Britain be founded on probability, the evidences of such a passage should be found in the neighbouring continent of Europe, and the general direction of the transported substances should be the same. Now this is precisely what is found to be the case. In Sweden and Russia large blocks of rock occur in great numbers, and no doubt can be entertained that they have been transported from the north. In Sweden the transported materials were observed by Brogniart to run in lines, sometimes inosculating, but having a general direction from north to south. Between Petersburg and Moscow the erratic blocks are very numerous, and consist of Scandinavian rocks. In some places, especially in Esthonia, these blocks appear at greater or less intervals, apparently owing to the form of the land at the time of their transport: for they occur where escarpments presented themselves; whilst, in places where the land sloped away, or became more or less horizontal, they disappear, thus seeming to show that the steep escarpments caught them in their passage.[1] In Eastern Prussia, and in that part of Poland situated between the Vistula and the Niemen, the granite blocks are abundant, and consist of the same varieties as those found in Finland; and thence westward over the whole of the north of Germany, we find boulders whose origin is unequivocally Scandinavian. Thus the hornblende blocks are from Southern and Western Finland; the quartzose blocks are exactly the same as the rocks named *fjall sandstein* between Sweden and Norway; the porphyritic blocks are of the same mineralogical character as the porphyries of Elfdal in Sweden; and some of the granites contain even particles of orthite, a mineral which has never been noticed anywhere except near Stockholm and in the eastern district of the northern peninsula. Deluge.

The same thing has been frequently observed in America; and there also these erratic blocks must have been rolled from the northward. Between Lake Erie and Lake Huron the woods are strewed with masses of gneiss, porphyry, conglomerate, and greenstone; and the summits of some of the highest hills in Nova Scotia, which are composed of slate, are also strewed with large boulders of granite.

The phenomena of scratches and abrasions on the surface of rocks was first accurately noticed by Sir James Hall in an elaborate paper in the *Edinburgh Philosophical Transactions*. It is well known that masses of rock carried down by torrents exhibit traces of their passage by scratches and abrasions on such smooth surfaces as they may have encountered in their progress, "frequently resembling those of a wet road along which a number of heavy and irregular bodies have been recently dragged."

The hypothesis derived from the foregoing facts was formerly supposed to receive further confirmation from the scratches and abrasions exhibited by the surface of many rocks, and in some instances it may be so; but modern investigations have now referred these rather to the action of glaciers—a theory first propounded by M. Agassiz, and since elaborately illustrated from a long series of observations by Professor J. D. Forbes and others.

It has been considered that the traces of currents which the surface of the earth exhibits, and which might be ascribed to diluvial action of some kind, are not the results of *one universal* simultaneous submergence, but of *many distinct* local aqueous forces for the most part continued in action for long periods, and of a kind precisely analogous to such agency as is now at work.

Notwithstanding the foregoing arguments in favour of a universal deluge, it is the more general opinion among geologists that the deluge must be referred to local action, and that it extended only to the then inhabited parts of the earth. Dr Pye Smith contends that there is no real contradiction between the natural phenomena bearing upon the subject which would favour the theory of a local deluge, and the description in the Mosaic record *when rightly interpreted*. This author shows, by a large comparison of similar passages, that the Scripture terms commonly taken to imply the *universality* of the deluge, are only to be understood as expressing a great extent; as Gen. xli. 56, and Deut. ii. 25.

In any point of view, it must be admitted that the subject involves difficulties of no inconsiderable amount; and if, after due consideration, we should still feel it necessary to retain a cautious suspense of judgment on the subject, it may be also borne in mind that such hesitation will not involve the dereliction of any material religious doctrine.

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[1] De la Beche's *Geological Manual*.

Delvino || Demetrius.

DELVINO, a large village of European Turkey, and capital of a sanjak; province of Albania. It is situated on the declivity of a hill 44 miles W.N.W. of Yanina, and has about 10,000 inhabitants.

DEMADES, an orator and demagogue, who, from being a common sailor, rose to a prominent position at Athens. He espoused the cause of Philip in the war against Olynthus; and having fallen into the hands of the Macedonians at the battle of Chæronea, he was instrumental in procuring a treaty of peace between Macedon and Athens. He continued to be a favourite of Alexander, and saved Demosthenes and the other obnoxious Athenian orators from his vengeance. Harpalus and Antipater both succeeded in bribing him to their cause; but the latter, discovering a correspondence which showed him to have been at the same time in communication with Perdiccas, put him to death along with his son Demeas. A fragment of a speech bearing his name is still extant, and is to be found in the *Oratores Attici*, but its genuineness is exceedingly doubtful.

DEMBEA, or TZANA, the principal lake of Abyssinia. See ABYSSINIA.

DEMENTIA. See MENTAL DISEASES.

DEMERARA, or DEMERARY. See GUIANA, *British*.

DEMESNE, or DEMAIN, in *Law*, is commonly defined to be the lord's chief manor place, with the lands thereto belonging, which he and his ancestors have from time immemorial kept in their own manual occupation.

DEMETER, in *Antiquity*, the goddess of corn. See CERES.

DEMETRIA, in *Grecian Antiquity*, a festival in honour of Demeter (Ceres). An annual festival of the same name was instituted by the Athenians in B.C. 307, in honour of Demetrius Poliorcetes; and to honour that prince the more, they also changed the name of the Dionysia to Demetria. Athenæus (xii.) appears to refer to the Dionysia under their new name.

DEMETRIUS, a son of Antigonus and Stratonice, surnamed *Poliorcetes* or the Besieger. At the age of twenty-two he was sent by his father against Ptolemy, who had invaded Syria, and he was totally defeated near Gaza; but he soon repaired his loss by a victory which he obtained over Cilles, in the neighbourhood of Myus. After conducting an expedition against Babylon, and engaging in several campaigns against Ptolemy on the coasts of Cilicia and Cyprus, Demetrius sailed with a fleet of two hundred and fifty ships to Athens, and restored the Athenians to liberty, by freeing them from the power of Cassander and Ptolemy, and expelling the garrison which had been stationed there under Demetrius Phalereus. After this successful expedition he besieged and took Munychia, and defeated Cassander at Thermopylæ. His reception at Athens, after these victories, was attended with the greatest servility; and under the title of "The Preserver" the Athenians worshipped him as a tutelary deity. In the next campaign he defeated Menelaus by land, and completely destroyed the naval power of Ptolemy. After an interval spent in the greatest luxury at Cyprus, he endeavoured to punish the Rhodians for having deserted his cause; and his ingenuity in devising new instruments of siege, in his attempt to reduce the capital, gained him the appellation of Poliorcetes. His subsequent successes in Greece, however, roused the jealousy of the successors of Alexander; and Seleucus, Cassander, and Lysimachus united to destroy Antigonus and his son. The hostile armies met at Ipsus, B.C. 301. Antigonus was killed in the battle, and Demetrius, after sustaining a severe loss, retired to Ephesus. This reverse of fortune raised him many enemies; and the Athenians, who had lately adored him as a god, refused even to admit him into their city. But he soon afterwards ravaged the territory of Lysimachus, and effected a reconciliation with Seleucus, to whom he gave his daughter Stratonice in marriage. Athens was at this time oppressed by the tyranny of Cassander; but Demetrius, after a protracted blockade, gained possession of the city, and pardoned the inhabitants their former misconduct. The loss of his possessions in Asia recalled him from Greece; and he established himself on the throne of Macedonia by the murder of Alexander the son of Cassander, B.C. 294. But here he was continually threatened by Pyrrhus, who took advantage of his occasional absence to ravage the defenceless part of his kingdom; and at length the combined forces of Pyrrhus, Ptolemy, and Lysimachus, assisted by the disaffected among his own subjects, obliged him to leave Macedonia, after he had sat on the throne for seven years. He passed into Asia, and attacked, with various success, some of the provinces of Lysimachus; but famine and pestilence destroyed the greater part of his army, and he retired to the court of Seleucus to seek support and assistance. Here he met with a kind reception; but, nevertheless, hostilities soon broke out; and after he had gained some advantages over his son-in-law, Demetrius was totally forsaken by his troops in the field of battle, and became an easy prey to the enemy. His son Antigonus offered Seleucus all his possessions, and even his person, in order to procure his father's liberty; but all proved unavailing, and Demetrius died in the fifty-fourth year of his age, after a confinement of three years, B.C. 284. His remains were given to Antigonus, honoured with a splendid funeral at Corinth, and thence conveyed to Demetrias. His posterity remained in possession of the Macedonian throne till the time of Perseus, who was conquered by the Romans. See MACEDONIA.

Demetrius

DEMETRIUS I., *Soter*, king of Syria, was sent to Rome as a hostage during the reign of Antiochus Epiphanes. He contrived, however, to escape from confinement, partly through the assistance of the historian Polybius, and established himself on the throne. He acquired his surname from the Babylonians on account of the expulsion of Heracleides from their capital; and is famous in Jewish history for his contests with the Maccabees. Demetrius fell in battle against the usurper Balas, about B.C. 150.

DEMETRIUS II., *Nicator*, was the son of the preceding, and lived in exile during the usurpation of Balas. At the head of a body of Cretan mercenaries, and with the assistance of Ptolemy Philometer, whose daughter he married, he regained the throne of Syria. His cruelties and vices, however, ultimately procured his expulsion from the kingdom; and Antiochus, the infant son of Balas, was proclaimed king in his stead. After ten years' captivity in Parthia, he succeeded in establishing himself once more upon the throne; but his wife Cleopatra, indignant at his subsequent marriage with a daughter of the Parthian king, procured his assassination (B.C. 126).

DEMETRIUS, *Phalereus*, an orator and Peripatetic philosopher, so called from the Attic demos of Phalerus, where he was born. He was the son of a poor man named Phanostratus, and was a scholar of Theophrastus. He acquired so much authority at Athens as an orator, that he governed the city for ten years, and 360 statues were erected to his honour. On the restoration of the old democracy by Demetrius Poliorcetes, he was obliged to leave the city, and escaped into Egypt, where he was protected by Ptolemy Lagus. This king, it is said, having asked his advice concerning the succession of his children to the throne, was advised by Demetrius to leave his crown to the children of Eurydice, rather than to Philadelphus, the son of Berenice. This displeased Philadelphus so much, that when his father died he banished Demetrius; and the unfortunate exile put an end to his life by the poison of an asp. Demetrius composed more works in prose and in verse than any other Peripatetic of his time. His writings treated principally of poetry, history, politics, rhetoric, and accounts of embassies; but none are extant

Demetrius ‖ Democritus.

except his rhetoric, which is usually printed among the *Rhetores Selecti.*

DEMETRIUS, a Cynic philosopher, and disciple of Apollonius Tyanæus, to whom he afterwards proved an able antagonist. He spent the greater part of his life at Corinth, and first became famous during the reign of Caligula. The emperor, wishing to gain the philosopher to his interest, sent him a large present; but Demetrius refused it with indignation, and said, "If Caligula wishes to bribe me, let him send me his crown." Vespasian was displeased with his insolence, and banished him; but the Cynic derided the punishment, and bitterly inveighed against the emperor. He lived to an advanced age; and Seneca observes, that nature had brought him forth to show mankind how an exalted genius may live uncorrupted by the vices of the world.

DEMI (formed from Lat. *dimidium, half*), a word used frequently in composition with other words.

DEMI-George, in *Fortification*, that part of the polygon which remains after the flank is raised, and which stretches from the curtain to the angle of the polygon. It is half of the vacant space or entrance into a bastion.

DEMI-Quaver, or *Semi-Quaver*, in *Music*, a note equal in value to half a quaver.

DEMI-Semiquaver, a note equal to half a demi-quaver.

DEMIGOD, one partaking of a divine nature; a general appellation of the inferior deities of Greece and Italy, more particularly of those fabulous heroes who were the mixed offspring of a divinity and a mortal.

DEMI ATTICI, boroughs or larger villages of Attica. See ATTICA, vol. iv., p. 193.

DEMISE (Lat. *demitto*), literally a laying or sending down; a term applied in law to an estate either in fee-simple, fee-tail, or for a term of life or years. As applied to the crown of England, demise signifies its transmission to the next heir on the death of the sovereign.

DEMIURGE, *Demiurgus* (from δῆμος, *people*, and ἔργον, *work*), literally signifies a handicraftsman; but in the language of the Platonists it was used to denote an exalted and mysterious agent, or *Æon*, employed by the Supreme Deity in the creation of the universe. The Platonizing Christians regarded the *Logos*, or Second Person of the Trinity, as one of an infinite series of Demiurgi employed by the Deity in the creation of the universe.

DEMIURGUS was also the title of the chief executive magistrate in some of the ancient Grecian states.

DEMMIN, a town of Prussia, capital of a cognominal circle in the government of Stettin, is situated on the Peene, which here receives the Trebel and the Tollense, 72 miles W.N.W. of Stettin. It has manufactures of woollen cloths, linens, hats, and hosiery; besides breweries, distilleries, tanneries, &c.; and an active trade in tobacco, gloves, corn, and timber. Pop. (1849), including military, 7609. Demmin is a town of considerable antiquity, having been a place of importance in the time of Charlemagne, and is noted for the number of sieges it has sustained. Its fortifications were destroyed in 1759. In 1807 several engagements took place here between the French and Russians.

DEMOCRACY (from δῆμος, *people*, and κρατέω, *to govern*), a form of government in which the supreme power is lodged in the hands of the people. Such were the governments of Rome and Athens of old; but the most perfect example of democracy is afforded by the United States of North America at the present day, the government of which, for the security it gives, the good order it preserves, the small burdens it imposes, and the judgment with which its foreign and domestic policy have been conducted, is deservedly considered as one of the best the world has seen.

DEMOCRITUS, a celebrated philosopher of antiquity, was a native of Abdera—an Ionian colony in Thrace. The date of his birth is not accurately known. By some authorities it is referred to the first year of the 80th Olympiad, *i. e.* 460 B. C.: by others to the year 470 B. C.; while Diodorus Siculus, perhaps the most reliable authority on this question, assigns it to B. C. 494. His father, whose name was Hegesistratus (though he is sometimes called Athenocritus and Damasippus), was an Abderitan of so great wealth, that when Xerxes passed through Abdera on his way back from Greece after Salamis, he entertained him and his suite with great magnificence. In return for this hospitality, the Persian monarch is said to have sent to Hegesistratus men skilled in all the learning of Persia and Chaldæa, to teach the young Democritus the sciences then cultivated in the East. The immense wealth which he inherited from his father he spent in travel, visiting India, Chaldæa, Persia, and Ethiopia. From these countries he is believed to have passed into Egypt, where he spent several years in studying the physical sciences which Pythagoras had learned there before him. It is not improbable that from Egypt he passed into Magna Græcia, where he found the minds of the people divided between the rival schools of Pythagoras and Zeno of Elea. From Italy he is said to have crossed over to Greece, attracted by the celebrity of Athens, where Socrates and Anaxagoras were then teaching, and to have attended the lectures of these philosophers *incognito*. A tradition also is current that he had a personal quarrel with Anaxagoras; but this is sufficiently refuted by certain passages in his own works, in which that philosopher is mentioned in terms of the highest praise. After wandering over nearly the whole of the then known world, he returned to his native Abdera so poor, despite his once large inheritance, that he was obliged to ask an asylum from his brother, by name Damasus. The history of his old age is even more obscure and contradictory than that of his youth. According to one tradition, he is said to have fallen into a state of imbecility, which so excited the sympathy of his countrymen, that they sent for the celebrated physician Hippocrates from Cos, and consigned the unfortunate philosopher to his care. According to other accounts, however, he is said to have prosecuted his studies without interruption almost till his death. The date of Democritus's death, like that of his birth, is very uncertain. By some he is said to have attained the great age of 109; by others, that of 104. Diodorus Siculus, whose version is probably the most reliable, states that at the time of his death Democritus had completed his 90th year. The memory of Democritus was held in high esteem by his countrymen, who, on his return home in poverty, are said to have presented him with large sums of money, and to have erected bronze statues to his honour in various parts of the town. His knowledge of natural science, in particular, is said to have proved on various occasions beneficial to the Abderitans, who honoured him on that account even more than on account of his philosophy. From the intensity of his application he is said to have injured his eye-sight so much that he ultimately became blind. On this story is founded the tradition of a later age, according to which he put out his eyes in order that his attention might not be distracted by the contemplation of a multiplicity of objects. His cheerfulness and humour he retained to the last; and, from his habit of viewing things on the bright side, and his extremely happy temperament, he earned for himself the title of the Laughing Philosopher. Heraclitus of Ephesus, who had regarded the world from the opposite point of view, had before this been familiarly known as the Weeping Philosopher.

Democritus.

According to Diogenes Laertius, Democritus was the author of seventy-two works. They are said to have comprised treatises on almost every subject of human inquiry. Of these, nothing has descended to our days except some titles and a few fragments. Some of these treatises are praised by Cicero as remarkable for the clearness and poetical beauty of the style, which, in his opinion, rivalled that

of Plato. The fundamental ideas of Democritus's cosmological philosophy were borrowed from Leucippus, and were in direct opposition to those of the Eleatic school. These were, 1st, that a vacuum exists as well as its opposite, and that non-existence is no less true than existence; 2dly, that the divisibility of being, an inevitable consequence of the existence of a void, has necessarily limits. Here, at the very outset, may be discerned the materialistic character of this system; for the property which is here ascribed to being in general only belongs to matter, which alone can be limited and divided by space. Democritus endeavoured to prove the existence of a vacuum from motion, and from certain experiments originally devised by Leucippus. In his ethical philosophy Democritus maintained that peace of mind was the object to the attainment of which all our efforts should be directed. From notices and fragments of his works which have come down to us, it may be inferred that his ethical system contained much practical wisdom; and his ideas on Virtue and the Good are marked by a very high standard of moral aspiration.

The best collection of the fragments of Democritus is that by F. G. A. Mullach, 8vo, Berlin, 1843. His doctrines have given rise to much historical inquiry in modern times. They are fully discussed in the following works:—Magneni *Democritus reviviscens, seu Vita et Philosophia Democriti*, Pavia 1646, and Leyden 1648; Genderi *Democritus Abderitâ, philosophus accuratissimus, ab injuriis vindicatus*, Altona, 1665; Jenichen, *Progr. de Democrito Philosopho*, Leipzig, 1720; Ploucquet, *De Placitis Democriti Abderitæ*, Tubingen, 1767; Hill, *De Philosophia Epicurea, Democritea, et Theophrastea*, Geneva, 1669; Gœdingi, *Dissert. de Democrito ejusque Philosophia*, Upsal, 1703; Schwartz, *Dissert. de Democriti Theologia*, Cobourg, 1718; Lutkemann, *Disput. Democrit. Eleaticæ Sectæ Antistitem*, Greifsw. 1718; Ritter, art. *Democritus* in Ersch and Gruber's Dictionary, Leipzig, 1833; Benjamin Lafaist, *Dissert. sur la Philosophie Atomistique*, Paris, 1833; Ritter, *History of Philosophy*, vol. i. p. 559; Brandis, *Rhein. Mus.* vol. iii. p 133, &c.; and Papencordt, *Atomicorum Doctrina*.

DEMOGORGON (δαίμων, *demon*, and γοργός, *terrible*), in *Pagan Mythology*, a mysterious divinity, regarded by some as the author of creation, and by others as a great magician to the power of whose spell all the inhabitants of Hades were subjected. The origin, attributes, and history of this dread Deity are involved in obscurity; but all writers concur in representing Demogorgon as an object of terror rather than of worship. Hence Milton—

> ——————— behold the throne
> Of Chaos, and his dark pavilion spread
> Wide o'er the wasteful deep: with him enthroned
> Sat sable-vested Night, eldest of things,
> The consort of his reign; and by him stood
> Orcus and Ades, and the dreaded name
> Of Demogorgon. *Paradise Lost*, B. ii.

DEMOIVRE, Abraham, an eminent mathematician, was born at Vitry, in Champagne, May 26, 1667. The revocation of the edict of Nantz, in 1685, determined him to fly into England rather than abandon the religion of his fathers. Having laid the foundation of his mathematical studies in France, he perfected himself at London, where he read public lectures for his support. The *Principia Mathematica* of Newton, which chance threw in his way, made him comprehend at once how little he had advanced in the science which he professed; but he pursued his studies with vigour; and soon became distinguished among first-rate mathematicians. His eminence and abilities opened to him an entrance into the Royal Society of London, and afterwards into the Academies of Berlin and Paris. His merit was so well known and acknowledged by the Royal Society, that they judged him a fit person to decide the famous contest between Newton and Leibnitz concerning the invention of fluxions. The collection of the Academy of Paris contains no memoir of this author, who died at London, Nov. 27, 1754, soon after his admission into that body; but the *Philosophical Transactions* of London contain several of his papers, all of them interesting. He also published some excellent works, such as *Miscellanea Analytica, de Seriebus et Quadraturis*, 1730, in 4to. But he has been more generally known by his *Doctrine of Chances*, or method of calculating the Probabilities of Events at Play. This work was first printed in 1618, in 4to, and dedicated to Sir Isaac Newton. It was reprinted in 1738, with great alterations and improvements; and a third edition was afterwards published with additions. He likewise gave to the world a *Treatise on Annuities*, 1724, in 8vo, dedicated to Lord Carpenter.

DEMON. See Dæmon.

DEMONSTRATION. See Logic.

DEMONTE, a town of Italy, kingdom of Sardinia, province of Coni, and 14 miles S.W. of the town of that name, on the right bank of the Stura. Pop. about 6000. Its fortifications were demolished by the French in 1801.

DEMOSTHENES, the most celebrated of all orators, sought the chief uses of his eloquence in the public emergencies of his agitated time. Neither his personal history nor his literary character can be rightly estimated, till a just account is taken of his position as a statesman. He lived and acted in the last struggle which Greece maintained for freedom; and he died when the battle was lost, a sacrifice to the vengeance of the conquerors.

To observers tolerably impartial it cannot but appear, that the policy which for thirty years Demosthenes so energetically advocated, was in its outlines not only self-consistent, but adapted with very much practical sagacity for the attainment of its purpose. Nor (though the point is disputed more or less openly by several of our modern historians) is it really less certain, that the purpose itself was noble and desirable. We must set very little value on national independence, or be infected by more than a reasonable dread of popular influences, if we fail to convince ourselves that the continued existence of Greece as a group of republics would, notwithstanding its imperfect cohesion, and all other faults and dangers, have been a state of things infinitely better than that fettered and terrified subjection to which she was reduced by her monarchical neighbours. In the history of that interesting generation, the most doubtful question that suggests itself is the question, whether the struggle on which the Greeks ventured was prudent—whether it could be entered on with a reasonable likelihood of success; and on this question, it must be confessed, opposite views were at the time adopted by Greeks equally virtuous and patriotic. On the one hand, for instance, Phocion, despondent, somewhat misanthropic, keenly sensitive to the vices of a time when corruption and decay had begun to enfeeble the race, and indignantly contemptuous of the abuses which arose out of a democracy destitute of fit checks—Phocion, the purity of whose motives no man ever questioned—despaired of his country during the whole period of his public life, and never cherished any higher aim than that of making favourable terms with the masters whose sway he believed it impossible to escape from. He survived long enough to see his worst prophecies of evil lamentably fulfilled. Yet was there not only a more honourable and manly spirit, but perhaps also a more correct calculation of probable chances, in that course of active resistance which recommended itself to the more sanguine temper of Demosthenes. Greece could not but have fallen, sooner or later, unless the urgency of the crisis had breathed, as it promised to breathe more than once, a fresh flame of patriotic inspiration into the hearts of her people; unless her several states had thrown off their ancient hatreds and their subsisting jealousies of each other, as they did throw off these in one or two hours of imminent peril; unless the citizens in each of the states had sacrificed, not (as they did) in short fits of alarm or indignation, but with steady and life-long devotion, the love of luxury which made rich and poor alike slow to aid the finances of the commonwealth, and the habits of pacific indolence which devolved the battles of the Hellenic

Demosthenes.

race on hordes of mercenary soldiers. But, fighting at every disadvantage, Greece would not have fallen when she did fall, if it had not happened that the enemy who attacked her, Philip, king of Macedon, was a man of extraordinary genius, both military and diplomatic. It was a fact which no man could have ventured to foretell, and which no Grecian statesman was entitled to assume in the earlier stages of the contest, that within a quarter of a century Philip should have raised a small, poor, and barbarous kingdom to a height of power, which not only laid Greece at its feet, but enabled his heroic son to found, by a few years of conquest, one of the great monarchies of the world. Even against adversaries thus formidable, the Greeks maintained a struggle which, at more crises than one, was decided against them by very narrow causes; and when, after the death of Alexander, they were again encouraged to rise, it was only, perhaps, by reason of the discouragement diffused by a generation of fruitless warfare, that this, the last act of the tragedy, did not issue in a different catastrophe.

The year of Demosthenes' birth has not been exactly ascertained. The authorities refer it to years ranging from 384 to 380 B.C.; the fixed point being, that it took place in the ninety-ninth Olympiad. His enemies used to taunt him with his barbaric pedigree. His maternal grandfather, Gylon, had been charged with betraying a fort in the Crimea (the Tauric Chersonesus), and, being driven into exile, had married a woman of foreign blood. The orator's father, whose name he inherited, was an Athenian citizen, extensively engaged in manufacture and commerce, and entered in the richest class on the tax rolls. Demosthenes was left an orphan between his fifth and his tenth year; and the affairs of himself and his sister were entrusted to three guardians, two of them kinsmen, from whom, after attaining his legal majority at the age of sixteen, he long endeavoured in vain to extort a reckoning. The property which in the end he was able to recover, saved him from being poor, but was not enough to make him by any means wealthy. He is said to have been first directed towards the study of oratory, by the necessity which he speedily foresaw of having to institute a law-suit against his guardians; for the Athenian forms of procedure did not, unless in cases of special exemption, allow litigants in private causes to plead in the courts otherwise than in person. At any rate, Demosthenes did so plead for himself in those matters, in three, or perhaps five, orations, still extant; besides delivering, long afterwards, in another personal suit, his energetic invective against Midias. The composition, also, for payment, of speeches to be delivered by litigants, was a part of the ordinary business of advocates or orators at Athens; and the state of his affairs, together, perhaps, with the desire of thus training himself better for political eloquence, led him to occupy himself much in this way, especially in the earlier part of his public life. Such occasions gave rise to a considerable number of the speeches which are preserved among his works. He gave instructions in oratory, likewise, as we gather from the sneers of Æschines.

Demosthenes accused his guardians of having thrown obstacles in the way of his education. But he was certainly, in his youth, instructed as fully and variously as any Athenian of that refined and well-informed time; and his feebleness and sickliness of body, while it clung to him in mature years, and was a drawback on his efficiency as a public man, increased from boyhood his natural turn for reading and reflection. He studied regularly under the orator Isæus; he benefited in one way or another from the teaching both of Isocrates and of Plato; he was a diligent student of Greek literature, especially in the history of Thucydides, which he is said to have copied till he had it by heart, and which was pronounced by his critical countrymen to have strongly affected the formation of his style; and his discourses exhibit a familiarity both with the details of business and with the principles of administration, which shows convincingly that, with all his zeal in mastering the art of communication, and amidst all the enthusiasm with which he contemplated the glory of the older Grecian times, he looked with a most observant eye on the concerns of actual and present life, and taught himself to glance from end to means with the coolest sagacity of a practical statesman. Yet we know enough to be fully assured, that he who was thus earnest in learning what to tell, employed, in learning how to tell it, an amount of labour never equalled by any other public speaker. Every one remembers the stories celebrating the indomitable perseverance with which, inspired by the lofty ambition of being a great orator in a time and country which made oratory the most honoured and powerful of all accomplishments, he toiled to overcome physical defects; how he shut himself up for months to write or to declaim; how he modulated his voice and strengthened his lungs for the din of the popular assemblies, by practising recitation in climbing steep hills, or in walking beside the stormy shore of the sea; how he received lessons from Satyrus the player, and went so far as to study attitudes before a mirror. By the sedulous use, in short, of all expedients available in a school of oratory more refined and elaborate than any other that the world has ever seen, he proved his deep sense of the truth and importance of his own sound maxim; that "good delivery" (for this, not "action" merely, is the right rendering of his phrase) is the first and greatest qualification of a public speaker. In spite of these exertions, it was not till after repeated failures that he attained that impressive force and dignity of elocution, which his adversaries themselves were compelled to acknowledge and admire, and which made the orations of Demosthenes, when they issued from his own lips, to be even mightier instruments of persuasion than they are when we read them in the quietness of the closet. As to the matter of his speeches, too, it is to be noted, that while Æschines and others of his contemporaries prided themselves on extemporaneous fluency, he never possessed much readiness of speech, and always shrunk from speaking publicly when he had not had full time for preparation.

Demosthenes.

The Orations which we have under the name of Demosthenes are sixty; or sixty-one, if those critics are right who divide the first Philippic into two. But no more than forty are universally admitted as genuine; and the evidence against a good many of the rest is quite conclusive. The collection, as it stands, falls into three classes: sixteen speeches delivered in the national assemblies (Δημηγορίαι); judicial speeches (Δόγοι Δικανικοί), forty-two in number, of which thirty deal with private civil causes, the others involving questions of public interest; and two orations of display (Δόγοι Ἐπιδεικτικοί), both of which are spurious. There is also a curious collection of fifty-four Proemia, or introductions to political discourses; the separate composition of which, to be used as occasion might occur, is a singular illustration of the carefully artificial character of Grecian eloquence in the hands of its greatest masters. Many of the Orations of Demosthenes are invaluable contributions to the history of his times, for some facts of which indeed they are our principal evidence; and the delivery of the leading ones, or the circumstances out of which they arose, mark almost all the most prominent epochs in the biography of the orator.

His public life may thus be distributed into four stages.

The first of these begins with the year B.C. 354, when he was somewhere between his twenty-seventh and his thirtieth year. Then, having sufficiently tried his powers, both by delivering the orations on his family-affairs and by composing several for other litigants, he stept into the arena of the public assemblies. The period thus begun came to a close in B.C. 346. At its opening, the duty which he thought mainly incumbent on him was to urge, in the Oration on the

Demosthenes. Symmories, union among the Greeks, and self-denying zeal on the part of individual citizens, and to caution his countrymen against wasting their strength in needless attacks on their ancient enemy Persia. Next year, in the Oration for the Megalopolitans, the text was still the abandonment of jealousies between state and state. Within a year after this, Philip of Macedon was in the Propontis; and now, while the old themes are not forgotten, and practical measures are recommended with the same statesman-like acuteness as before, Macedon is denounced as the enemy against whom Grecian liberty must be protected most vigorously. These and similar views furnish the matter of the First Philippic. The Speech for the Rhodians followed; and next, while Philip was overrunning the Chalcidic peninsula, came the three noble Olynthiacs. The rash invitations of the discordant Greeks had now, in the Sacred War, brought Philip to the very gates of their country. Demosthenes himself, already the most active leader of the Anti-Macedonian party in Athens, was unable to make head against the general despondency; and in B.C. 347 he consented to be one of the envoys in that famous embassy to Philip, in which, not by him, Athens was betrayed, and her allies were sacrificed. The king of Macedon was allowed to occupy the pass of Thermopylæ, admitted to the Amphictyonic League, and elected its chief.

The second period in the career of Demosthenes lasted about six years from B.C. 346. It was not fertile in great public events, but all the more so in great efforts of the orator, now in the years just before and after his fortieth. There was peace in name between Macedon and Athens. But Philip was using, by encroachments continually spreading, the footing which he had gained in Greece; and the Athenians were led, by Demosthenes and his party, into a series of indirect and isolated resistances to him, which ended, as they could not but end, in open warfare. The political speeches of this stage came in the following order: the second Philippic; the Oration on the Misconducted Embassy to Philip, delivered on the first of those two celebrated occasions which brought the character and the policy of Demosthenes into close comparison with those of Æschines, his eloquent rival and personal enemy; the masterly and impassioned Oration on the affairs of the Chersonese; and the third and fourth Philippics.

In autumn B.C. 340 began the third of our periods, the most eventful epoch in the times. A contest of five years, conducted by the Greeks with an energy which might have saved them if it had been exerted sooner, issued in a discomfiture which was total and proved to be irremediable. Demosthenes, now at the summit of his popularity and power, had in the meantime no opponent strong enough to call forth his eloquence; and his time was closely and anxiously occupied by discharging, amidst difficulties of which the worst was the worthlessness of his chief assistants and instruments, duties which have been described fairly when he is called the war-minister of Athens. After war was declared, he carried through valuable reforms in the administration of the fleet; and, in the panic and anger which were aroused when Philip had marched into the heart of Greece, he organized without opposition the generous proposals which brought about alliance between Athens and Thebes. But, in August B.C. 338, the fatal battle of Chæronea laid the Greeks prostrate before their enemy; the endeavours of the Athenians to gain allies for a renewal of the war were fruitless; and a peace was concluded which really made Greece a province of Macedon. Philip was assassinated two years afterwards; but the dreams raised on his removal were dissipated by the unexpected vigour of his son. Alexander having carried his army to the Danube, the Thebans revolted, and were assisted by Athens with a subsidy received from Persia. The young king rapidly returned home, captured Thebes, and destroyed it. Besides executing other bloody punishments, he demanded surrender of nine leaders of the war-party at Athens, Demosthenes being of course in the number. It is disputed whether his withdrawal of the demand was caused by the venal negotiations of the orator Demades, or by the more honourable intercession of Phocion. Thus, in B.C. 335, the last hopes of the Greeks seemed to be extinguished. Even during Alexander's absence in the East, their courage did not rise high enough to prompt any general revolt. Demosthenes.

Accordingly, during the twelve years after B.C. 335, which were the closing stage in the great orator's life, he was a fallen man; fallen from power and popularity, and exposed to continual attacks from old and now very dangerous enemies. But he was still full of courage, not destitute of hope, and as vigorous of intellect as ever. His oratorical masterpiece, the Oration on the Crown, or for Ctesiphon, belongs to this period, the trial which gave opportunity for it taking place in B.C. 330, when he must have been somewhat past his fiftieth year. A public honour which, immediately after the defeat at Chæronea, the Athenians had done honour to themselves by conferring on Demosthenes, was now made a ground of impeachment against Ctesiphon, on whose motion it had been granted. Demosthenes was the person really attacked; and a hostile survey of his whole political life makes, with a short notice of the question ostensibly at issue, the staple of the magnificent address in which Æschines supported the prosecution. This oration, and that of Demosthenes in answer, are the very finest monuments which the records of eloquence have to show. The proceedings which were challenged by Æschines having been clearly irregular, the verdict of acquittal which was pronounced was certainly wrong in law. But it was creditable to the popular board which constituted the court, to have refused to pronounce a verdict of conviction which, though seemingly bearing only on the nominal defendant, would avowedly have been accepted as a condemnation of the most distinguished and patriotic citzen in the state, as well as of the whole line of policy by which the corrupted Athenians had in part reclaimed the ancient lustre of their name. A subsequent attack on Demosthenes, made in B.C. 324, was more successful. Harpalus, one of Alexander's satellites, deserted the province of which he had been made governor, sought shelter in Athens with large plunder, and endeavoured to prevail on his hosts to take up arms in his defence. In the course of the agitation thus excited, Demosthenes was accused of having been bribed by the refugee, was convicted, heavily fined, and thrown into prison, whence he escaped, and fled into exile. The question of his guilt or innocence has been warmly argued on both sides. The recorded evidence against him is extremely slight, and the presumption in his favour from antecedents almost impregnably strong; nor is it hard to believe that he was sacrificed to the terror of Alexander, which was felt by the cowed citizens, and fostered by the intrigues and threats of the Macedonian partizans. His countrymen themselves revoked their sentence immediately on commencing preparations for a new rising, when, in B.C. 323, Alexander's death was heard of. Demosthenes, recalled by a national resolution, and having his fine paid out of the public exchequer, was again the most trusted of Athenian statesmen. But this was only a lightening before death—it did not endure many months. The campaign in Thessaly, usually described as the Lamian War, ended in the defeat of the allied Greeks by Antipater at Crannon. Alexander's general and successor repeated the demand for blood which had been made by his master; and there was now neither protection nor intercession. Demosthenes, solemnly reconciling himself with the orator Hyperides, another of the victims, sought, in the temple of Poseidon, in the islet of Calaurea, a sanctuary which, he knew well, would not be respected. The exile-hunters pursued him to his retreat; and

Demotic. he died before falling into their hands, having, as is commonly believed, poisoned himself. His death took place in the year B C. 322, when his age was not less than fifty-eight or more than sixty-two.

The name of Demosthenes is written in the last of the four periods, which comprehend the brilliancy and purity of Grecian literature. In the period of epic poetry, Homer stands superior and apart; in the period of lyric poetry, a pre-eminence nearly as decided belongs to Pindar; in the next period came the historians, Herodotus, Thucydides, and Xenophon, the four chiefs of the Attic drama, the early philosophers, Socrates and the sophists. Then followed the period of the Greek philosophers and orators; and in it, Plato and Aristotle do not project more sublimely beyond all other thinkers of the ancient world, than does Demosthenes beyond all its masters of eloquence. This, in truth, is far too little to say. Perhaps no literary judgment has been pronounced with fewer dissents, than that which has, in every enlightened generation during the last two thousand years, declared Demosthenes to be the greatest of all orators ancient or modern. The opinion has been clothed in such a multiplicity of forms, and has been expressed so finely by men themselves eloquent, that a respectful acquiescence in it is all that can now be called for. That reasons not only various, but sometimes not quite consistent with each other, should have been assigned in support of it, is a fact which, if rightly dissected, may be found to be really a proof of the diversity and profundity of the powers out of which the marvellous effect is generated. In comparing such criticisms, all of us shall often discover that, even where the several points of excellence do not seem to be either exhaustively apprehended or justly subordinated to one another, each brings to the surface something overlooked by the rest, and yet important for the right appreciation of the works; while, after we have endeavoured to collect into one focus the scattered rays of illumination, there rests on us a fixed impression that the deepest coils of the secret spring still remain undetected. Critical analysis is as incompetent to unveil the ultimate mysteries of a mighty soul worthily actuated, as is the dissector's knife to lay bare the principle of animal vitality. The law thus hinted at is valid for literature as much as for action, and for eloquence nearly as much as for poetry; the genius of Homer is scarcely further beyond the reach of lower intellects, than is the genius of Demosthenes: he who could completely fathom either, would be a Homer or a Demosthenes himself.

The praise of Demosthenes is by no one expressed more warmly, and by few more discriminatingly, than by the cautious David Hume. "Could his manner be copied, its success would be infallible over a modern assembly. It is rapid harmony exactly adjusted to the sense; it is vehement reasoning without any appearance of art; it is disdain, anger, boldness, freedom, involved in a continual stream of argument; and, of all human productions, the Orations of Demosthenes present to us the models which approach the nearest to perfection." Some of the orator's most striking peculiarities, and not a few of the methods by which his effects were attained, are analysed in the "Dissertation on the Eloquence of the Ancients," appended to the collected edition of Lord Brougham's speeches.

The older editions of Demosthenes, of which the most noted were those of Taylor and Reiske, have been superseded in the present century by that of Bekker. Bibliographical details are fully given in Westermann's *Geschichte der Beredtsamkeit*. The biography of the orator may be studied best in the general histories of Greece, or in some historical works devoted to particular periods. The Macedonian side is taken up by Mitford with his usual keenness and spirit, and somewhat less decidedly by Droysen: a fairer estimate may be gathered from Thirlwall and Grote. (W. S.)

DEMOTIC or ENCHORIAL characters, in *Egyptian Antiquities*, are terms used synonymously to distinguish the alphabet used by the common people; in contradistinction to the Hieratic, or that used by the priests. The words are derived respectively from δημοτικός, 'belonging to the people,' and ἐγχώριος, 'indigenous,' or 'of the country.' See HIEROGLYPHICS. Demotica || Dempster

DEMOTICA, a town of European Turkey, on the Maritza, province of Roumelia and sanjak of Gallipoli, at the foot of a conical hill surmounted by a castle, 25 miles S. of Adrianople. Pop. about 10,000. The town is tolerably well-built, and has a mosque, several Greek churches, colleges, and public baths; and manufactures of silk and woollen stuffs and earthenware. Charles XII. of Sweden resided here for more than a year after the battle of Poltava.

DEMPSTER, THOMAS, one of the most learned men whom Scotland has produced, was born at Cliftbog in Aberdeenshire, on the 23d of August 1579, being the twenty-fourth out of twenty-nine children by the same mother. His father, who bore the same name with himself, he describes as proprietor of Muresk, Auchterless, and Killesmont, and *prorex*, or lieutenant, of the county of Banff and the district of Buchan. His mother was Jane, the sister of Lesley of Balquhain; and one grandmother was daughter to the last earl of Buchan of the family of Stewart, and the other was sister to Lord Forbes. He was born during the lifetime of his grandfather, at whose decease, the family, more distinguished by its gentility than its opulence, was left in very unprosperous circumstances.

According to his own account, his first step in learning was as wonderful as any part of his subsequent progress; for, at the age of three years, he completely mastered the alphabet in the space of a single hour. He was afterwards committed to the care of Andrew Ogston, a schoolmaster at Turreff, and was next removed to Aberdeen, where he was initiated in classical learning by Thomas Cargill, an excellent grammarian. In the mean time, the family was involved in ruin, chiefly by the misconduct of James, his eldest brother; of whom he has given an account which it would have been much wiser to suppress. This brother took the extraordinary step of marrying his father's concubine, Isabella Gordon of Achavach; and having consequently been disinherited, he attempted to revenge himself by collecting a band of Gordons, and making a violent assault upon his father when he was one morning proceeding on horseback, with the view of transacting some public business. Several attendants of the latter were slain in this encounter, and, amongst others, his brother-in-law Gilbert Lesley; he was himself dangerously wounded. Two of the Gordons were likewise left dead on the field, and several were wounded on both sides. In order to cut off all hope of succession from such an heir, he sold to the earl of Errol his estate of Muresk, situated in the county of Aberdeen; but the bargain was never fulfilled by the other party, and he was unable to recover either his lands or their price. Thus, we are told, he only left to his son Thomas an empty title. But Thomas, who represents himself as the twenty-fourth child, does not venture to assert that, if the estate had still remained in the family, he was next in the order of succession; and when in various works he styled himself baron of Muresk, he must have been aware, even taking baron in the sense of *laird*, that his title was as empty as could well be imagined. After this act of atrocious violence, his brother James fled to the northern islands, and having there collected a band of ruffians, he lived in open defiance of the laws, till he at length set fire to the bishop of Orkney's palace, and then returned to the country which he had been compelled to abandon. His wife, who had become the mother of seven children, was now discarded; and having made choice of another companion, he sought an asylum in the Netherlands, where

Dempster. he served as a captain of horse. But the divine vengeance at last overtook him; for having been guilty of some gross act of violence towards his colonel, he was executed at Utrecht in the most appalling manner; he was torn limb from limb by four horses, and thus, according to his brother's account, ended a career of more than common crime and infamy.

In the progress of these events, Thomas, by the advice of his uncle John Dempster, whom he describes as an eminent lawyer of Edinburgh, was induced to seek in another country that fortune from which he seemed to be precluded in his own. In the tenth year of his age, he repaired to Cambridge, where he for some time studied in Pembroke Hall. He afterwards directed his course to France: and having on his journey been robbed of his money and stript of his clothes, he with difficulty made his way to Paris. Here he was kindly treated by some of his countrymen, and was beginning to think of resuming his studies, when he was seized with a contagious disease, which deprived the schools of their auditors, and the city of its inhabitants. When he at length recovered from this dangerous malady, he hastened to the university of Louvain, which was then adorned by the erudition of Lipsius, but not long after his arrival he found that William Crichton, a Jesuit, principal of the Scotish College, had received instructions to send some of his young countrymen to Rome; and those whom he selected, besides Dempster himself, were Patrick Anderson, who was already a Jesuit, Robert Hill, who died professor of philosophy at Montpellier, and Thomas Lyon, who was blind from his infancy. He reached the papal city after a dangerous journey, for the plague was raging in Germany, and Italy was the scene of military operations. By the kindness of Cardinal Cajetano, protector of the Scotish nation, he was admitted as a student in the Roman seminary, and, under the tuition of Stephoni, began the study of poetry, that is, the art of Latin versification: but having again been attacked by a dangerous disease, the physicians recommended a change of climate; and, in company with Andrew Crichton, proceeding by way of Switzerland, he directed his wandering steps towards the Netherlands. At Tournay he experienced the kindness of his countryman James Cheyne, who sent him to the university of Douay, where he was maintained by a pension from the king of Spain and the archduke Albert. He now prosecuted the study of poetry with new vigour, but did not neglect the other branches of learning. In poetry he obtained the first, and in philosophy the second prize. Having taken the degree of A. M. he for a short time taught humanity at Tournay; but as his prospects were not there very encouraging, he again presented himself at Paris, and having taken the degree of doctor of the canon law, he succeeded David Sinclair as a regent in the College of Navaire. At that period, according to his own statement, he had not attained the age of seventeen; and he must therefore have obtained his preferment in the year 1596. In what university he afterwards took the degree of doctor of the civil law, he has omitted to mention; but in several of his works he describes himself as *Juris utriusque Doctor*, or doctor of both laws, civil and canon.

From the beginning to the end of his career he was a restless wanderer, and he soon quitted Paris with the intention of settling at Toulouse. On his route, he halted for some time at St Maixant in Poitou. At Toulouse he began to teach humanity; but his zeal in contending for Dempster. the interests of the university excited the resentment of certain individuals of rank or influence, and he again thought it expedient to change his place of residence. His views were next directed to a professorship of philosophy at Montpellier, whither he appears to have been invited by his countrymen Adam Abernethy and Andrew Currie, the former of whom is still remembered as an author; but, in the mean time, he made his appearance at Nismes, where the professorship of eloquence was to be awarded to the most deserving competitor, and where only one of twenty-four judges decided against him. As this was a seminary appropriated to the Huguenots, Bayle conjectures that he must have suspended his zeal for the Romish faith.[1] One of the unsuccessful candidates, Jacob Grasser of Basel, sought to avenge himself by making a violent assault upon Dempster, by publishing a libel against him, and by applying for a legal interdict to prohibit him from discharging the duties of his office; but the professor, who possessed courage as well as strength, repelled the joint attack of Grasser and some of his associates, and found means to have him committed to prison, first at Nismes, and afterwards, when he had made his escape, at Montpellier, and again at Paris. After a tedious litigation of two years, the cause was at length decided in his favour by the parliament of Toulouse, and the libel published against him was ordered to be burnt at Nismes by the hands of the executioner.

Nor did he long retain his professorship of eloquence. After making a journey into Spain, he accepted the appointment of preceptor to Artus d'Espinay, subsequently bishop of Marseille, a son of the famous Sainte Luc, grandmaster of the artillery of France, who was killed at the siege of Amiens in the year 1597. But a quarrel in which he involved himself at Brissac with one of his pupil's relations, hastened the termination of this engagement, and he now adopted the resolution of returning to his native country. With the view of recovering some portion of the family property, he brought an action in the court of session, and, according to his own impression, would ultimately have succeeded, if he had not found it expedient to withdraw before the decision was pronounced. His relations were either reduced to poverty, or were unwilling to assist him, on account of his adherence to the popish faith; and for the same reason he was exposed to persecution from the Scotish clergy, chiefly, as he conceives, at the instigation of William Cowper, afterwards bishop of Galloway. With this divine he was for three days engaged in a theological disputation at Perth, and he appears to have been extremely well satisfied with the manner in which he acquitted himself. To the resentment of Cowper in being foiled, not by a theologian, but by a lawyer, he imputes the injurious representations which were made to the king.[2] He again bad adieu to Scotland, and, returning to Paris, was for seven years employed, with honour as well as emolument, as a regent in four different colleges, those of Lisieux, Grassins, Du Plessis, and Beauvais.[3]

Of the decision and ferocity of his character he exhibited a notable instance in the last of these colleges. Grangier, the principal, having occasion to absent himself from Paris, appointed Dempster to act as his substitute, being no doubt persuaded that he had sufficient energy to maintain the most rigid discipline. A student challenged one

[1] Bayle, Dictionaire Historique et Critique, tom ii. p. 986.

[2] Dempsteri Historia Ecclesiastica, p. 195. 677.

[3] A. du Saussay, bishop of Tulle, in his continuation of Bellarmin, has mentioned Dempster in the following terms: "Docuit magno discipulorum concursu, nec minori omnium doctorum æstimatione et plausu: inter ejus auditores in mea juventute constiti. Cæterum tantus vir pugnaci animo et contentioso ac instabili fuit, quo genio ductus plerumque domicilia mutavit." (De Scriptoribus Ecclesiasticis, p. 82. edit. Colon. 1684, 4to.)

Dempster. of his companions to fight a duel: the vice-principal was moved with indignation at such a proceeding; and having seized the offender and untrussed his points, he placed him on the back of a sturdy knave, and, in the presence of the whole college, gave him a sound flogging. The young gentleman, burning with resentment, brought one day to the college three of his kinsmen who served in the guards; but Dempster, undismayed at this military invasion, put arms into the hands of the servants, and having ordered them to kill the horses which were left at the gate, made so formidable an attack on the soldiers, that they were speedily reduced to the necessity of begging for mercy. Their lives were spared by the victor, who however detained them for a short time as prisoners in the college belfry. When they had thus ascertained that he was a match for them at their own weapons, they endeavoured to find a more competent remedy; and as he was not persuaded that a legal enquiry into his proceedings would tend to his advantage, he quitted his station in the College of Beauvais, and sailed for England.[1] According to one of his Irish antagonists, the cause of his flight was of a much more foul description;[2] but the work which contains this statement displays such a fierce spirit of detraction, as must deprive it of all historical credit. He had been invited to England by King James, who bestowed upon him the title of historiographer royal, and made him a present of two hundred pounds, which at that period was no inconsiderable sum. This gift he received in the thirteenth year of the king's reign, namely, in 1615 or 1616.[3] At London he married Susannah Wallier, a woman of great beauty and elegance, who afterwards proved a very precarious acquisition. His hopes of obtaining preferment were defeated by the remonstrances of the clergy, particularly Dr Montague, bishop of Bath and Wells: they endeavoured to impress the king with a sense of the impropriety of thus taking under his protection, and into his favour, a known and zealous catholic. He therefore took his leave of the learned monarch, and again directed his course towards Italy. When he arrived at Rome, he was suspected of being a spy, and for a single night was detained in custody; but his character and pretensions were easily ascertained, and from the pope and several cardinals he obtained letters of recommendation to the grand duke of Tuscany, Cosmo II. Being likewise befriended by Guicciardini, the duke's ambassador at the court of Rome, he proceeded to Florence, and in the year 1616 was appointed professor of the Pandects in the university of Pisa.[4] He had previously distinguished himself by the publication of various works in prose and verse, and had earned the reputation of extensive erudition. At an early period of his life he had betaken himself to the study of the law; and by his edition of the *Antiquitates Romanæ* of Rosinus, printed in the year 1613, he had evinced his proficiency as a civilian. The study of the Roman law is so closely blended with the study of Roman history and antiquities, that the one cannot be safely disjoined from the other.

Soon after he had been admitted to this office, he was furnished with letters and money by the grand duke, and returned to England for the purpose of conveying his wife to Italy. They proceeded by way of Paris; and when they were one day walking in the street, his lady attracted a crowd of gazers, not merely by the beauty of her person, but chiefly by exhibiting a more ample portion of her bosom and shoulders than suited the established usages of the country. So great was the concourse of people, that they were obliged to fly for shelter to an adjoining house.[5] In due time he returned to Pisa, and read his inaugural lecture on the second of November. His salary was augmented to four hundred ducats, and he now appeared to have a fair prospect of honour and emolument. He recommended himself to the duke by undertaking his great work *De Etruria Regali*, which he must have completed with wonderful energy and dispatch. In the year 1617, he paid another visit to Britain, with the view of arranging some private affairs. But his restless and turbulent disposition did not long permit him to enjoy tranquillity. He involved himself in an angry and pertinacious dispute with an Englishman, whose name he has not thought proper to mention, nor is the origin or progress of this dispute rendered in any degree intelligible by his abrupt narrative. It however appears that his antagonist, who was probably an ecclesiastic, succeeded in producing a favourable impression on the grand duke, who only left Dempster the alternative of making an apology or quitting the Tuscan dominions. The learned civilian was of too stubborn a nature to be readily convinced that he was in the wrong, and too proud to stoop to what he considered as an unworthy compliance: he accordingly accepted the latter part of this alternative, and took his departure from Pisa on the 21st of July 1619. Dempster.

Disgusted with Italy, he now reverted to the plan of settling in his native country; but on arriving at Bologna, he paid his respects to Cardinal Capponi, legate of that papal city, who prevailed upon him to abandon his intention, and within the short space of twelve days procured him the appointment of professor of humanity. This was an honourable and a lucrative office, which had been held by men of high reputation, by P. Manutius, Sigonius, and Robortellus. A new office naturally involved such a person in new contentions: the professor of humanity was entitled to take precedence of other professors; and as this place of honour was fiercely contested, he maintained his own rights with his usual pertinacity, and with more than his usual success.

More serious evils awaited him. The Englishman who had interrupted his tranquillity at Pisa, still infested him at Bologna: he accused the professor of being a catholic of dubious faith, and of being guilty of the crime of having heretical books in his library. Dempster addressed to his adversary a letter, which appears to have been so intemperate as to incur the censure of some of the cardinals; but he proceeded to Rome in person, and after obtaining more than one audience of the pope, was enabled to remove any aspersions which had been aimed at his character. A formal reconciliation was at length effected between these pertinacious antagonists, but the spirit of reconciliation was probably wanting in both parties. The professor mentions that he had prepared a full statement of his case, and that if his adversary recurred to his former practices, it should be transmitted to posterity. In the mean time, he discharged his duty in the university

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[1] Erythræi Pinacotheca Imaginum illustrium Doctrinæ vel Ingenii Laude Virorum, tom. i. p. 24. Colon. Agrip. 1645–8, 3 tom. 8vo.—This account seems to receive some confirmation from Dempster's more brief statement: "A Joanne Robillardo Normano Cadomensi periculum vitæ adiit, qui frequenti stationario milite comitante sub noctem irrumpens, armis cum suis exutus ac in custodiam datus, iter conceptum Thomæ acceleravit." (Historia Ecclesiastica, p. 677.)

[2] Hiberniæ, sive Antiquioris Scotiæ, Vindiciæ, p. 52–8. Antverp. 1621, 8vo.

[3] Nichols's Progresses of King James the First, vol. ii. p. 136.

[4] Fabronii Historia Academiæ Pisanæ, tom. ii. p. 234. Pisis, 1791–5, 3 tom. 4to.

[5] Erythræi Pinacotheca, tom. i. p. 25.

Dempster. with diligence and ability. His reputation attracted pupils of a higher rank, and his salary was augmented to eight hundred crowns. His love of wandering seems at length to have abated; for he declined an offer of a thousand crowns a year as professor of the civil law in the university of Padua. Pope Urban VIII. who was himself a Latin poet, treated him with more than usual distinction, by conferring upon him the honour of knighthood, and accompanying this honour with an annual pension of one hundred pieces of money, but of what denomination, is not sufficiently apparent. Dempster likewise became a member of the Accademia della Notte, in which, according to the Italian fashion, he assumed the name of Evantius, and in the proceedings of which he is said to have taken a great interest. He now appeared to have reached a place of rest, when he was overtaken by the severest of all his calamities. After his arrival in Italy, his wife had born a daughter, who did not survive many days, and this was fortunately the only offspring of such a mother. On returning from one of his lectures, he discovered that she had made an elopement, in which one or more of his own pupils were either concerned as principals or accessories. He immediately commenced a pursuit of the fugitives, who seem to have added robbery to their other crime; but when he had proceeded as far as Vicenza, a city of Lombardy, he found that they must already have passed the Alps. This painful journey had been performed during the heat of the dog-days. Oppressed with fatigue of body and anguish of mind, he sought repose and tranquillity at Butri, in the neighbourhood of Bologna; but having been suddenly attacked with a fever, he was removed to his own residence, and there died on the 6th of September 1625, soon after he had completed the forty-sixth year of his age. His remains were interred in the church of St Dominic, where his brethren of the Accademia della Notte erected a monumental stone to his memory, and added a Latin inscription written in a very quaint style. One of their number, Ovidio Montalbani, pronounced his funeral oration, which was published in the course of the following year.[1]

Such was the turbulent life, and such the premature death, of Thomas Dempster, a man distinguished by some eminent endowments of body as well as mind. In his person, he was above the ordinary size, and was possessed of proportional strength. He had an ample head, with black hair, and a dark complexion, so that in Italy he might easily have been mistaken for an Italian. He was a man of a noble aspect, and was possessed of undaunted courage. The irritability of his temperament involved him in many quarrels, nor was his sword less formidable than his pen. He never acquired the habit of restraining the natural impetuosity of his mind, and was equally decided and undisguised in his friendships and in his resentments. To his friends he was very pleasant, and equally odious to his enemies. Little inclined to forgive injuries, he pursued his enemies with the most violent animosity, and expressed his tumultuous feelings without any scrupulous regard to decency.[2] In several of his works, we find sufficient evidence of his being somewhat loose in his assertions; and indeed men of a violent and perverse disposition seem frequently to be incapable of distinguishing falsehood from truth: they are much inclined to embrace as true whatever is best suited to the state of their mind during its morbid excitement. Dempster

Dempster's intellectual endowments were likewise of a mixed character. He was endowed with such extraordinary powers of memory, and read with such indefatigable diligence, that he was regarded as a speaking library. It was customary with him to devote fourteen hours a day to study. He was allowed to possess an equal knowledge of the Greek and Latin languages; and his knowledge of both was so familiar, that in either language he undertook to dictate verses as rapidly as the pen of a ready writer could commit them to paper. He was a poet and philologer, as well as a civilian and historian. He evinces no mean portion of poetical fancy, and his verse is more elegant than his prose. His *Musca* is one of the few Latin poems, written by natives of Scotland, which the learned Wasse has recommended for republication.[3] In his more elaborate works, he displays very extensive and diversified erudition, but in many instances his learning appears superior to his judgment. The life which he led was subject to many vicissitudes, and his writings partake of the same desultory character. His style is unequal, and frequently unpolished, nor is he sufficiently scrupulous in selecting words of the purer ages of Latinity.

His principal work, *De Etruria Regali*, was completed in the space of about three years; and when we consider its great extent, and its ample stores of recondite knowledge, we cannot but regard it as a wonderful performance. Errors and defects may naturally be expected to occur in a work relating to such a subject, and executed with so much rapidity; but sufficient room is still left for our admiration of the author's vivacity of mind, and resources of learning. His edition of Rosinus likewise displays the copiousness of his reading, and it has supplied materials to all those who have subsequently laboured in the department of Roman antiquities. His juridical works entitle him to a respectable place among civilians. Ludewig, who is himself an able writer, has expressed a wish that his notes on the Institutes of Justinian should be reprinted.[4] As a classical critic, his character is chiefly to be ascertained from his editions of Claudian and Corippus, two poets who belong to the declining ages of Roman literature, and one of them indeed belongs to the latter part of the sixth century.[5] The editor might easily have selected purer models of language and taste; but on various occasions he chose to travel in a by-path of his own, and his annotations on Corippus, as well as on Claudian, have contributed to his reputation as a man of miscellaneous erudition. Among his own works he enumerates notes on Statius and a commentary on Ælian, but there seems no reason to believe that they were ever printed.

On the ecclesiastical and literary history of Scotland, some of his publications are very slight and unsatisfactory. His *Menologium* and *Scotia Illustrior* are so much occu-

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[1] Ragionamento funebre havuto publicamente nell' Accademia della Notte, per la Morte dell' eccellentissimo Tomaso Demstero. Bologna, 1626.—This publication, which we have never seen, is mentioned by Bayle, and likewise by Niceron, Memoires pour servir à l'Histoire des Hommes illustres dans la Republique des Lettres, tom. xxviii. p. 314.

[2] "Moribus ferox fuit, apertus omnino, et simulandi nescius, sive enim amore, sive odio aliquem prosequeretur, utrumque palam; consuetudine jucundissimus, amicis obsequentissimus, ita inimicis maxime infensus, acceptæque injuriæ tenax, eam aperte agnoscens ac repetens." These are the expressions of Matthæus Peregrinus, who has completed the account of Dempster which occurs at the end of his *Historia Ecclesiastica*.

[3] Wasse's Memorial concerning the Desiderata of Learning: Bibliotheca Literaria, No. iii. p. 11.—See likewise Borrichii Dissertationes Academicæ de Poetis, p. 151. A selection from Dempster's poems may be found in the Delitiæ Poetarum Scotorum, tom. i. p. 306.

[4] J. P. de Ludewig Vita Justiniani, p. 45. Halæ Salicæ, 1731, 4to.

[5] Leyseri Historia Poetarum Medii Ævi, p. 172. Halæ Magdeb. 1721, 8vo.

Dempster. pied with fierce contentions "de lana caprina," that they can now excite little interest or curiosity. His *Nomenclatura* is a mere catalogue of names, which were to be illustrated in a subsequent work. In his native country, he is most generally known as the author of a book on which he has bestowed the title of *Historia Ecclesiastica Gentis Scotorum*, a title which is by no means descriptive of its contents. It contains a long enumeration of Scotish saints, writers, and other worthies, who lived, or are supposed to have lived, at periods very remote from each other. Of many of his saints and writers, the very existence is considered as more than doubtful, and many of the rest belong, not to Scotland, but to other countries. It is not always easy to distinguish the early Scotish from the early Irish writers. The name of Scotia or Scotland has not been traced in any author who flourished before the third century.[1] At first it was exclusively applied to the country now called Ireland; but after the descendants of the Irish had established themselves in the north of Britain, they still retained the appellation of Scots; although it was not before the eleventh century that the name of Scotland was transferred from the one country to the other.[2] After that period, the green island gradually lost its ancient designation. Some degree of confusion may therefore be supposed to be connected with this identity of names, nor has it always been avoided by writers more accurate than Dempster. His notices of persons who lived in earlier times are necessarily very scanty, and are often very erroneous. Nor are his catalogues of books less remarkable than his list of writers: he ascribes various works to various individuals who flourished long before the art of writing was introduced into Scotland; and nothing can be more ludicrous than his formal enumeration of the productions of such imaginary authors. The principal value of his book consists in its notices of those writers who belonged to his own time, and particularly of those who passed the better part of their lives on the continent.[3] Relative to these, he presents us with many curious gleanings of information, which is nowhere else to be found; and on many occasions his information is more authentic than his readers may be inclined to suppose. According to Bishop Lloyd, he "was as well inclined to believe a lye as any man in his time;"[4] and to Dr Towers he "seems to have thought it highly meritorious to advance the grossest falsehoods, if those falsehoods would, in any degree, contribute to the honour of his country."[5] A person convicted of many errors is naturally suspected of many more. Thus, when Dempster speaks of Kidd, or Cadanus, as being an eminent professor of law in the university of Toulouse, and the author of several works in prose and verse, he has perhaps by some readers been suspected of introducing an imaginary character; and yet the same individual, utterly forgotten in his native country, is mentioned by Baluze as a professor of great ability and reputation.[6] On the continent there were many Latin poems and tracts published by natives of Scotland, during the age of Dempster and a short period immediately preceding; and such of them as were written by individuals who did not acquire any considerable celebrity, have in various instances left but few traces behind them. Dempster.

The works of Dempster are very numerous and very miscellaneous. We subjoin a list, which is as complete as we have been able to render it; but he has himself enumerated various others, which do not appear to have been published. All the articles from No. 29 to No. 47 inclusive, are copied from his own list; and it is to be regretted that he has not described them in a more satisfactory manner.

1. Cl. Claudiani quæ extant, cum notis Thomæ Dempsteri Scoti. Flexiæ, 1607, 16mo.
2. In Claudianum Commentarius lib. i. Lugduni, et alibi.
3. Epithalamion in Nuptiis generosissimorum Jacobi Comitis Perthani, Domini Drommondi, Baronis Stobhalliæ, &c., et Isabellæ unicæ Roberti Comitis Wintonii, Domini Setonii, &c. filiæ. Edin. 1608, 4to.
4. In desideratissimum Rectoratum clariss. viri D. D. Jacobi Vassorii, Panegyris extemporanea. Par. 1609, 4to.
5. Eucharisticon, dictum post Telemachum il. v. D. D. Petri Valentis in Aula Montana Cal. Septemb. Par. 1609, 8vo.
6. Corippi Africani Grammatici de Laudibus Justini Minoris Augusti libri quatuor: Thomas Dempsterus a Muresk, J. C. recensuit, lacunas supplevit, mendis expurgavit, commentarium adjecit, &c. Par. 1610, 8vo.
7. Musca; sive Strena Kal. Jan. ad illustrem nobilissimumque virum D Petrum Huraldum Hospitalium Fayum, Dominum de Bel-ebate, &c. Par. 1610, 4to.
8. Epinicion; seu Victrix Academia. Par 1612, 4to.
9. Tragœdia Decemviratus abrogatus. Par. 1613, 8vo.
10. Antiquitatum Romanarum Corpus absolutissimum, in quo præter ea quæ Joannes Rosinus delineaverat, infinita supplentur, mutantur, adduntur. Par. 1613, fol.—Of this work there are many subsequent editions. Under the title of "Thomæ Dempsteri Kalendarium Romanum," an extract from this work is inserted in Grævius's *Thesaurus Antiquitatum Romanarum*, tom. viii. col. 115.
11. Panegyricus augustiss. potentiss. q. Principi Jacobo I. Britanniar. Lond. 1615, 4to.
12. Strena Kal. Januar. ad Jacobum Hayum, Dominum ac Baronem de Saley. Lond. 1616, 4to.
13. Votum illustriss. generosiss. q. D. Roberti Caro, Somerseti Comiti, &c., 4to.
14. Licitatio Professorum; sive Præfatio solemnis habita Pisis postridie Kal. Novembris M.DC.XVI. Pisis, 1616, 4to.
15. Troia Hetrusca; sive Gamelia Ludicra. Floren., 1616, 4to.
16. Bandum Mediceum; sive Strena Kl. Jan. MDCXVII. de Stemmate, Pila, Hercule, Leone Florent. 1617, 4to.
17. Bononia; sive Præfatio solemnis, habita ix. Cal. Novembris. Bononiæ, 1619, 4to.

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[1] Usserii Britannicarum Ecclesiarum Antiquitates, p. 728. Dublin. 1639, 4to.

[2] Pinkerton's Enquiry into the History of Scotland, vol. ii. p. 228.

[3] "Post hos, rem literariam aggressus Dempsterus, omnia ad criticam severitatem minime exegit, sed multa futilia undique corrasit; et quo fidem suam sacrificulis Romanis probaret, non potuit non religionis et libertatis vindices identidem latrare. Nec tamen sua laude fraudandus est. De meliore nota multa congessit, de iis præsertim scriptoribus qui, exules patriæ, interiores et reconditas literas in academiis Gallorum, Italorumque et Germanorum, non sine gloria docuerunt. Alii literas humaniores, mathematicas disciplinas alii jurisprudentiamve colentes, laudem haud mediocrem adepti sunt; professores vel etiam gymnasiorum præsides sunt facti, nomenque Scoticum late per orbem terrarum propagarunt. Viderat ipse Dempsterus multos, quorum meminit, sacerdotes, professores, milites, et interdum mores hominum notat." (Præf in Hist. Ecclesiast. editionem alteram, p. xii.)

[4] Lloyd's Historical Account of Church-Government as it was in Great Britain and Ireland, when they first received the Christian Religion, p. 153. sec. edit. Lond. 1684, 8vo.

[5] Biographia Britannica, vol. v. p. 94.

[6] "Deinde per tres continuos annos in academia Tolosana, quæ tum in jure docendo ceteras Europæ facillime anteibat, jus civile et canonicum audivit, usus magnis doctoribus, Gulielmo Marano, Gulielmo Cadano Scoto, Vincentio Chabotio, et Jano a Costa, qui tum publice jus utrumque in ea civitate profitebantur. Sed in primis secutus est Cadanum, tunc interpretantem Novellam Constitutionem cxxiii. Imperatoris Justiniani, virum, ut ipse aiebat, in utroque jure consultissimum, sed qui canonicum calleret ad miraculum, bonasque literas legum ac canonum cognitioni addidisset; eorumque tarditatem deplorabat, qui obscuritatem in Cadano deprehenderent." (Baluzii Epistola de Vita Petri de Marca, Archiepiscopi Parisiensis, p. 10. Paris. 1663, 8vo.) Dempster calls him James, instead of William.

[7] P. Burmanni Secundi præf. in Claudianum, p. xi.

Dempster ‖ Demurrage.

18. Scotorum Scriptorum Nomenclatura, &c. Bonon. 1619, 4to.

19. Scotia Illustrior, seu Mendicabula repressa, modesta Parecbasi; qua libelli famosi impudentia detegitur, mendacia ridicula confutantur, Scotiæ Sancti sui vindicantur, ac bona fide asseruntur. Lugduni, 1620, 8vo.

20. Asserti Scotiæ Cives sui, S. Bonifacius Rationibus ix. Joannes Duns Rationibus xii. Bonon. 1621, 4to.

21. Ulyssis Aldrovandi Quadrupedum omnium Bisulcorum Historia: Joannes Cornelius Uterverius Belga colligere incœpit, Thomas Dempsterus, Baro a Muresk Scotus, J. C. perfecte absolvit, Hieronymus Tamburinus in lucem edidit. Bonon. 1621, fol. Bonon, 1642, fol.

22. Menologium Scotorum. Bonon. 1622, 4to.

23. Apparatus ad Historiam Scoticam lib. ii. Accesserunt Martyrologium Scoticum Sanctorum DCLXXIX. Scriptorum Scotorum MDCIII. Nomenclatura. e Bonon. 1622, 4to.—The first book treats "De Religione," and the second "De Regno." The work was intended as a prelude to his *Historia Ecclesiastica*.

24. Κεφαυνος και 'Ομβλος in Glossas lib. iv Institutionum Justinianæ. Bonon. 1622, 8vo.

25. De Juramento lib. iii Bonon. 1623, 8vo

26. Benedicti Accolti de Bello a Christianis contra Barbaros gesto, pro Christi Sepulchro et Judæa recuperandis, libri iii. Thomas Dempsterus mendis expurgavit, et notis non vulgaribus illustravit. Florent. 1623, 4to. Nunc denuo ad exemplar Florentinum CIↃIↃCXXIII. ab curavit Henricus Hofsnider, cum indice satis luculento. Groningæ, 1731, 8vo.

27. Lessus; sive Laudatio Funebris illustriss. D. Julio Cæsari Signio, Episcopo Reatino. Bonon. 1623, 4to.

28. Votum Divæ Virgini Sanlucianæ. Bonon. 1623, 8vo.

29. Tragœdia Stilico lib i. Sammaxentii.

30. Epithalamium Marchionis Brandeburgici lib. i. Francofurti.

31. Epithalamium Vicecomitis Hadintonii lib. i. Londini.

32. Panegyricus Clementi VIII. Pontifici lib. i. Romæ.

33. Panegyricus Paulo V. Pontifici lib. i. Romæ.

34. Expostulatio cum Musis et Senatu Aremorico, dum custodiam suæ innocentiæ ultro subivit. Nemausi

35. Divinatio ad Regem lib. i. Londini.

36. Eucharisticon Alberto Archiduci lib. i. Duaci et Lovanii.

37. Actio Scholastica de S. Catharina lib. i. Lutetiæ.

38. Poemata de S. Thoma Aquinate lib. i. Tolosæ.

39. Acrosticha de Europæ Principibus lib. i. Duaci.

40. In Elizabetham Angliæ Reginam lib i. Duaci.

41. Lachrymæ ad Timoleontem d'Espinay Sanlucium in Funere Uxoris lib. i. Par. et Lugduni.

42. Judicium de omnibus omnium Gentium et Temporum Historicis lib. i Par.

43 Notæ in Sphæram lib. i. Francofurti.

44 Politicæ Parecbases, nuncupatæ Alexandro Razivillo, Principi Polono, auditori suo, lib. i Par.

45. Genethliacon Delphini Franciæ, nunc Regis Ludovici XIII. lib. i. Flexiæ.

46. De Inundatione Anglicana lib. i. Flexiæ.

47. Votum Scipioni Burghesio, S. R E. Cardinali, lib. i. Romæ.

48. Historia Ecclesiastica Gentis Scotorum lib. xix qua viri sanctitate, literis, dignitatibus, toto orbe illustres, et familiæ Scoticæ, in varias urbes transmissæ, et præcipue Placentium, recensentur. Illustrissimo viro Fabio Scoto Placo. Miceni Com. dicata. Bononiæ, 1627, 4to.—This posthumous work is printed in the most negligent manner, insomuch that very many passages are scarcely intelligible. The reprint for the use of the Bannatyne Club: "Thomæ Dempsteri Historia Ecclesiastica Gentis Scotorum: sive, de Scriptoribus Scotis. Editio altera." Edinb. 1829, 2 tom. 4to, was superintended by Dr Irving, who, in a preface of considerable length, has given an account of the author and his singular performance.

49. Cerasum et Sylvestre Prunum; opus poematicum, de Virtutum et Vitiorum Pugna; authore Alexandro Montgomrio Scoto, in Latinos versus translatum. Arctauni Franc. 1631, 8vo. Edin. 1696, 8vo.

50. De Etruria Regali libri vii. nunc primum editi, curante Thoma Coke, Magnæ Britanniæ Armigero. Florentiæ, 1723-4, 2 tom. fol.—A supplement to this work was published by Giambattista Passeri. Lucæ, 1767, fol. (D. I.)

DEMPSTER *of Court*, the name formerly given in Scotland to the common executioner or hangman.

DEMSTER, or DEEMSTER, a judge; see DEEMSTER.

DEMULCENTS (Lat. *demulceo*, to soften), medicines for removing or counteracting acrimonious humours. Such are the roots of marsh-mallows, gums, and other mucilaginous substances.

DEMURRAGE (Lat. *demorar*, to delay), in *Commerce*, an allowance made to the master of a ship for delay or detention in port beyond the time appointed for his departure. This expense is paid by the merchant who causes the detention.

Demurrer ‖ Denbigh.

DEMURRER, in *Law*, a stop put to any action upon some point of difficulty.

DEMY (Fr. *demi*, half), is used to signify a size of paper intermediate between royal and crown, and measuring 22 inches by 18.

DEMY is also applied to a half fellow at Magdalen College, Oxford.

DENAIN, a village of France, department Du Nord, arrondissement and 14 miles east by south of Douay, near the left bank of the Scheldt. It is celebrated in history as the scene of the decisive victory gained in 1712 by Marshal Villars over the allies commanded by Prince Eugene.

DENARIUS, in *Roman Antiquity*, the chief silver coin among the Romans, worth in our money about 7¾d. It was originally of 62 grains weight; and was considered equivalent to the Attic *drachma*, which, however, weighed 67 grains. It was originally one-seventh, but afterwards fell to one-eighth ounce. (See Arbuthnot on *Coins*.) There was also a golden denarius, of which there is a specimen in the British Museum weighing 60 grains, besides others of less weight. As a weight it was equal to the seventh part of a Roman ounce.

DENARIUS is also used in our law-books for an English penny.

DENBIGH (Welsh *Dinbych*, signifying a hill fort), the capital of the county of the same name, a market and borough town 179 miles N.W. from London, beautifully situated on an eminence in the vale of Clwyd, surmounted by the extensive ruins of the fine old castle. The houses are well built of stone, and there are many very handsome edifices amongst them. The public buildings are not of much pretension. There is a good modern market building lately constructed. The corporation consists of a mayor, six aldermen, and twelve councillors. In conjunction with the boroughs of Holt and Ruthin, it returned one member to parliament from 1536 to 1832, since which time Wrexham has been added as one of the returning towns. Constituency in 1832, 1131; in 1852, 858 only. The political influence is chiefly in the hands of the Myddelton Biddulphs of Chirk Castle (liberal), and the Wests of Ruthin Castle (conservative), and of the Williams Wynns of Wynnstay (conservative). The assessed taxes yield annually L.2668. The annual value of real property paying income tax is L.41,518. The population in 1851 was 16,614. There are weekly markets on Wednesdays and Saturdays, and several fairs in the course of the year. The quarter sessions are held here, but the assizes are held at Ruthin, as being in a more central situation.

A large export trade in leather and shoes, which are manufactured in the town, is carried on; but Denbigh is chiefly resorted to as an agreeable place of retirement.

Denbigh is well supplied with school accommodation. There is a foundation called the Blue Coat School which clothes and educates 24 boys. There is also a grammar-school and a commodious national, as well as British and foreign school. Near the town is a very extensive and well managed asylum for the insane of North Wales.

Denbigh, in ancient times, was a place of great military importance, and the castle was successively vested—after having been wrested from the Welsh—in Henry Lacy, Earl of Lincoln (who built the castle in the time of Edward I.), Roger Mortimer, and Dudley, Earl of Leicester, the favourite of Elizabeth. It was gallantly held by Colonel William Salisbury for the king during the civil wars of the revolution, but finally surrendered to the parliamentary forces under General Mytton.

Denbigh-shire.

DENBIGHSHIRE (Welsh *Sir Ddinbych*), a county of North Wales, which, from its particular configuration, partakes of the characters both of a maritime and inland county. It is bounded N.W. by the estuary of the Dee, N. by Flintshire, N.E. by Cheshire, E. by Cheshire, part of Flint and Shropshire, S. by Montgomery and Merioneth shires, and W. by Caernarvonshire. Its greatest length from S.E. to N.W. is about 39 miles, and its greatest breadth from S.W. to N.E. about 29 miles. It possesses an area of 603 square miles, or 386,052 acres, and is the seventh largest of the Welsh counties. It was in the time of the Romans included in that part of Cambria occupied by the Ordovices, and formed a part of Venedotia, one of the minor partitions of Britannia Secunda.

This county possesses very varied geological features. The west and south are occupied by the lower, middle, and upper Silurian beds. The northern central portion, comprising the celebrated vale of Clwyd, lies upon the new red sandstone; and there is also a considerable extent of the same formation on the extreme east, the intermediate space being occupied by the carboniferous limestone, the millstone grit, and the coal measures; while on the borders of the *new* red in the vale of Clwyd, and separated from it by the mountain limestone, there exists a narrow strip of the *old* red sandstone, serving to illustrate the changes to which the earth's crust has been subjected.

Denbighshire occupies an important position as a mineral county, and possesses very valuable seams of coal and iron; which are extensively worked at Chirk, Ruabon, Minera, and Brymbo. It also exports annually immense quantities of limestone for the purpose of fluxing the ironstone in Staffordshire. Some idea of the extent of this trade may be formed, when it is mentioned that from one quarry alone, that of Col. Myddelton Biddulph, near Llangollen, sometimes as much as from 70,000 to 100,000 tons a-year are sent by canal into the great iron districts of the midland counties. It also possesses extensive slate and flagstone quarries, and some lead mines.

Denbighshire is very mountainous, and is traversed throughout its entire length by the Berwens—the principal mountain range in North Wales, which commences near the sea at Prestatyn, and following a south-east direction along the northern edge of the vale of Clwyd forms the county boundary, separating it from Flint. After approaching the town of Llangollen, the direction of the range is changed to south-west; and after crossing the county at its narrowest part, it again forms the county boundary, separating it from Merioneth. Some of the peaks are lofty and imposing, though far inferior to those of the neighbouring county of Caernarvon. The principal are Cader Fronwen 2563 feet, Cader Ferwyn 2107, and Moel Ferna 2108 feet in height above the level of the sea. These mountains are situated in the extreme south on the borders of Merioneth. In the vale of Clwyd, the Moel Fammau rises to the height of 1845 feet, and is crowned by a pillar commemorating the jubilee of George the Third.

The valleys of Denbighshire have long been famed for their beauty. The best known is the vale of Llangollen, which being embosomed among mountains, and watered throughout its entire length by the river Dee, presents an appearance of romantic beauty hardly to be surpassed. The smiling verdure of the vale is greatly enhanced by the savage grandeur of the surrounding mountains; while the interest is heightened by a conical hill which rises from the middle of the valley, bearing on its summit the grey ruins of a renowned stronghold of Gryffydd ap Maelor, one of the most famous of the Welsh chieftains. In the middle of the county, to the north, lies the vale of Clwyd, said to be the original of Johnson's "Happy Valley. Like the vale of Llangollen, it is surrounded on all sides except its mouth by fine mountains, and is watered by the placid stream from which it takes its name. In the extreme west there is the valley of the Conway in the immediate neighbourhood of the lofty Caernarvonshire mountains. Besides these, there are several other valleys of considerable extent, among which may be mentioned the vale of Mochnant, watered by the Tanat, and the vale of Llansaintfraidd Glyn Ceiriog, watered by the river Ceiriog, from which it takes its name.

Denbigh-shire.

The principal rivers in the county are the Conway, forming the western boundary of the county for a distance of nearly 30 miles. The Dee (Welsh *Du*), which, rises in Merionethshire, enters the county near Llangollen, and first flowing west, crosses the county to the borders of Shropshire, near the village of Chirk, from which point it flows in a direction nearly due north, forming the county boundary, till it leaves it at a point near Chester. The Clwyd also rises in Merionethshire, and traverses the centre of the county in a direction nearly due north, watering the town of Ruthin in its course, and finally leaving the county at St Asaph. The Clwyd ranks among its tributaries the Aled and the Elwy, two considerable streams which traverse the western extremity of the county; while the Dee in the S. and E. has the Gerrw, the Ceiriog and the Alyn. The Ceiriog is a stream of considerable historical interest, as being the scene of the struggles between Owen Glendower, the famous Welsh chieftain, and Henry II.; and it was down this stream that the English monarch retreated after his defeat by the Welsh. A curious confirmation of the correctness of the tradition as to the scene of one of the combats, was lately picked up by a ploughman in the shape of a gold piece of Henry's reign.

Denbighshire possesses few lakes. The most important is Llyn Aled in the S.W. In the S.E., near a village called Llanrhaidr yn Mochnant, is the finest of all the Welsh waterfalls. It is called in Welsh *Pistyll Rhaidr*, two words signifying a spout of water and a cascade, as if to mark its importance by the double expression. It falls nearly 210 feet, and when the stream is full presents a grand appearance.

The climate of Denbighshire is mild and soft in the north and in the valleys; but in the southern and more elevated portions it is cold and bleak. In the valleys, and more especially in the vale of Clwyd, the soil is fertile, and bears excellent crops of corn and turnips; but a great part of the mountainous district is abandoned to the little hardy Welsh sheep, and the no less hardy Welsh ponies, which brave the blasts of winter on these savage wastes without shelter, subsisting on the scanty herbage and on the shoots of the heath, when the snow prevents their reaching the grass. The cereal crops consist of wheat, oats, barley, and bere; turnips, pease, beans, potatoes, vetches, carrots, and mangold-wurtzel. The vale of Clwyd annually exports a large quantity of wheat to Liverpool. The other exports are cattle, sheep, and ponies; butter, cheese, and wool; oats and barley; timber and oak-bark; slates, paving flags, iron, coals, and limestone; also lead ore; paper and Welsh flannels, for the manufacture of which there are several mills in the county; also leather, shoes, and millstones. The farms are generally of considerable size, and great efforts are making to improve the farming. These have as yet been most successful at Chirk in the E., where the quality of the farming is rapidly approaching that of the best farmed districts: there, also, the best description of Cheshire cheese is made. It is calculated that about one-half of the county is in open sheep-walks or heaths.

There are two railways in the county,—one in the east from Chester to Shrewsbury, the other in the west passing along the shores of the estuary of the Dee from Chester to Holyhead,—two others have been projected to pass through the centre of the county from east to west. There is a very excellent canal, a branch of the Chester and Ellesmere, which traverses the vale of Llangollen from a point immediately beyond the town, and leaves the county at a point near the village of Chirk. This canal in its course passes

Denbighshire.

over the valleys of the Ceiriog and the Dee on two aqueducts constructed by the celebrated Telford, and considered amongst the finest of his works; but although these are now dwarfed in comparison by the splendid viaducts of the Shrewsbury and Chester railway over the same valleys, still the Pont y Cysyllte, the aqueduct over the Dee, remains an elegant monument of mathematical skill and genius when such great works were less common than they now are.

The principal towns are Denbigh, Ruthin, and Wrexham; but besides these there are Llanrwst, Abergele, Holt, and Ruabon. Denbigh, Ruthin, and Holt, are boroughs. The county has returned two members to parliament since the reform act period; from 1536 to which time it only sent one. The political influence is chiefly in the hands of Sir Watkyn Williams Wynn of Wynnstay, and Col. Myddelton Biddulph of Chirk Castle, who is also lord lieutenant. Constituency in 1852, 3901. The average gross rental of the county is estimated at fourteen shillings per acre. The annual value of real property paying income-tax is L.431,504.

The population of the county by the last census was 92,583, giving an average of 153 persons to a square mile, or 4·2 persons to an acre. Of the total number, 46,708 were males, and 45,875 females. The number of inhabited houses was 18,352, uninhabited 994, building 168; giving an average of 32 inhabited houses to a square mile, and 4·8 persons to each house. The following table gives the census return for the last fifty years:—

1801.	1811.	1821.	1831.	1841.	1851.	Increase of Population per cent. in Fifty Years.
60,299	64,249	76,428	82,665	88,478	92,583	54

It is calculated that about one-fourth part of the whole population are in the condition of labourers, servants, &c.; about 9 per cent. live by trade, manufactures, &c., and nearly 13 per cent. by agriculture; while about two thousand persons possess independent means.

In 1847 the total number of children of the working-classes at day-schools within the county was 7405. The total number of schools was 127, of which 60 were church or national, with 3846 scholars; 2 Calvinistic Methodists, with 92 scholars; 2 Independents, with 84 scholars; 1 Wesleyan, with 85 scholars; 11 British and Foreign, with 1740 scholars; 11 without any precise distinction, with 626 scholars; 2 workhouse, with 123 scholars; 38 private adventure, with 809 scholars. In 119 of these schools, instruction was given in English only, and in 8 in Welsh and English. It appears that the average annual income of the teachers was L.25, 18s., and that the average annual income of each school was L.31, 3s. 6d. The total number of Sunday schools was 235, with 23,806 scholars, of which 32 were Church of England, with 3145 scholars; 19 Baptist, with 1343 scholars; 104 Calvinistic Methodist, with 13,066 scholars; 40 Independent, with 3023 scholars; 38 Wesleyan, 2980 scholars. Other denominations, 2 with 249 scholars. A very considerable number of the inhabitants use Welsh habitually, but the proportion who can speak English also is rapidly increasing.

This county contains some fine old castles and other structures and remains of interest and importance. Denbigh Castle, now in ruins, has been likened to Stirling, in respect of its situation. It is placed on the summit of a commanding eminence in the vale of Clwyd, and, even in ruins, presents a grand and imposing appearance. Ruthin Castle, also in the vale of Clwyd, the residence of Mr Frederick West, is a fine extensive structure of red sandstone, rising in the midst of and overlooking the town of Ruthin. It has lately been partly rebuilt by the present possessor. Chirk Castle, in the east of the county, is one of the finest specimens of the old Norman strongholds remaining in a perfect condition in the country. The present structure dates from a very remote antiquity, and is said to have been built on the site of a still older structure of the pre-historic period. It was a place of great importance during the revolutionary period, and was besieged and occupied by the royalists and republicans in succession; Charles himself having on one occasion occupied it for some days. The present possessor of this noble edifice has lately had it placed in the most perfect repair, in accordance with the style of the period to which it belongs. Wrexham Church is a fine structure of the time of Henry VII., and was long reckoned one of the wonders of Wales. The tower of this church is one of the most beautiful in existence. There is a most interesting ruin of an abbey of Cistercian friars near Llangollen, generally known by the name of Valle Crucis, so called from the pillar or cross of Eliseg, which stands in a ruinous condition in the valley near the abbey.

Denderah || Denham.

The celebrated Sir Hugh Myddelton, who brought the New River to London, was a native of this county.

DENDERAH, the ancient Tentyris, now a mere village on the left bank of the Nile. It possessed a magnificent temple, of which extensive remains still exist. See EGYPT.

DENDERMONDE, or TERMONDE, a fortified town of Belgium, capital of a cognominal arrondissement in the province of East Flanders, at the confluence of the Dender with the Scheldt, 16 miles east of Ghent, and on the line of railway from the latter place to Mechlin. Pop. (1851) 8225. It is defended by a citadel constructed in the sixteenth century; and has a town-hall, several churches and chapels, numerous schools, a hospital, lunatic and orphan asylums, &c.; also extensive bleaching and dye works, cotton factories, and breweries; and the vicinity is celebrated for the growth of fine flax.

DENDRITIC, containing the figures of shrubs or trees, as a dendrite or arborescent mineral.

DENDROMETER (δένδρον, a *tree*, and μετρέω, *to measure*), an instrument for measuring trees, invented by Duncombe and Whittel. It is fitted to a theodolite, and may be used either with or without it, as occasion requires. Its principal use is to measure the length and diameter of a tree, perpendicularly or obliquely to a horizontal plane, or in any situation of the plane on which it rests, or of any figure, whether regular or irregular, and also the length and diameter of the boughs, by mere inspection. The inventors also calculated tables, by the help of which the quantity of timber in a tree may be obtained without calculation or the use of the sliding rule. Roger's dendrometer is an instrument for the same purpose.

DENDROMETER, an instrument for measuring distances by a single observation, proposed by Mr Pitt of Pendeford, near Wolverhampton. See *Repertory of Arts*, vol. i.

DENDROPHORIA, in *Antiquity*, the carrying of boughs or branches of trees; a religious ceremony, so called because certain priests, thence called *dendrophori* or tree-bearers, marched in procession, carrying the branches of trees in their hands in honour of some god, as Bacchus, Cybele, and Sylvanus. The college of the dendrophori is often mentioned on the ancient marbles; and in basso-relievos, bacchanals are frequently represented carrying little shrubs or branches of trees.

DENEB, an Arabic term signifying *tail*, and used by astronomers to denote several fixed stars. Thus, *deneb elect* signifies the bright star in the Lion's tail; and *deneb adigege* that in the Swan's tail.

DENHAM, SIR JOHN, an eminent English poet, the only son of Sir John Denham, chief baron of the exchequer in Ireland, was born at Dublin in 1615. His father having, in 1617, been made a baron of the exchequer in England, he received his education in that country; and in his youth he was greatly addicted to gaming. In 1641 he published a tragedy called the *Sophy*, which was much ad-

Denier ‖ Denina.

mired by the best judges; and in 1643 he composed his *Cooper's Hill*—a poem which Dryden says will ever be the standard of good writing for majesty of style. Denham was sent as ambassador from Charles II. to the king of Poland; and at the Restoration he was made surveyor-general of his Majesty's buildings, and created Knight of the Bath. On obtaining this post he is said to have renounced poetry for more important studies. He died at his office in Whitehall in 1668; and his works have since been often printed. The sixth edition is that of 1719; but besides this collection, Wood mentions several pieces, which are either his productions, or have been ascribed to him. "Denham," says Dr Johnson, "is deservedly considered as one of the fathers of English poetry. Denham and Waller, according to Prior, improved our versification, and Dryden perfected it. He appears to have had the ambition of being upon proper occasions a merry fellow; and to have been by nature or by early habits debarred from it. Nothing is less exhilarating than the facetiousness of Denham. He does not fail for want of effort: he is familiar, he is gross; but he is never merry, unless the 'speech against peace in the close committee' be excepted. For grave burlesque, however, the imitation of Davenant shows him to have been well qualified. *Cooper's Hill* is the work that confers upon him the rank and dignity of an original author. He seems to have been, at least amongst us, the author of a species of composition that may be denominated local poetry, of which the fundamental subject is some particular landscape, to be poetically described, with the addition of such embellishments as may be supplied by historical retrospection or incidental meditation. He appears to have been one of the first that understood the necessity of emancipating translation from the drudgery of counting lines and interpreting single words. How much this servile practice obscured the clearest and deformed the most beautiful parts of the ancient authors, may be discovered by a perusal of our earlier versions. Denham saw the better way, but has not pursued it with great success. His versions of Virgil are not pleasing, but they taught Dryden to please better."

DENIER, a small French copper coin, of which there were twelve to a sol.

DENINA, Carlo Giovanni Maria, an eminent Italian writer, was born at Revel, in the principality of Piedmont, in the year 1731. Having studied at Saluzzo, he was about to enter into the order of the Grand Augustines at Ceva, at the age of fifteen, when one of his uncles appointed him to a benefice. He accordingly assumed the ecclesiastical habit, and remained two years at Saluzzo, where he learned a little divinity, and acquired a knowledge of the French language through the medium of a Swiss officer. In 1748 he obtained an exhibition, which enabled him to prosecute his studies at the provincial college in the University of Turin. Some time afterwards he took orders; and in 1753 he was appointed professor of humanity at Pignerol. In consequence, however, of a quarrel with the Jesuits, he was obliged to quit Pignerol and the royal schools, and was sent to the schools of an inferior order. In 1756, on taking his degree of doctor in theology at the Palatine schools of Milan, he printed his first work, which was a theological tract. After this he was restored to the royal schools, and appointed extraordinary professor of humanity and rhetoric at the Superior College of Turin; and six months afterwards he had the offer of the situation of an ordinary professor at Chambéry, which he refused. About this period he projected, but did not execute, a work on the literary history of Piedmont. His discourse *On the Vicissitudes of Literature*, which was printed in 1760, attracted a considerable degree of attention, and drew upon him the vengeance of Voltaire, who attacked him in his *Homme aux quarante écus*, published in 1767. The publication of the first volume of his great work *On the Revolutions of Italy* obtained for him the professorship of rhetoric in the Superior College of Turin; and twelve months afterwards, on the publication of the second volume, he was preferred to the chair of Italian eloquence, and of the Greek language, at the university. The third volume, which was published in 1771, was still more favourably received than the preceding; while at the same time it tended to augment the number and to increase the virulence of his enemies. The misfortune, however, which he now experienced, was partly occasioned by his own indiscretion. A manuscript, containing some obnoxious opinions, which he had entrusted to Cambiagi at Florence, having been published by authority of the Tuscan censors, but without that of the censors of Turin, Denina was declared to be guilty of an infraction of the Piedmontese laws, and punished with great severity. His book was suppressed, and he was compelled to pay the costs. He was then banished to Vercelli, and afterwards received orders to retire to his native province. Denina's friend, the Abbé Costa d'Arignan, undertook his defence, and procured the restoration of part of his annual pensions, with permission to return to Turin.

Denina.

In 1782 he repaired to Berlin, having before his departure received the honorary title of librarian to the king of Sardinia. On his arrival at Berlin, Frederick II. appointed him a member of the Royal Academy, but he never became a favourite of that prince. He continued to reside in Germany for many years, where he occupied himself with literary pursuits, and published a variety of works. Being at Mentz in 1804, he attracted the notice of Napoleon, who, in the month of October of that year, appointed him his librarian. Denina accordingly went to Paris, where he continued to reside until his death, on the 5th of December 1813.

Denina is esteemed one of the most distinguished of the later Italian authors. The work upon which his reputation is principally founded is his *History of the Revolutions of Italy*, of which an improved edition was published at Turin in 1782, in five volumes 4to. In this work the facts are related with accuracy, and the narrative exhibits considerable talent for historical inquiry. Some able critics in the Italian language have remarked that there is a great difference between the style of this work and that of the other writings of the same author; and Denina acknowledged that he had submitted his history to the review of his friend the Abbé Costa d'Arignan, afterwards Cardinal and Archbishop of Turin, who made a good many judicious corrections.

The following is a list of his other works:—*De Studio Theologiæ et norma fidei*, 1758, 8vo. *Discorso sopra le vicende della Letteratura*, 1760, 12mo, which was reprinted, with additions, at Glasgow, in 1763, and has since gone through several editions. *Lettera di N. Daniel Caro* (the anagram of Carlo Denina), *sopra il dovere de' ministri evangelici di predicare colle istruzioni, e coll' esempio l'osservanza delle leggi civili, e specialmente in riguardo agl' imposti*, Lucca, 1762, 8vo. *Saggio sopra la Letteratura Italiana, con alcuni altri opuscoli*, Lucca, 1762. This work is a supplement to the first edition of his *Revolutions of Literature*. *Delle Lodi di Carlo Emmanuele III. re di Sardegna*, 1771, 4to and 8vo. *Panegirico primo alla Maesta di Vittorio Amedeo III.*, Turin, 1773, 4to and 8vo. *Panegirico secondo alla Maesta di Vittorio Amedeo III.*, 1775, 4to and 8vo, with notes. In 1777 he composed a third panegyric on the same prince. *Bibliopea, o l'arte di compor libri*, Turin, 1776, 8vo. *Dell' impiego delle persone*, Florence, 1777. This was the work which gave so much offence, and occasioned the persecution of the author. It was reprinted at Turin, 1803, in 2 vols. small 8vo. *Istoria politica e letteraria della Grecia*, Turin, 1781–2, 4 vols. 8vo. Reprinted at Venice, 1783. *Elogio storico di Mercurino di Gattinara*, Turin, 1782, 8vo. *Elogio del Cardinal Guala Bichiere*, 1782, 8vo. *Discors au Roi de Prusse sur les progrès des Arts*, 1784, 12mo. *Viaggio Germanico, primo quaderno delle lettere Brandenburgensi*, Berlin 1785, 8vo. A second series of these letters afterwards appeared. *La Sibilla Teutonica*, Berlin, 1786. Reprinted in the fourth volume of the *Revolutions of Literature*. *Réponse à la question Que doit on à l'Espagne?* Berlin, 1786. This tract was translated into Spanish, and was also printed at the end of the later editions of the *Vicende*. *Lettres Critiques*, a supplement to the preceding, 1786, 8vo. *Apologie de Fréderic II. sur la préférence que le Roi parut donner à la Littérature Française*, Dessau, 1787, 8vo. *Dis-*

Denis ‖ Denmark.

cours sur les Progrès de la Littérature dans le nord de l'Allemagne, Berlin, 1788. *Essai sur la Vie et le Règne de Frédéric II.* &c., Berlin, 1788, 8vo. *La Prusse Littéraire sous Fréderic II*, &c, Berlin, 1790–1, 3 vols, 8vo. This work may be considered as a supplement to the Life of Frederic. *Guide Littéraire*, 1790–1, 8vo. *The Russiad*; a poem, 1799. It was translated into French by M. André in 1809, under the title of *Pierre le Grand*. *The History of Piedmont, and of the other States of the King of Sardinia*; translated into German by M. Frederick Strass, from the Italian manuscript of Denina, Berlin, 1800–5, 3 vols. 8vo. In this history the narrative is brought down to the recovery of Turin, under the reign of Victor Amadeus II. *Revoluzioni della Germania*, Florence, 1804, 8 vols. 8vo *La Clef des Langues, ou Observations sur l'Origine et la Formation de principales Langues qu'on parle et qu'on écrit en Europe*, Berlin, 1804, 3 vols. 8vo. *Tableau Historique, Statistique, et Morale de la Haute-Italie*, &c., Paris, 1805, 8vo. *Essais sur les traces anciennes du caractère des Italiens modernes*, &c, 1807, 8vo. *Discorso istorico sopra l'origine della gerarchia e de' concordati frà la podesta Ecclesiastica e la Secolare*, 1808, 8vo. This work was afterwards suppressed. In the *Mélanges de Philosophie, d'Histoire, de Morale, et de Littérature*, No. 49, there is a long and severe article upon the *Discorso Istorico*. *Istoria della Italia occidentale*, 1809, 6 vols 8vo. Besides these works, Denina wrote some other tracts, which were inserted in various journals.

There is a biographical account of Denina in the *Magazin Encyclopédique* for January 1814, by M Barbier. See also the *Biographie Universelle*. (J C)

DENIS, ST, a small town of France, department of the Seine, on the line of the Great Northern railway, about five miles from Paris. It stands not far from the right bank of the Seine, at the junction of two small streams, the Rouillon and the Croud, and is traversed by a branch of the grand canal de l'Ourcq. St Denis is without the fortifications of Paris, but within the circle of forts with which that city is now girded round on every side. It is clean and well-built, and has an appearance of industry and thrift such as few towns of the same size in France possess. The antiquity of the town is very great. It is said that the martyred St Denis was buried here about the middle of the second century, and that a chapel was erected over his grave. Four centuries later the chapel was replaced by a handsome oratory, which in turn gave way to a splendid church. On the site of this latter edifice was built the magnificent abbey church, which now constitutes the principal ornament of St Denis. It was begun in 1130, and not completed till 1281. In the crypts of this church the whole Capetian dynasty of France was interred, the body of each king being buried in the floor of the church in front of the high altar, where it lay till the next king died. It was then removed to the crypts, and its place occupied by the coffin of the succeeding monarch. The last king thus interred was Louis XVIII., whose remains have lain undisturbed since his death before the high altar. On the outbreak of the first French revolution it was decreed by the convention that these monuments should be destroyed. They were accordingly broken open by the mob, who treated with the most revolting indignities the bodies of the dead kings, many of which were found nearly entire. Under the Directory the old windows of stained glass were removed, the lead stripped from the roof, and serious thoughts were entertained of levelling the cathedral with the ground. When Napoleon assumed the reins of government, he began to restore the church, and after various interruptions this work was completed by Louis Philippe on a scale of greater magnificence than the church had ever exhibited before. The abbey of St Denis, to which this church was an appendage, was suppressed in 1792. The abbey buildings have been converted into a school, in which the orphans of members of the Legion of Honour receive a gratuitous education. St Denis possesses a considerable trade. In the town are several large flour mills, some manufactories of chemicals, cotton mills, bleaching-greens, &c. A fair of great importance is annually held at St Denis in the latter end of June, and lasts for a fortnight. Pop. of commune (1851) 12,213.

Denizen ‖ Denmark.

DENIZEN (Welsh, *dinassdyn, man of the city*), in *Law*, an alien made a subject by letters of denization granted by the crown through the home-secretary of state.

A denizen is in a kind of middle state between an alien and a natural-born subject. He may take lands by purchase or devise, which an alien may not; but he cannot take by inheritance, for his parent through whom he must claim, being an alien, had no inheritable blood, and therefore could convey none to the son; and upon a like defect of blood, his issue born previous to his denization cannot inherit, but his issue born after may. A denizen is not excused from paying the alien's duty, and some other mercantile burdens. No denizen can be of the privy-council, or sit in either house of parliament, or hold any office of trust, civil or military, or receive any grant of lands, &c., from the crown.

Denization differs from naturalization only in degree; the latter merely conferring a few additional privileges.

The act 7th and 8th Vict. cap. 66, affords greater facilities for the naturalization of an alien than formerly existed for obtaining the lesser privilege of denizenship; and hence it is probable that denization will be superseded entirely.

DENMAN, THOMAS, *Lord*, one of the most distinguished of the chief-justices of England, was born at London 23d July 1779. He received the rudiments of his education at Palgrave School, near Diss, in Norfolk, at that time conducted by Mrs Barbauld. After attending various preparatory schools he was entered at St John's College, Cambridge, where he graduated honourably in 1800. Soon after taking his degree he married; and in 1806 was called to the bar at Lincoln's Inn, when he engaged in the active pursuit of the law. At the general election of 1818, he was returned M.P. for Wareham, and at once took his seat with the Whig opposition. In the following year he was returned for Nottingham, for which place he continued to sit till his elevation to the bench in 1832. His liberal principles had obtained his exclusion from office till in 1822 he was appointed common serjeant by the corporation of London. In 1830 he was made attorney-general under Lord Grey's administration. Two years later, after his elevation to the bench, he was raised to the peerage. In 1850 he resigned the chief-justiceship of the queen's bench and retired into private life, followed by the best wishes of the numerous friends whom he had attached by the integrity of his personal character, his noble efforts for the abolition of the slave-trade, and his unceasing exertions in the cause of law and political reform. Lord Denman died September 26, 1854.

DENMARK,

History.

A KINGDOM in the north of Europe, small in extent and scanty in population, but known in history from an early period of the Christian era. There is no authentic account of the origin of the name of Denmark, nor of the quarter from which the country received its early inhabitants. From the similarity of the Danish and German languages, as well as from the general course of migration in early ages, it seems probable that Denmark was peopled by immigrants from the south—from Holstein, Hanover, and Saxony. There are no means of ascertaining whether natives of Denmark formed part of the formidable hordes which passed the Roman frontiers in the fifth and sixth centuries; but the attacks on this empire were probably made by tribes less remote, the expeditions of the Danes being in general

Maritime expeditions of the Danes.

maritime. For such expeditions they were remarkable as early as the eighth and ninth centuries, as was proved by their repeated invasions of England, their occasional descents on Scotland, and their conquest, followed by permanent occupation, of Normandy. To cross a sea of three or four hundred miles in breadth was a bold undertaking for men unacquainted with the use of the compass; but the number of islands in Denmark early accustomed the inhabitants to navigation, and gave them a practical dexterity in it, similar to that acquired by the Dutch from their vicinity to arms of the sea, and to the mouths of great rivers. Both countries proved the advantage of a maritime position, for in those days neither France nor England were capable of sending forth a naval armament.

At the period in question, or rather somewhat later, viz. about the early part of the tenth century, commences the authentic history of Denmark. Till then the country, ill cultivated and thinly peopled, seems not to have been subject to one sovereign, but to have obeyed provincial or local rulers, like England during the Heptarchy. Alfred had, it is well known, various conflicts with those northern invaders; but he had the judgment eventually to suspend hostilities, and to assign to them a portion of his territories. He knew how small a part of England was cultivated, and he considered that there was ample room in the country for both Dane and Saxon. The establishment thus given to the Danes in England, and the subsequent arrival of bodies of their countrymen, joined to the talents of two of their princes, Sweyne and Canute, enabled the latter to acquire the crown of England. Canute completed the conquest begun by his father, and became king of England as well as of Denmark in the year 1017: he resided generally in this country, and left the crown to his sons Harold and Hardi-Canute. On the death of the latter, without male heirs, the Danish dynasty in England came to a close in 1041. After the eleventh century, we read of no invasion of England by the Danes, although a considerable proportion of the inhabitants of our eastern and northern counties were doubtless descended from Danish settlers.

Settled in the east part of England.

The progress of society and the course of political events in Denmark resembled in several points those of our own country. The feudal system was introduced there in the twelfth century, which, as well as the thirteenth, were marked in Denmark, as in England, by contentions between the sovereign and the barons, and by concessions from the former in the style of Magna Charta. About the thirteenth century, the population of towns in Denmark, as in Germany and the central parts of Europe, though still very small, became such as to entitle them to obtain from the crown charters of incorporation, and an exemption from the control of the barons, in whom was vested almost the whole property of the land. A regular constitution began now to be formed in Denmark; and the towns sent deputies or representatives to the states or parliament, which, it was enacted, should meet once a-year. It was also ordered that the laws should be uniform throughout the kingdom, and that no tax should be imposed without the authority of parliament.

Similarities in Danish and English history.

It would be tedious and uninteresting to recapitulate the successive sovereigns of Denmark in the middle ages, of whom few were of distinguished ability. The names of most frequent occurrence among them in those early times were Canute, Valdemar, and Eric. Those of Christiern or Christian and Frederick were of later date. One of the most remarkable of the Danish sovereigns in the middle ages was Valdemar II., who succeeded to the crown in 1203, and some time afterwards proceeded to Livonia, in which his predecessors had endeavoured to introduce Christianity. He found no great difficulty in defeating bodies of men so little advanced in civilization as to be clothed in the skins of wild beasts; but a country in so barbarous a state presented little attraction in either a commercial or political sense; so that the Danes found little inducement to extend their settlements on the southern shores of the Baltic.

The chief mercantile intercourse of Denmark in those times was with Lubeck and the north-west of Germany. To the Baltic Lubeck was nearly what Venice was to the Mediterranean, the earliest commercial town of consequence. There was also some traffic from Denmark to the mouths of the Vistula; the name of Dantzic or Dansvik (Danish town or port) indicating that a Danish colony, aware of the advantages of the situation, had established itself there. The more remote provinces of Courland and Esthonia were also objects of ambition to the Danes; but they did not find it practicable to keep settlements there. Holstein was more within their control, and much more advantageous, from the comparative civilization of its inhabitants.

Lubeck and Dantzic.

At the time of which we are now treating, namely, the fourteenth century, the association of the Hans Towns had acquired considerable strength, and asserted strenuously the freedom of commerce in the north of Europe. Denmark, commanding the great entrance into the Baltic by the Sound, was the power most interested in laying merchant vessels under a toll or regular contribution; and the result was repeated contentions, followed at times by open war, between the Danish government and this powerful confederacy.

Hans Towns.

The most important event in the history of Denmark, or indeed of Scandinavia, in the middle ages, was the conjunct submission of Sweden, Denmark, and Norway to one sovereign, by the compact or union of Calmar, in the year 1397. The circumstances were as follows: Valdemar III., king of Denmark, having died in the year 1378, left two daughters, of whom the second, Margaret, was married to Haquin or Haco, king of Norway. On the demise of her husband the government of Norway remained in her hands; and afterwards, on the death of her son, who had been declared king of Denmark, the states or parliament of that country fixed this princess on the throne, on her consenting to extend and secure their rights and privileges. The states of Norway followed their example; so that Margaret, finding herself seated on the thrones of Denmark and Norway, directed her attention to that of Sweden, the succession to which would have fallen to her husband Haquin had he survived. The Swedes were divided into two parties—that of Margaret, and that of a Duke of Mecklenburg, who, though unconnected with the royal family of Sweden, claimed to be king by election. Margaret, a princess of great activity and ambition, was indefatigable in obtaining the support of the clergy and nobility of Sweden; an appeal to arms took place, and the result was favourable to the cause of the queen, her competitor being defeated and made prisoner. In 1397 the states of the three kingdoms were convoked at Calmar, a town centrally situated for such an assemblage, being in the south of Sweden. There they concurred in passing the well-known act called the Union of Calmar, the purport of which was, that the three kingdoms should henceforth be under one sovereign, who should, however, be bound to govern each according to its respective laws and customs. To guard against their separation, it was enacted, that if a sovereign should leave several sons, one of them only should be the ruler of the three kingdoms, the other holding fiefs under him; and in the event of the reigning king or queen dying without children, the senators and parliamentary deputies of the three kingdoms should jointly proceed to the election of another sovereign, that the union of the kingdoms might be maintained.

Union of Calmar.

Such were the precautions taken by this vigilant and able princess, who has been called the Semiramis of the North, in order to banish war and political dissensions from Scandinavia. For a time they were successful, and peace

and concord were maintained during the lifetime of Margaret and two of her successors. But the union, as regarded the Swedes, was far from being cordial; they submitted reluctantly to a foreign family, and considered themselves as obliged to act in subserviency to the political views of Denmark. They saw the chief places of trust in their country conferred on Danish or German ministers, and viewed these foreigners with as much jealousy as the Belgians in our day felt towards the Hollanders introduced by the house of Orange. These and other causes prevented the union of Sweden from being cordial or complete. Local insurrections, fomented by particular classes, and strengthened by national antipathy, occurred from time to time during the century, or somewhat longer period, that the union of Calmar continued to exist. At last the severity, or rather the cruelty, of one of the Danish kings, Christian II., and the appearance of an able assertor of Swedish independence in Gustavus Vasa, a man of rank, led to an insurrection, which beginning in the northern province of Dalecarlia, extended throughout Sweden, and led to a definitive separation of the two crowns in the year 1523.

Sound dues paid by English vessels.

In 1490 the reigning king of Denmark made a commercial treaty with Henry VII. of England, by which the English engaged to pay the Sound dues on all vessels entering or returning from the Baltic; and in return they were allowed to have mercantile consuls in the chief sea-ports of Denmark and Norway. By this time the extension of trade had given rise in Denmark, as in England, to a middle class, among whom the sovereign found in each country the means of balancing the political weight of the nobility; hence a grant was made by the kings of Denmark of various privileges to traders, and relief from a number of local imposts on the transit of merchandise.

Plundering shipwrecked vessels.

The rude habits of the age were strongly marked by the difficulty which the Danish government found in putting a stop to the practice of plundering merchantmen shipwrecked on the coast. Vessels proceeding to and from the Baltic necessarily approached the coast of Jutland, particularly in an age when the ignorance of mariners led to their considering the vicinity of the land in the light of a protection. Shipwrecks were consequently of frequent occurrence there, and were generally turned to the profit of the nobility, who were proprietors of the maritime districts. We may here remark, that the nobles claimed not only the soil, but even the persons of the peasantry; for the principle of personal bondage was until lately maintained in Denmark. The practice was to collect in the vicinity of a wreck such a number of the inhabitants as to prevent the master or mariners from opposing the seizure of the merchandise. Even bishops residing on the coast, though humane in their treatment of the crews, did not scruple to aid in taking forcible possession of the cargo; so crude were in those days the notions of justice towards merchants. It is a remarkable fact, that a law passed by the king about the year 1521 for the prevention of these practices was abrogated and publicly burned at the instance of the barons and clergy a few years after, when a new sovereign had succeeded to the crown.

The Reformed faith introduced into Denmark.

The doctrines of the Reformation happily found their way into Denmark at an early date. Frederick I., who began to reign in 1525, and had formerly been duke of Holstein, in that year embraced the Protestant religion. The inhabitants of Denmark being divided between the Catholics and Protestants, Frederick began by an edict for tolerating both religions. An assembly of the states or parliament next passed a solemn act for the free preaching of the Reformed faith, and for allowing ecclesiastics of any class to marry and reside in any part of the kingdom. The consequence of this was a reduction of the number of the inmates of abbeys, monasteries, and convents, along with the general diffusion of the Lutheran faith throughout the kingdom. This rapid progress enabled the succeeding sovereign, Christian III., to act like Henry VIII. of England, by annexing the church-lands to the crown, and strengthening the power of the sovereign at the expense of that of the clergy.

The great religious war which broke out in 1618 for the first time fixed the attention of Europe on Denmark. The victories of the Imperial General Tilly, and Maximilian of Bavaria, over the Protestants, appeared to make the Emperor Ferdinand, who was the head of the Catholic party, complete master of Germany, when Christian IV. of Denmark, encouraged by England and France, determined to take up the Protestant cause as a principal in the general contest. But being weakly supported by his allies, the Danish king, after one year's campaign, was obliged to fly before the victorious army of Wallenstein (1626), and to sue for peace, which was concluded at Lubeck 1629. By the stipulations of this peace Denmark bound itself never to interfere in the affairs of Germany, and was besides compelled to acknowledge Wallenstein Duke of Mecklenburg. This peace would have been still more humiliating for Denmark, if France, already influenced by the counsels of Richelieu, had not interposed its efforts on behalf of the vanquished. The emperor now thought of nothing less than the entire subjection of Germany to his will. A new adversary, however, arose in Gustavus Adolphus the king of Sweden. The short and glorious career of this king will be found described in its proper place. But this much must be here observed, that despite the fall of Adolphus in the battle of Lutzen in 1632, the power of Sweden was becoming continually more considerable and consequently an object of real envy to all its neighbours, but especially to Denmark. Thus it happened that, besides the general religious war, repeated hostilities were being carried on between Sweden and Denmark separately.

Treaty of Copenhagen.

The first contest lasted from 1637 to 1645, and the treaty concluded in the latter year proved rather a truce than a peace. The Danish government formed an alliance with Holland, and aided that republic in her sanguinary contest in 1652 with England, then under the authority of Cromwell. The king of Sweden at that time was Charles Gustavus, a prince in the vigour of life, and actuated by all the ambition and enterprise of the house of Vasa. He had carried his military operations into Poland, which then, as at other times, seemed to invite the presence of foreigners by its internal dissensions. But on learning the hostile disposition of the Danish government, Charles withdrew his troops from Poland, entered Holstein, and overran the whole province. As soon as the winter had advanced, and it had become practicable to cross on the ice the arms of the sea separating the Danish islands from the mainland, the Swedish army traversed in that manner the Little Belt, took Odensee, the capital of the island of Funen, and even invested Copenhagen. That capital was not without a military force, but its walls were weak, nor was it adequately supplied with provisions or military stores. On this occasion the Danes, with their king Frederick III. at their head, discovered great firmness, and resisted the efforts of the Swedes, until, under the mediation of the English envoy at the court of Copenhagen, hostilities were suspended, and a treaty signed. This treaty, however, was only partly carried into execution. Dissatisfied at the delay which took place, Charles Gustavus made a second attempt on Copenhagen in the autumn of 1658; but he found it impracticable to prevent supplies being introduced into the city by sea, as the Dutch now came to the assistance of their Danish allies. Still the Swedes persisted in the siege, and in the depth of winter (in February 1659) made an attempt to take Copenhagen by storm. The attacks were made on three points, each headed by an able commander, but each was unsuccessful, and the siege was necessarily converted into a blockade. Soon afterwards the king of

Sweden died, and the sanguinary contest was brought to a close by the treaty of Copenhagen in 1660. This peace ceded to the Swedish crown Sconia, Aland, several places on the island of Rugen, and a free passage through the Sound.

Revolution in the constitution of Denmark.

In the following year, 1660, the vicissitudes of war were succeeded by a remarkable revolution in domestic politics. The reigning king of Denmark had gained great popularity, as well by his spirit and firmness in the field, as by resisting the claims made by the nobility to the disadvantage of the other orders of the state. He was thus assured of the support of the middle classes in any attempt to reduce the power of the nobility. On assembling the states or parliament, the representatives of the different towns were found sufficiently strong, when united with the clergy and strengthened by the power of the crown, to outweigh the influence of the nobility, and the court determined to act with vigour in extending its prerogative. The political contest began about the crown lands, which had hitherto been let to nobles only, and at very low rents. It was proposed and carried in the parliament, that men of any class or station might henceforth be candidates for them, and that they should be let to the highest bidder. The next proposition of the clergy and commons was, that the crown, hitherto in some degree elective, should be so no longer, but should devolve, as a matter of right, on the lawful heir, whether male or female. To a people who had suffered so greatly from the contentions of factions, this proposition was highly acceptable; and even the nobility felt the necessity of concurring in the measure, which was followed by an alteration in the coronation oath of the sovereign. That oath had hitherto specified explicitly the rights of the nobility, but it henceforth contained no stipulation on the part of the sovereign. The record or original of the oath which the reigning king had signed at his accession, and which limited his authority, was surrendered to him, and an engagement of unqualified allegiance was then taken by each of the orders. These important changes were, some time afterwards, followed by an act or law still more comprehensive and absolute, which invested the sovereign with unlimited power, and declared him to possess the right to make, repeal, and interpret any law, or to enter into any engagement without reference to parliament. This applied equally to foreign and domestic affairs. Henceforth, in Denmark, whatever power could be shown to have belonged to any ruler in any country, was now forthwith to be understood as belonging to the king.

This remarkable change in the form of the government is to be explained chiefly by the repugnance of the people of Denmark to the ascendency of the nobility. The French revolution proceeded from causes somewhat similar; but in Denmark the control possessed by the privileged class was not tempered, as in France, by civilized and refined habits. The direct authority of the nobles was also greater, for they possessed the power of life and death over their vassals. Many of them attempted to resist the change, but without success—so powerful was the union of the people and the sovereign. Frederick lived ten years after this singular revolution; a period which enabled him to consolidate it, and to reinstate in peace the trade and finances of his country.

Renewed war with Sweden.

His successor, led away by the ardour of youth, abandoned the pacific policy of his father, and ventured to make war against Sweden. He relied on the aid of the Elector of Brandenburg, commonly called the Great Elector; the possession of so extensive a country as Prussia placing him quite at the head of the princes of the empire. Swedish Pomerania was chosen as the scene of operations, from being open to attack by the Prussians. The Swedes were overmatched in force, but being well commanded, they made a firm and spirited resistance. By sea the Danes had the advantage, having the aid of a Dutch squadron commanded by the well-known Van Tromp. This enabled them to convey an invading force to Schonen or Scania, the southern and most fertile province of Sweden. Here the forces of the Swedes were brought to bear against their opponents, with the advantage of vicinity to their supplies; nearly in the same way that the military means of France were at that time concentrated in Flanders and Alsace against those of more distant powers. The result was, that the Danes were obliged to retreat from Scania, and, after several alternations of success, peace was signed between the two kingdoms in 1679, the year after the treaty of Nimeguen had suspended the war in the central part of Europe. As usual, after much bloodshed and many vicissitudes of fortune, the adverse states were placed by the treaty in nearly the same situation as at the commencement of the war; but hopes of peace for the future were justified by the marriage of the young king of Sweden, Charles XI., with a princess of Denmark.

These hopes were realized during twenty years; and peace continued until 1699, when Charles XI. having died, the reigning king of Denmark, Frederick IV., was tempted by the youth of Charles XII. of Sweden to invade the dominions of his ally the Duke of Holstein. Frederick was little aware of the spirit of his opponent, who became afterwards so well known in the wars of the north of Europe. Charles, determined to strike at once at his enemy's capital, lost no time in crossing the narrow sea between Sweden and Denmark, and in investing the city of Copenhagen. The inhabitants in alarm appealed to the humanity of the young monarch; and the result was the speedy conclusion of peace, with the payment of a sum of money to the Swedes. Taught by this lesson, the Danish government remained neutral in the following years, when the course of events led Charles and his army into Poland and Saxony. There success attended him year after year, until his memorable march into the heart of the Ukraine in 1708. The Swedes were even then superior to their uncivilized opponents, but no discipline would bear up against privations and absolute want. The consequence was the loss of the battle of Pultowa, the capture of the Swedish army, and the flight into Turkey of its heroic leader. The king of Denmark then found himself independent, and eagerly embraced the opportunity of renewing hostilities with Sweden, invading both Holstein in the south, and the province of Scania to the north. Scania was badly provided with troops, but it had officers trained in one of the best military schools of the age, and a peasantry full of national antipathy towards the Danes. The result was a spirited attack on the invading army, followed by its defeat and precipitate flight into Denmark. The war was then carried on with alternate success in different parts—in Pomerania, in Holstein, and in Norway; until at last the military career of Charles XII. came unexpectedly to a close in the end of 1718. Some time afterwards, negotiations were opened between Sweden and Denmark, under the mediation of England, and ended in 1720 in a definitive treaty of peace, concluded at Stockholm. It was then that Sweden lost all the advantages gained since the peace of Westphalia, and that George I. of England as Elector of Hanover, Prussia, and Peter the Great, shared with Denmark the spoil of Sweden. Henceforth no danger threatened Denmark from the side of its neighbour, though the cessation of the rivalry was more perceptible in the decline of Sweden than the progress of Denmark.

The Danish government had now ample experience of the sacrifices attendant on war, and of the expediency, to a state of such limited power, of avoiding political collisions. It consequently adopted a policy to which it has almost ever since endeavoured to adhere, a course of uninterrupted peace.

It was towards the middle of the eighteenth century that the family of Bernstorff became known in the councils of Denmark; the first minister of that name, a man of superior talent and information, having come forward at that time. By the prudence of the ministry, and the pacific disposition of the sovereign, Denmark was kept from taking part in the war begun in Germany in 1740, as well as in the more general contest begun in the same country in 1756.

The ministry of Bernstorff.

Frederick V. of Denmark was twice married, and died in 1766, leaving a son by each wife. The crown devolved of course on the elder, his son by the first wife, who took the name of Christian VII. He was a weak prince, and listened too readily to the insinuations of his step-mother, whose secret wish was to secure the succession of the crown to her own son, and who did not scruple, with that view, to sow discord between Christian and his young consort, a princess of England, and youngest daughter of George II. The circumstances were these: A German adventurer named Struensee had ingratiated himself into the favour of Frederick V., the late king, and had found means to be appointed his prime minister—a situation which he was ill qualified to fill. He continued to hold that office under Christian, and was introduced to the young queen as her husband's confidential minister. On this the queen dowager founded an intrigue, and succeeded in persuading the king that the queen, in concert with Struensee and his friend Count Brandt, had formed a project to set him aside, and to get herself declared regent of the kingdom. By working on the fears of this weak prince, the queen dowager prevailed on him to authorize the arrest of the queen and the two ministers. The latter were thrown into prison, and Struensee was accused of having abused his authority as minister, and of other criminal acts. As there was no proof of these acts, recourse was had to the barbarous alternative of torture, the dread of which led Struensee to declare, in the form of a confession, much to the injury of the young queen, which is now considered as unfounded. This, however, did not enable him to escape; for he and Count Brandt were both beheaded in April 1772; whilst the queen consort was, at the instance of the British government, allowed to retire and to pass the remainder of her short life at Zell, in Hanover, repeatedly but fruitlessly demanding an open trial. This ill-fated princess died in her twenty-third year, without the satisfaction of knowing that the author of her misfortunes, the queen dowager, had lost her influence at the court of Denmark.

Counts Struensee and Brandt.

One of the principal political questions between England and Denmark occurred in the year 1780, in the midst of our war with France, Spain, and the North American colonies. During that arduous contest, England, superior at sea, had no difficulty in obtaining, by her own merchantmen, a supply of hemp, cordage, and other naval stores, from the Baltic, whilst France and Spain trusted to receiving such supplies by neutral vessels. But our government denied the right of neutrals to carry warlike stores; and the northern powers, headed by the ambitious Catherine of Russia, entered into a compact, called the armed neutrality, by which, without resorting to actual hostility, they sought to overawe this country, and to continue the questionable traffic. Happily no bloodshed followed this diplomatic menace, and the question fell to the ground in 1782, on the negotiation for a general peace.

The armed neutrality of 1780.

The king of Denmark, subject all along to imbecility, became after 1784 quite incapable of governing. His son, the crown prince, was therefore appointed regent, and soon passed several judicious enactments. The peasants living on the crown lands were gradually emancipated—an example followed by a number of the nobility on their respective estates. In the abolition of the African slave trade Denmark had the honour of taking the lead among the governments of Europe. The crown prince guided by the counsels of Count Bernstorff, son of the minister already mentioned, long remained neutral in the political convulsion engendered by the French Revolution. He continued to adhere steadfastly to this plan until in 1801 the Emperor Paul of Russia having, as in the case of the armed neutrality, formed a compact of the northern powers hostile to England, a British fleet was sent into the Baltic under the orders of Sir Hyde Parker, with Lord Nelson as his second in command.

It was this fleet which taught the Danes that their capital was not impregnable, and that the long line of men-of-war moored in front of the harbour was an insufficient defence against such enterprising opponents. The attack took place on 2d of April 1801; and the resistance of the Danes was spirited, but fruitless. The loss of the English in killed and wounded exceeded 1000 men, but that of their opponents was much greater, and most of their shipping was destroyed. Happily little injury was done to the capital. A cessation of hostilities took place forthwith, and was followed by a treaty of peace. The death of the Emperor Paul, which occurred soon afterwards, dissolved the compact between the northern courts.

Lord Nelson's attack on Copenhagen.

But no treaty of peace could be regarded as permanent during the ascendency of Bonaparte. After defeating first Austria, and then Prussia, that extraordinary man found means to obtain the confidence of the Emperor Alexander of Russia, and in the autumn of 1807 threatened to make Denmark take part in the war against England. Although the Danish government discovered no intention to violate its neutrality, our ministers, eager to please the public by acting on a system of vigour, despatched to the Baltic both a fleet and an army, in order to compel the surrender of the Danish navy upon condition of its being restored at a peace. To such a demand the crown prince gave an immediate negative, declaring that he was both able and willing to maintain his neutrality, and that his fleet could not be given up on any such condition. On this the English army landed near Copenhagen; laid siege to that city; and soon obliged the government to purchase its safety by surrendering the whole of its naval force.

Copenhagen again attacked.

This act, the most questionable in point of justice of any committed by the British government during the war, can hardly be defended on the score of policy. The battle of Trafalgar had ere this been fought; and after that great victory our superiority at sea was so decisive as to exempt us from the necessity of offending foreign powers by adopting extreme measures. The resentment felt on that occasion by the Emperor of Russia was so great as to deprive us during four arduous years of the benefit of his alliance; and the seizure of the Danish fleet so exasperated the crown prince and the nation at large, that they forthwith declared war against England, throwing themselves completely into the arms of France.

The hostilities between England and Denmark were carried on by sea, partly at the entrance of the Baltic, and partly on the coast of Norway. These consisted of a series of actions between single vessels or small detachments, in which the Danes fought always with spirit, and not unfrequently with success. In regard to trade, both nations suffered severely; the British merchantmen in the Baltic being much annoyed by Danish cruizers, whilst the foreign trade of Denmark was in a manner suspended by our naval superiority.

War between England and Denmark.

Such continued the situation of the two countries during five years, when at last the overthrow of Bonaparte in Russia opened a hope of deliverance to those who were involuntarily his allies. The Danish government would now gladly have made peace with England; but our ministry, in order to secure the cordial co-operation of Russia and Sweden, had gone so far as to guarantee to these powers the cession of Norway on the part of Denmark. The Danes,

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ill prepared for so great a sacrifice, continued their connection with France during the eventful year 1813; but at the close of that campaign a superior force was directed by the allied sovereigns against Holstein, and the result was, first an armistice, and eventually a treaty of peace in January 1814. The terms of the peace were, that Denmark should cede Norway to Sweden, and that Sweden, in return, should give up Pomerania to Denmark. But Pomerania being too distant to form a suitable appendage to the Danish territory, was exchanged for a sum of money and a small district in Lauenburg adjoining Holstein. On the part of England, the conquests made from Denmark in the East and West Indies were restored; all, in short, that had been occupied by British troops, excepting the small island of Heligoland.

Since the Congress of Vienna, by which the extent of the Danish monarchy was considerably reduced, the court of Copenhagen has been from time to time disquieted by a spirit of discontentment manifesting itself in the duchies, and especially in that of Holstein, the outbreak of which in 1848 threatened the monarchy with complete dissolution. A short recapitulation of the relation of the different parts of the kingdom to each other will furnish a key to the better comprehension of these internal troubles. When Christian I. of the house of Oldenburg ascended the throne of Denmark in 1448, he was at the same time elected Duke of Sleswick and Holstein, while his younger brother received Oldenburg and Delmenhorst. In 1544 the older branch was again divided into two lines, that of the royal house of Denmark, and of the dukes of Holstein Gottorp. Several collateral branches arose afterwards, of which those that survived are, the Augustenburg and Glucksburg branches belonging to the royal line, and the ducal Holstein-Gottorp branch, the head of which was Peter III. of Russia. In 1762 Peter threatened Denmark with a war, the avowed object of which was the recovery of Sleswick, which had been expressly guaranteed to the Danish crown by England and France at the peace of Stockholm 1720. His sudden dethronement, however, prevented him from putting this design into execution. The empress Catharine agreed to an accommodation, which was signed at Copenhagen in 1764, and subsequently confirmed by the emperor Paul, 1773, by which the ducal part of Sleswick was ceded to the crown of Denmark. The Czar abandoned also his part of Holstein in exchange for Oldenburg and Delmonhorst, which he transferred to the younger branch of the Gottorp family. According to the scheme of Germanic organization adopted by the Congress of Vienna, the king of Denmark was declared member of the Germanic body on account of Holstein and Lauenburg, invested with three votes in the General Assembly, and a place, the tenth in rank, in the ordinary diet.

Discontent in the duchies.

After the restoration of peace in 1815, the states of the duchy of Holstein, never so cordially blended with Denmark as those of Sleswick, began to show their discontent at the continued non-convocation of their own assemblies despite the assurances of Frederick VI. The preparation of a new constitution for the whole kingdom was the main pretext by which the court evaded the claims of the petitioners, who met, however, with no better success from the German diet, before whom they brought their complaints in 1822. After the stirring year of 1830, the movement in the duchies, soon to degenerate into a mutual animosity between the Danish and German population, became more general. The scheme of the court to meet their demands by the establishment of separate deliberative assemblies for each of the provinces failed to satisfy the Holsteiners, who continually urged the revival of their long-neglected local laws and privileges. Nor were matters changed at the accession of Christian VIII. in 1838, a prince noted for his popular sympathies and liberal principles. The feeling of national animosity was greatly increased by the issue of certain orders for Sleswick, which tended to encourage the culture of the Danish language to the prejudice of the German. But what served to increase the jealousy of race against race, was the expected extinction of the male line of the reigning dynasty—a topic freely discussed by the press, as affording the prospect of rendering the duchies entirely independent of the crown of Denmark. In 1842, the union of Sleswick with the German confederacy was formally discussed in the provincial assembly, and advocated by a part of the German press. This agitation was met by a letter patent from the king, in which it was proclaimed, that with the exception of some parts of Holstein, in reference to which some changes must be made, the laws regulating the succession were the same in Denmark, Sleswick, and Lauenburg. The consequence of this was, that the gap between the Danish and German party became every day wider, and the more so as the German party felt encouraged by the diet. The elements of a revolution were thus ready, and only waiting some impulse to break forth into action. Christian died in the very beginning of 1848, before the outbreak of the French revolution in February, and left his throne to his son Frederick VII., who had scarcely received the royal unction when half of his subjects rose up in rebellion against him.

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The Parisian revolution at once reacted on the whole of Germany, which was then apparently on the eve of an entire reorganization; and this latter circumstance could not fail to hasten the open rupture of Holstein with Denmark, as well as to make Prussia, from its jealousy of Austrian supremacy, openly declare for the duchies. In March 1848, Prince Frederick of Augustenburg, having gained over the garrison of Rendsburg, put himself at the head of a provisional government proclaimed at Kiel. A Danish army, marching into Sleswick, easily reduced the duchy as far as the banks of the Eider; but, in the meantime, the new national assembly of Germany resolved upon the incorporation of Sleswick; and the king of Prussia followed up their resolution by sending an army into the duchies under the command of General Wrangel. The Prussian intervention (it is needless to remark), while calculated to increase the anxiety of the court of Copenhagen, materially altered the nature of the war. The Prussian general, after driving the Danes from Sleswick, marched into Jutland;—a step fully sufficient to excite the attention of foreign powers, and especially that of England and Russia. The mediating efforts of these powers to settle the dispute at the very beginning, however, appear not to have been of a nature to bring the belligerents to a desire of peace; though the sudden evacuation of Jutland by the Prussians was attributed to foreign influence. At the instance of the Assembly of Frankfurt, to whom this retreat appeared exceedingly suspicious, Wrangel received orders to move onwards; and did so ostensibly, when, contrary to all expectation, and to the no small displeasure of the Frankfurt Assembly, Prussia and Denmark agreed to an armistice of seven months, signed at Malmoe, August 26. According to this agreement, the government of the duchies was intrusted to a commission of five members—two nominated by Prussia, two by Denmark, and the fifth by the common consent of the four, Denmark being also promised an indemnification for the requisitions made in Jutland. It is needless to say, that Sleswick-Holstein was still less satisfied with the conduct of the court of Berlin than with that of the Assembly of Frankfurt.

After the expiry of the armistice, the war was renewed with the aid of Prussian and other troops of the confederacy, (from March to July 1849), when Prussia signed a second armistice for six months. The duchies now continued to increase their own troops, being determined to carry on the war at their own charge without the aid of Prussia, whose policy they stigmatized as inconsistent and treacherous. The chief

command of the Sleswick-Holstein army was intrusted to General Willisen, a scientific and able soldier; but henceforth the Danes had little to fear, especially as the cry of German unity brought but an insignificant number of volunteers to the camp of the Holsteiners. The last victory of the Danes, under Generals Krogh and Schlepegrell, was at the battle of Idsted (July 23). Near this small village, protected by lakes and bogs, Willisen lay encamped with his centre; his right wing at Wedelspung, extending along the lake Langso; his left spreading along the Arnholtz lake. The Danes, approaching on the high road from Flensburg to Sleswick, attacked the enemy on all sides; and, after having been repeatedly repulsed, they succeeded in driving the Sleswick-Holsteiners from all their positions. The forces engaged on each side were about 30,000; the number of killed and wounded on both sides was upwards of 7000. Some attributed this victory to artificial manœuvres and peculiar strategy of the Danes, though one might with more reason assign it to the want of discipline and good officers in the camp of Willisen.

Peace with Prussia.

After the victory of Idsted, the Danes could hardly expect to meet with any serious resistance. But what tended most of all to raise the confidence of the court of Copenhagen was the peace concluded with Prussia (July 1850), by which the latter abandoned the duchies to their own fate, and soon afterwards aided in their subjection. This strange phenomenon may be thus easily explained. While Austria was threatened with complete dissolution on the side of Italy and Hungary, the court of Berlin hoped to secure to its account the convulsions of Germany by conniving at the proceedings of the Frankfurt Assembly, which was then engaged in framing a new charter for the empire. For a while the popularity of Frederick William IV. was so great, that he was even offered the imperial throne. Prussia was able even to gain over Hanover and Saxony for a while for her ambitious designs, having afterwards convoked a diet at Erfurth, with the view of re-organizing the empire under her own auspices, to the utter neglect and disregard of the house of Hapsburg. It naturally flowed from this policy that, though unwilling to sanction the revolutionary principle, Prussia was led by her own interest to espouse the cause of the duchies, so popular in Germany, and so closely connected with the idea of German unity. But about the end of 1849, Austria, having reduced both Hungary and Italy, immediately turned her attention to the affairs of Germany; and her first step was, to convoke a meeting of the diet at Frankfurt to counteract the decisions of the Prussian diet of Erfurth. The new attitude of Austria, and the remonstrances of the Czar, soon made the weak Prussian king pause in his ambitious schemes of innovation, and his feigned sympathies with Sleswick-Holstein. England, too, which had exerted a tardy mediation during the two years' war, never countenanced the idea of the dismemberment of the Danish monarchy, to which Prussian policy at first tended. Hence it happened, that while Denmark was treating with Prussia in Berlin, a protocol, guaranteeing the integrity of the Danish monarchy, was signed in London (July 4, 1850). Soon after the signing of this deed, the two great German powers, under the influence of the Czar, agreed in the conferences of Olmutz as to the measures to be taken for the pacification of Germany; and a joint army of Austrians and Prussians was immediately marched into the two duchies to disarm the inhabitants. Thus was Denmark most seriously threatened, and at the same time rescued, by foreign influence.

The sole question of importance which awaited its solution was the order of succession, which the European powers thought to be of such importance as to delay its final settlement till 1852. Before proceeding to this critical point of Danish affairs, we will first indicate the internal reforms introduced since the outbreak of the war of 1848.

The new constitution, sanctioned by Frederick VII., acknowledges the principle of limited monarchy, the king sharing his power with a diet of two houses, both of which are elective. The first, called Folkething, has the privilege of discussing the budget and other public questions, while the other is confined to the local affairs of the provinces. The liberty of religion and of the press, and the inviolability of person and property, are amply guaranteed by the new charter. All the reforms, however, failed to produce uniformity between the government of the different parts of the kingdom, not to speak of the duchies. Of the anomalies to be found in the new state of affairs, the principle of responsibility offers the most striking instance. The ministers for Denmark Proper, for example, are responsible to the diet, while those of the two duchies depend solely on the king. But what is still more singular is, that even the responsible ministers, as those of War and Foreign Affairs, whose control extends also over the duchies, are only responsible as far as Denmark Proper is concerned. The state of Sleswick-Holstein, however, must not be regarded as definitively settled.

The extinction of the male line in the present King Frederick was an event foreseen by the king, the people, and the foreign powers. The heir presumptive to the throne, Prince Frederick Ferdinand, uncle of the king, besides being advanced in age, was likewise without issue, and in absence of a general arrangement, the kingdom would probably be dismembered in consequence of the laws of succession established in the different provinces. In Denmark Proper, the succession might pass over to the female line, while, according to the ancient laws of Holstein, females are excluded from the throne. Besides this, in Holstein, the eldest branch was represented by the duke of Augustenburg, who headed the revolution; and after it came the family of Glücksburg; and lastly, the Emperor of Russia was the representative of the Holstein-Gottorp line. The German party, in fact, flattered themselves with the hopes of seeing Holstein, and even Sleswick, in which the rights of succession were variously construed, become entirely independent of the Danish crown, with the expected extinction of the reigning male line. But the foreign courts thought otherwise. After protracted negotiations between the different courts, the representatives of England, France, Austria, Russia, Prussia, and Sweden, the following treaty relative to the Danish succession was signed May 8, 1852:—

Art. I.—After having taken into serious consideration the interests of his monarchy, his Majesty the King of Denmark, with the assent of his Royal Highness the hereditary Prince, and his nearest of kin, called to the succession by the royal law of Denmark, as well as in concert with his Majesty the Emperor of all the Russias, chief of the elder branch of the house of Holstein-Gottorp, having declared his desire to regulate the order of succession to his states in such a manner as that, in default of male issue in the direct line of King Frederick III. of Denmark, his crown may be transmitted to his Highness the Prince Christian of Sleswick-Holstein-Sonderburg-Glücksburg, and to the descendants sprung from the marriage of that prince with her Royal Highness the Princess Louisa of Sleswick-Holstein-Sonderburg-Glücksburg, born princess of Hesse, in the order of primogeniture from male to male; the high contracting parties, appreciating the wisdom of the views which have determined the adoption of this combination, bind themselves by a common agreement, whenever the eventuality contemplated may arise, to recognise in his Highness the Prince Christian of Sleswick-Holstein-Sonderburg-Glücksburg, and his descendants male, sprung in direct line from his marriage with the said princess, the right to succeed to all (*à la totalité*) the states actually united under the sceptre of his Majesty the King of Denmark.

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ART. II.—The high contracting parties, recognising the principle of the integrity of the Danish monarchy as permanent, bind themselves to take into consideration such ulterior overtures as his Majesty may think it proper to make to them, if (which God forbid) the extinction of the heirs male, in the direct line of his Highness Prince Christian of Sleswick-Holstein-Sonderburg-Glücksburg, by his marriage with the Princess Louisa, should become imminent.

ART. III.—It is expressly understood, that the rights and reciprocal obligations of his Majesty the King of Denmark, and of the Germanic confederation, concerning the duchies of Holstein and Lauenburg, rights and obligations established by the federal act of 1815, and by the existing federal law, shall not be altered by the present treaty.

ART. IV.—The high contracting parties reserve to themselves the right of bringing the present treaty to the knowledge of other powers, by inviting them to accede to it.

At first sight this treaty, which guaranteed the integrity of the Danish kingdom, ought to have been as gratifying to the Danes as it was calculated to excite the resentment of the duchies. Its promulgation, however, produced discontent even in Denmark Proper. Highly gratified as the Danes were at the idea of the indivisibility of the monarchy, they looked with apprehension at a change which, while it abolished the *lex regia* of 1665, admitting the succession of the female line, and transferred the right of succession to the branch of Glücksburg, expressly confined it to the male line, and reserved the whole question for further settlement in case of its extinction.

The apprehension of the Danes on the subject was still heightened by the consideration that Russia possessed claims to a portion of the duchies, which, though formerly renounced, would again become valid with the extinction of the new male line. Hence the terms of the treaty of May were attributed solely to Russian influence; which, under the pretext of maintaining the integrity of the Danish kingdom, sought on this very ground to open up a way for the eventual succession of the czars. The possibility of such an event was apparent, Prince Christian Glücksburg having only one son; and the fact of the treaty of London having been preceded by a protocol of Warshau, signed between the courts of St Petersburg and Copenhagen, by which the Emperor Nicholas reserved to himself the ancient right of succession to a portion of the duchies in case of the extinction of the Glücksburg male line, was sufficient to rouse the suspicions of the nation. The protestations of Russia did not avail to dispel such apprehensions; so that, while the courts declared their satisfaction with the treaty, the Danes saw under the newly-established indivisibility a door opened for a Russian pretender.

The new order of succession was announced to the diet n October 1852; and a committee of seventy members, nominated by the assembly to examine the royal message, rejected the new law by a large majority. After the dissolution of this diet, the measure met a similar fate when introduced before the new house (Feb. 1853). The court then determined upon a second dissolution, and in consequence of this several of the ministers resigned. After Oersted was called to the head of affairs a third parliament was convened (June 24), which adopted the new law. It must here be observed, the ministry of Copenhagen itself was caught by the spirit of diffidence with which the measure was regarded out of doors; but, once pledged to the foreign powers, it accepted their assurances that the Danish throne, if becoming vacant, would again become a European question to be decided collectively by the powers who guaranteed the treaty of May. The result of this arrangement (which, it must be confessed, is exceedingly obscure and indefinite) remains yet to be seen.

As to the present state of the duchies, the outward traces of the late war seem to have entirely disappeared; but the antagonism between the Scandinavian and German elements can hardly be said to have been extinguished with the end of the campaigns. The Danish government, however, well deserves praise for their lenient treatment of the parties implicated in the war; especially if contrasted with the course pursued by the king of Prussia after the Berlin revolution, and the policy of Austria in regard to the revolutionary outbreaks in Hungary and Italy.

Denmark

The kingdom of Denmark, comprehending, besides Denmark Proper, the duchies of Sleswick, Holstein, and Lauenburg, and also several islands in the Baltic and Cattegat, lies between N. Lat. 53. 22. 42. and 57. 44. 52.; and between E. Long. 7. 37. 22. and 12. 34., with the exception of the island of Bornholm, which lies between E. Long. 14. 42. and 15. 10. It is bounded N. by the Skagerrack; E. by the Cattegat, the Sound, and the Baltic; S. by the Elbe and Mecklenburg; and W. by the North Sea. The kingdom of Denmark Proper has an area of 14,642 square miles, of which 9667 belong to the mainland of North Jutland, and 4975 to the islands. Of these last, Zealand with its smaller islands contains 2698, Fühnen with its smaller islands 1280, Laaland 445, and Bornholm 222 square miles. The duchy of Sleswick has an area of 3534, the duchy of Holstein of 3259, and that of Lauenburg of 402 square miles; giving the entire area of the Danish kingdom at 21,837 square miles.

Statistics.

The increase and distribution of the population will appear from the following table:—

Statistics of population.

	1769.	1834-35.	1840.	1845.
Denmark Proper ..	814,238	1,223,797	1,283,027	1,350,327
Sleswick.....	249,104	337,378	348,526	362,900
Holstein	278,963	435,596	455,093	479,364
Lauenburg....		...	45,342	46,486

The population of Denmark Proper, 1st February 1850, was as follows:—

	Towns.	Rural Districts.	Total.
Zealand and Moen.....	170,392	338,068	508,460
Bornholm	9,451	18,476	27,927
Fuhnen, &c.	31,324	156,494	187,818
Laaland and Falster..... ..	11,164	67,853	79,017
North Jutland.....	68,234	536,291	604,525
	290,565	1,117,182	1,407,747

The population of the principal towns of Denmark Proper (1st February 1850) was as follows, viz.:—Copenhagen 129,695; Odensee 11,122; Helsingor 8111; Aarhuus 7886; Aalborg 7745; Rauders 7338; Horsens 5827; Rönne 4717; Svendborg 4556; Fredericia 4326; Viborg 4039; Slagelse 4011; and Roeskilde 3805.

In the duchy of Sleswick, the principal towns with their populations on 1st February 1840 was as follows, viz.:—Flensborg 12,561; Sleswick 11,204; Hadersleve 6165; Eckernsförde 4058; and Apenrade 4021. In that of Holstein as follows, viz.:—Altona 28,095; Kiel 12,344; Rendsburg 10,009; and Glückstadt 5939.

Colonies.

The colonial possessions of Denmark are the Färoe Islands, Iceland, Greenland, and the islands of Santa Cruz, St Thomas, and St John, in the West Indies. Tranquebar and Serampore, in the East Indies, were sold to the English East India Company in 1846; and the Danish settlements on the coast of Guinea were ceded to England two years afterwards. The extent and population of these in 1850 were as follows, viz.:—

	Square Miles.	Population.
Färoe Islands	495	8,150
Iceland	38,200	60,000
Greenland	3,950	9,400
West Indies—		
Santa Cruz	74	23,720
St Thomas	23	13,666
St John	21	2,228
Total	42,763	117,164

Zealand and the adjoining islands.

The island of Zealand contains about 2700 square miles of territory, corresponding in extent to two middle-sized counties in England. Its surface is in general flat, and only

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a few feet higher than the level of the sea. The highest point is only about 490 feet above the sea.. Possessing an undulating and woody surface, its aspect is the most pleasant of any part of the territory of Denmark; but in other respects it is greatly behind England or the Netherlands. Though personal slavery has been abolished among the peasantry of Denmark since the beginning of the present century, there yet remain many traces of the feudal system. Having hardly any capital, the tenants, even in Zealand, pay their rent in produce, or by the labour of themselves and their cattle. It is only in the present age that Danish landholders have considered their peasantry as entitled to take land on lease. Tithes are still collected by government: one portion of the collection is for the church as a body, another for individual clergymen, and a third for the royal treasury. The island is in general fertile, but less so in the northern parts and the elevated districts of the interior, where a sandy soil prevails. Fühnen, the island next in extent to Zealand, is traversed by a chain of hills in the S. and W. The northern parts are level, unwooded, and fertile. After these come the smaller islands of Laaland, Langeland, Falster, and Bornholm,—the last situated at some distance in the Baltic. In the islands, as on the mainland, a part of the crown lands is let on easy terms to tenants, who become bound to carry certain improvements into effect.

Jutland.

The provincial divisions of Denmark on the mainland occupy a much wider extent of territory than those on the islands. Jutland is a hundred and eighty miles in length, and nearly eighty in breadth, its extent being 9667 square miles. Its general outline is oblong, with a triangle towards the north. It is divided into four stifts or dioceses, viz. Aalborg in the north, Wyborg in the centre, Aarhuus in the east, and Ribe in the south and west. The rivers of Jutland are necessarily small, from the few hills and the limited breadth of the country; but there are numerous bays or inlets of the sea which run a great way up into the interior, of which by far the longest and most extensive is the Lymfiord. Fish forms consequently a staple article of food in Jutland.

Jutland was in former ages covered with forests. Part of these still remain; and the features of this part of the Danish territory are wilder than those of the islands. Still Jutland is agreeably diversified with woods and pastures. Wild animals formerly abounded in its forests; but they have gradually disappeared with the extension of cultivation. As to the soil of Jutland, a great proportion of it is dry and sandy, which, when raised in clouds by the wind, and scattered over cultivated districts, is productive of great mischief. The best means of lessening these calamities is to sow bent grass and plant shrubs in the sandy soil, as is practised in the downs in Holland, and as has long been enjoined by the Danish government.

The pasturages in Jutland are extensive, and the horses are of large size, but fitter for draught than for the saddle. The horned cattle are also of a good breed, and large numbers of them are annually sent to Holstein. In minerals neither Jutland nor indeed any part of the Danish territory is rich. Coal is found in very few parts,—a great privation in a country where the facility of communication by water would make coal so generally useful. The common fuel is either peat or turf.

South Jutland, its west coast or marsh land.

Such is the state of three-fourths of Jutland. A different scene is presented along its western coast, as well as along the western shore of Sleswick and Holstein. In all these the surface is a continued level, gained in the course of ages from the sea, and fortified against inundation, as in Holland, by dikes or mounds. It is called the marsh land, and resembles the fens in Lincoln and Cambridgeshire. The soil being rich, is well adapted for wheat and barley, as well as oats and rye. The crops of oats are very heavy; rape is also cultivated with advantage; but the chief pursuit of the agriculturists is cattle-rearing. The horses of Holstein have long been noted for their shape as well as spirit, and are exported annually in considerable numbers to Germany, France and Russia. Denmark.

Sleswick is of an oblong form, about seventy miles in length, and from thirty to fifty-six in breadth. Its surface is 3534 square miles. A mountain range intersects the duchy from N. to S., the highest points being towards the north. To the east of this ridge are fruitful well-cultivated fields, interspersed with patches of woodland. To the west the ground gradually slopes into a plain covered with moors and marshes. The climate resembles that of the north of England. Rain occurs with both east and west winds, and the extremes of cold or heat are seldom of long continuance. Here, as in Jutland, the greater part of the interior is dry and sandy. Sleswick.

Holstein, somewhat less in extent than Sleswick, has a surface of 3259 square miles. The western part, adjoining the German Ocean and the banks of the Elbe, was, like the maritime border of South Jutland, reclaimed in former ages from the sea, and is secured by dikes against inundations. It has the rich soil of an alluvial country, whilst that of the inland part of the duchy is light, and in some degree sandy. The products are rye, barley, oats, with more wheat than in any other part of the Danish territory. The state of the peasantry here, as in Sleswick, is not quite so backward as in Jutland. Holstein.

In the marsh lands along the western coast of the Danish dominions, the dikes exclude the action of the high tides. In former ages melancholy scenes are known to have occurred from irruptions of the sea; but during the last two centuries such irruptions have been completely obviated, the banks and dikes being sufficiently strong to resist the violence of the waves. Fields, and even districts, when under water, are drained by windmills, as in the Netherlands. The mounds and other defensive works are under the management of a government board, which, like the Waterstaat in Holland, prescribe regulations, which the local proprietors or tenants are bound to follow. It is curious to trace the successive extensions of the cultivated land by the old embankments, which are seen at some distance inland, all along the west side of Sleswick and Holstein, and which form a continued level, as in the Dutch provinces. The prevailing malady of a marshy district, ague, is also common to these countries with Holland.

In order to complete our account of the territory subject to Denmark, it only remains to notice the duchy of Lauenburg, on the banks of the Elbe, a short distance above Hamburg. It has an area of about 400 square miles, with a population of 46,486. In the north and west the country is flat; but in the south, along the banks of the Elbe, it assumes a hilly character. Woods occupy one-sixth of the entire area. In the east the picturesque Razeburger and Schall lakes form the boundary on the side of Mecklenburg. The population is almost wholly agricultural. This petty state, formerly governed by its own dukes, became incorporated with Hanover in 1689. It was made over to Denmark in 1815 at the congress of Vienna, along with a sum of money, in lieu of Swedish Pomerania, which, as already stated, was too distant to form a suitable appendage to the Danish dominions. Duchy of Lauenburg.

Climate.—The climate of Denmark may be said to bear some resemblance to that of Scotland; and differs from it less in the nature of the seasons than in the rapidity of their transitions. The following is the mean annual temperature (Fahr.) in Altona, Apenrade, Copenhagen, and Frederickshavn:— Climate.

	Altona.	Apenrade.	Copenhagen.	Frederickshavn.
Winter,.....	32·45	32·	32·9	32·
Spring,.....	47·3	45·05	43·7	43·02
Summer,.....	62·375	62·375	63·05	60·35
Autumn,.....	49·775	49·55	49·1	48·65
Whole Year, ...	47 975	47 24	47·18	46·00

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Snow falls on an average for thirty days in the year, and westerly winds are more prevalent than easterly in the ratio of 16 to 10. Storms of wind and rain are exceedingly frequent, particularly in July and August, and the atmosphere is certainly more humid than that of Scotland. In the district of Aalborg, in the north of Jutland, a cold and dry N.W. wind called *Skai* prevails in May and June, and is exceedingly destructive to vegetation, while along the entire west coast of the peninsula similar effects are produced by a salt mist which carries its influence to a distance of from 15 to 30 miles inland.

Agriculture.

Despite its maritime position, Denmark derives its greatest resources from the productions of the soil; and it is estimated that 60 per cent. of the population are engaged in agricultural pursuits. This remark, however, does not apply to the duchies of Sleswick-Holstein.

In 1847 the chief articles of agricultural produce in English quarters were as follows:—

	Denmark.	Sleswick.	Holstein.
Wheat	282,857	90,640	183,652
Rye	1,642,142	211,702	278,753
Barley	1,765,761	220,151	221,707
Oats	2,007,761	436,904	644,359
Pease	347,285	42,674	82,720
Buckwheat	69,666	97,638	92,187
Rapeseed	52,380	37,394	63,789
Total,	6,167,852	1,137,103	1,567,167

But, though agriculture is more highly developed under the more genial climate of the duchies, its progress is no less perceptible in the whole kingdom. Many tracts of land have been, within late years, reclaimed by the husbandman, and the people have gradually profited by the scientific improvements in the construction of implements, tile-draining, and the practice of manuring. In the same ratio that the duchies surpass Denmark in agricultural produce the former have the advantage in cattle-breeding. This progress is mainly owing to the abolition of serfdom, though the barons still retain many of their feudal privileges.

The large estates of the nobles are generally in the hands of farmers; but the greater part of the land is possessed by the peasantry, who maintain a hereditary attachment to their ancestral farms. According to Mr Laing, "the number of large farms in the two duchies (generally possessing a range of pasture for 200 cows) is above 3000; while that of the small peasant estates (generally capable of supporting from 10 to 15 cows) is above 125,000. Below these there is also a class of smaller landholders called *junsters*, who are properly cottars, with a house, a yard, and land for 1 or 2 cows, and number about 67,710. The comparatively happy condition of the labouring class is a fact generally known. The money wages of farm-servants is generally above three pounds a-year, besides board and lodging; which, though small in Britain, is reckoned good pay in Denmark. The people are well lodged, and more roomily and warmly than in England. On the meanest dwelling there is always a good sound heavy roof of thatch. The country abounds in small lakes—scarcely a farm without a pool; and the abundance of reeds and of rye-straw makes the roofing material plentiful and cheap. The side walls and gables are constructed of brick in wooden framework; or of clay and straw, as in Bedfordshire; and are whitewashed every year, and the wooden beams painted black. The houses of the peasant proprietors are entered by a large folding door in the gable, through which the long waggon with its two horses is received into the dwelling-house. On the one side stand the horses and cattle, on the other are the dwelling rooms, and above in the loft is stowed a large proportion of winter fodder.....In the rooms there is much neatness and comfort; and even the great hall—which is stable, cow-house, and waggon-house, and into which they have their usual entrance—is always very clean. One sees many indications that the inhabitants enjoy some ease, and have leisure to bestow on the gratifications of taste. The windows of the poorest house rarely want a bit of ornamental drapery, and are always decked with flowers and plants in flower-pots.....In no part of Europe are the ordinary garden flowers produced in such abundance and luxuriance as in Holstein and Sleswick."[1] The most remarkable feature in their husbandry is, that greater value is attached to the produce of the dairy than to that of the soil; and that much of horse-power is withdrawn from the field, and employed in the work of the dairy. Independently of the stock maintained upon the large dairy farms, this branch of industry has given rise to a distinct class of men hiring cows by the year. Notwithstanding the large quantity of land in pasture, the country produces more grain than is required for its own consumption; a fact perhaps to be mainly attributed to the slow increase of the population.

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Whether or not a larger market for the raw products of Denmark would be furnished if the government assumed a less restrictive policy as regards the importation of foreign manufacture; and whether such a liberal policy would in the end benefit those whom the government means to protect by the present system; and lastly, whether such a change might, to the advantage of the landed interest, overthrow the dairy husbandry, and turn the whole energy of the agricultural classes to the arable land—are questions which in this place it is enough merely to hint at.

Manufacture.

In an industrial point of view, the most flourishing part of the kingdom is Holstein; and Sleswick takes precedence of Denmark Proper. In the duchies upwards of 23 per cent. of the population are engaged in industrial pursuits, but in Denmark Proper little more than 21 per cent. Very little advantage has yet been taken of the natural facilities for manufacture and trade which this country preeminently enjoys. Its easy access to the coal-fields of England, and its own abundant resources of turf, afford an extensive basis for the prosecution of various branches of manufacture. Its rich clays also present valuable materials for the manufacture of earthenware. In several parts of the kingdom glass and porcelain works are carried on with considerable activity. Of the former class four extensive factories exist in Denmark, annually producing articles to the value of L.5600 sterling. In Sleswick and Holstein the glass-works are neither so numerous nor so extensive in their scale of operations. The principal porcelain-work, viz. that at Copenhagen, gives employment only to about 80 men. In the kingdom and duchies there are about 1000 brick and tile works, and about 300 limekilns, but they are mostly of small size, and their products comparatively inconsiderable. The iron-works of the kingdom and duchies have recently made considerable progress since its separation from Norway; and the importation of raw material from England has been trebled within the last ten years. The largest iron-foundry is at Carlshülte, near Rendsburg, employing about 250 workmen. In the duchies the principal foundries are at Altona, Kiel, and Flensburg. There are no less than 16 iron-foundries in and around Copenhagen.

The woollen, linen, and cotton manufactures of Denmark are for the most part domestic, and carried on purely for local consumpt. The number of persons engaged in weaving in the kingdom (1850) amounted to 12,971; in the duchies (1845) to 6594. Linen is the principal article of domestic industry in Zealand. During the war the manufacture of cloth received a considerable impulse, having then the sole command of the market; but after the establishment of peace it again declined. The woollen manufac-

[1] Laing's *Denmark and the Duchies.*

Denmark. ture in the kingdom employs 1800 men, and in the duchies 1200; and the annual product of both is about 49,270 cwt.

The sugar refineries, of which the largest are at Copenhagen and Flensburg, prepare most of the sugar required for domestic consumption. The manufacture of paper employs about 1100 men, and yields an annual product of about 548,200 cwt. The distilleries of brandy throughout the kingdom and duchies yield annually about 10,000,000 gallons.

Commerce. Formerly the commercial legislation of Denmark was to such a degree restrictive that imported manufactures had to be delivered to the customs, where they were sold by public auction, the proceeds of which the importer received from the custom-houses after a deduction was made for the duty. To this restriction, as regards foreign intercourse, was added a no less injurious system of inland duties impeding the commerce of the different provinces with each other. The want of roads also, and many other disadvantages, tended to keep down both the development of commerce and industry. Within the present century, however, several commercial treaties were concluded between Denmark and the other powers of Europe, which made the Danish tariff more regular and liberal. Denmark.

Of no less importance were the regulations made from time to time concerning the Sound toll, a question which in the seventeenth century led to many hostilities between Denmark, Sweden, and Holland. Having formerly possessed both sides of the entrance to the Baltic, the Danish crown looked upon the Sound as exclusively her own, refusing to admit any foreign vessel without paying a certain duty; and this right was never contested by the other powers. These duties form a considerable item in the revenue of Denmark.

The principal seaports are Copenhagen, Elsinore, Kiel, Flensburg, Aarhuus, Aalburg, Frederikshavn, Gluckstadt, and Altona.

The chief articles imported are sugar, syrup, coffee, tea, woollen and linen manufactures, silk goods, iron, coal, and salt. The main seat of the transit commerce is Altona. The exports are corn, flour, peas, horses, black cattle, and sheep.

The following Table shows the value of the Exports and Imports to and from the various countries for the year 1852.

	Denmark.			Sleswick.			Holstein.		
	Imports.	Exports.	Total.	Imports.	Exports.	Total.	Imports.	Exports.	Total.
	L.	*L.*	*L.*	*L.*	*L.*	*L.*	*L.*	*L.*	*L.*
England	577,221	832,494	1,409,715	72,107	218,831	290,938	28,705	14,091	169,621
Norway and Sweden.	389,072	629,490	1,018,562	89,007	26,710	115,717	43,243	8,832	52,075
Hamburg	255,894	3,646	613,972	435,673	176,084	611,757	652,002	684,954	1,336,956
Transit Imports through Kiel	354,432	...		...	...	...	...	...	...
America, West Indies, and South Sea	487,156	19,305	506,461	15,230	...	15,230	1	...	1
Lubeck	172,211	27,084	199,295	17,981	10,899	28,880	59,083	46,610	105,693
Danish West Indies	162,948	14,840	177,788	15,108	27,291	42,399	245	...	245
Iceland, Greenland, and the Faroe Islands	137,017	74,742	211,759	8,100	2,039	10,139	9,905	1,418	11,323
Russia	188,701	27,606	216,307	74,039	4,863	78,902	24,066	4,584	28,650
Prussia	96,077	87,183	183,260	21,795	13,455	35,250	7,337	18,413	25,750
Holland & Belgium	105,630	73,382	179,012	10,144	25,374	35,518	1,870	62,384	64,254
Mecklenburg	29,318	5,424	34,742	590	7,164	7,754	1,819	27,008	28,827
France	63,497	16,155	79,652	7,256	991	8,247	186	2,775	2,961
Altona & Wandsbeck	51,790	51,102	102,892	94,799	107,552	202,351	250,104	245,252	495,356
Mediterranean	43,332	2,022	45,354	238	..	238	...	...	...
Hanover & Bremen	63,453	1,420	64,873	37,945	14,739	52,684	26,329	32,708	59,037
East Indies, China, and Guinea	56,856	5,081	61,937	...	...	...	...	...	...
Other countries	12,738	70,309	83,047	922	4,205	5,127	12,977	13,698	26,675
Total	3,247,343	1,941,285	5,188,628	900,934	640,197	1,541,131	1,117,872	1,289,552	2,407,424

The towns of Altona and Wansbeck are included under the head of foreign commerce, as standing without the toll-regulations of the kingdom.

Canal of Kiel. The navigation from the north of Germany to Denmark, around the northern point of Jutland, being always tedious, and sometimes dangerous, gave rise to the idea of uniting the two seas by means of a canal, communicating with the river Eyder. The work was commenced in 1777, and finished in the course of seven years, at a great expense. This is the Canal of Kiel, which begins near the town of that name, on the side of the Baltic, and extends eastward about twenty-three miles, when it comes in connection with the Eyder. This canal is nearly 100 feet wide at the surface, and 54 at the bottom; it has six locks, and its least depth of water is 10 feet; it admits vessels of 120 tons burden; and of such small shipping no less than from 2000 to 3000 pass in a year. Of no less importance is the Stecknitz Canal, which, along with the railway between Altona, Glückstadt, and Kiel, serves to promote the commerce of the duchies. There are also railways from Copenhagen to Elsinore, and from Copenhagen to Roeskilde; and one has been recently opened from Tonning to Flensburg, with a branch to Rendsburg. Tonning is the port on the east coast, and the length of navigation from there to the Baltic is about 105 miles.

The passage to the Baltic by the Sound continues to be followed by English, Dutch, and other vessels of heavy burden, as well as by Swedes and Norwegians, on account of the vicinity of their respective countries to the Sound; but coasting vessels and other traders from Oldenburg, Hamburg, the mouth of the Elbe, as well as from Tonning and the ports of Sleswick, and still more small Danish barks belonging to the islands, find it a great convenience to traverse the Canal of Kiel. The hazard on the north coast of Jutland arises from extensive sandbanks and a number of currents.

After 1807, when the open war between Denmark and Britain made the passage by the Sound inexpedient, if not impracticable, for our mercantile convoys proceeding up the Baltic, recourse was had by them to the Great Belt, the

Denmark. width of which is nowhere less than ten miles, and in most parts much greater. The width of the Sound is not more than five English miles.

National character. The Danes are of a middling stature and fair complexion, and are habituated more than the inhabitants of the south of Europe to the use of animal food and spirituous liquors. The inhabitants of Holstein, and even of Sleswick, partake a good deal of the German character. Without going into any nice discrimination of manners, it may be remarked in general terms that the Danes have the habits of a people living in a northern latitude, and are little acquainted, except in the capital, with the improvements of the more polished parts of Europe. The peasantry, moreover, are but recently emancipated from a state of feudal subjection.

Army. According to the organization of 28th April 1842, the Danish army in time of peace was divided into the general staff, an engineer corps, an artillery brigade, 27 squadrons of cavalry, and 23 battalions of infantry. Its nominal strength amounts to about 25,000 men, but of these not more than the half are in actual service. By the same organization the standing army in time of war consists of 40,000 men, of which three-fifths, or 24,000, may be levied in Denmark Proper, and two-fifths, or 16,000, in the duchies. The militia, when called, musters an effective force of 60,000 men.

Navy. The following is the state of the Danish navy in 1854:—

5 Ships of the Line	3	of 84 guns = 252 guns.	
	1	72	72
	1	66	66
6 Frigates	1	60	60
	1	48	48
	3	46	138
	1	44	44
4 Corvettes	1	28	28
	2	20	40
	1	14	14
1 Barque			14
4 Brigs	2	16	32
	2	12	24
3 Schooners	1	8	8
	2	1	2
90 Gun-boats			
6 Steam-vessels			35
1 Cutter			6
120			883

The financial state of the kingdom will best appear from the following estimates contained in the budget for 1854–5:—

Revenue for the whole monarchy, with the exception of Lauenburg.

RECEIPTS.

Domains	L.189,748
Surplus from Lauenburg	34,683
Lotteries	5625
Posts and Telegraph	2601
Sound, River, and Canal Dues	238,308
Customs, Stamps, &c.	733,331
Sundries	31,217
Interest on State Capital	154,300
Floating Debt	146,250
	L.1,536,063
Deduct Receipts of the West Indian Colonies	1,063
	L.1,535,000

EXPENDITURE.

Civil list	L.90,000
Appanage of the Royal Family	36,133
Privy-council	5,130
Foreign department	25,942
War do.	521,837
Marine do.	185,480
Finance do.	47,780
Pensions	171,810
Interests, &c.	834,660
Extraordinary expenses	16,751
	L.1,935,523

Besides these, there are special estimates for each of the duchies, and also for Denmark Proper. The total amounts of each for the above year are as follows, viz.:— Denmark.

General receipts	£1,535,000
Special receipts of the kingdom	572,719
Do. do. of the duchy of Sleswick	236,696
Do. do. of the duchy of Holstein	238,828
Do. do. of the duchy of Lauenburg	34,226
Total	L 2,617,469
General expense	L 1,935,523
Special expenses of the kingdom	322,095
Do. do. of the duchy of Sleswick	81,996
Do. do. of the duchy of Holstein	91,720
Do. do. of the duchy of Lauenburg	21,720
Total	L.2,453,054

The national debt in 1853 amounted to L.13,612,500.

Form of government. The government of Denmark, like that of other Gothic countries, was formerly far from despotic; the succession to the crown was even elective until the revolution of 1660. That singular change is to be explained, by supposing, on the part of the nation, not so much an indifference to free institutions, as a resentment of the overbearing conduct of the nobility, and a consciousness of the perpetual uncertainties of an elective government. The court found it thus a matter of little difficulty to unite the clergy and commons against the aristocracy; and the power of the crown has since continued without a parliament or any constitutional check. But by the constitution of 1848 mentioned before, Denmark became in form of government similar to the other limited monarchies of Europe.

The privy-council consists of the king, prince Frederick Ferdinand, and the ministers. The duchies have a special ministry responsible only to the king.

The titles of nobility in Denmark Proper are only two; those of count or earl, and baron; but there is an untitled nobility, consisting of the most ancient families in the country, which rank higher in public estimation than even those whom the crown has ennobled. The nobility of Sleswick and Holstein form a distinct body.

The king of Denmark, as already observed, is a member of the Germanic body as constituted in 1815, having, on account of Holstein and Lauenburg, three votes in the general assembly, and a place, the tenth in rank, at the ordinary diet.

Laws. In regard to law, there have been from time to time various improvements based on the code of Christian V. The most effective changes were made since 1848. Besides courts of arbitration, about the usefulness of which no doubt can be entertained, the distribution of justice is secured by the superintendence of the higher courts over the lower ones, while provisions are made to prevent idle delays and useless expense. Sleswick and Holstein have separate courts of justice and administration.

Religion. The established religion in Denmark is the Lutheran, which was introduced as early as 1536, the church revenue being at that time seized and retained by the crown. At present the nomination of the bishops is vested in the king. The bishops in Denmark have no political character; they inspect the conduct of the subordinate clergy, confer holy orders, and, in short, enjoy nearly all the privileges of fellow dignitaries among us, except that of voting in the legislature. Complete toleration is now enjoyed in Denmark.

The ancient literature of Denmark Proper is in itself not very important, as hardly anything except inscriptions is preserved; but the Icelandic, with which it is connected, is in a very high degree interesting. Still the literature of Denmark forms a continuous chain, from the classical age, that of the Scalds, through the middle ages downwards, to the commencement of the modern literature. Each of these three periods has its peculiar language and peculiar taste.

Denmark.

In the first, Braghi hinn Gemli is prominent; Saxo Grammaticus, who wrote in Latin, belongs to the second; and to it also belong Arild Hvidtfeld and Sven Aageson, who wrote in a dialect intermediate between the ancient and modern Danish, in which likewise are compared the songs of the Danish champions or heroes called *Kæmpeviser*. The German has exercised a considerable influence on the formation of the modern Danish.

In respect of literature and literary culture, Denmark is partly original and isolated, or rather the chief representative of the ancient Scandinavian family, and partly owes to Germany the eminence which she has attained—forming in regard to literature, as well as to politics, a portion of that country. The language, the poetry, the history, the entire polite literature, and the laws of Denmark, are Scandinavian; but religion, science, and several political institutions, she has borrowed from Germany. The language, cognate as it is to the Teutonic dialects, belongs entirely to an independent and distinct family (the Scandinavian), and is, both with regard to structure and roots, more remote from modern High German than French is from Portuguese. The principal distinctive characters which the Danish possesses as a Scandinavian language, and which the Teutonic languages in general have not, are, 1. a postpositive definite article; 2. a passive and middle voice in the verbs, formed by inflection, whilst the Mœsogothic only has a passive voice; 3. the want of the German preformative, which the supines and past participles of that language require; 4. the want of two of the forms which the German has in the inflection of its adjectives, that language having four, whilst the Danish has only two, a definite and an indefinite. There are several characters besides, positive as well as negative, which distinguish the Scandinavian and Teutonic languages from each other; but the above are a few of the most essential. Yet the similitude, and even identity, of roots is so great between the Teutonic and Scandinavian languages, that no doubt can be entertained of their common origin. The separation, however, of these languages into two distinct families must have taken place long before the period of commencement of authentic history, and thus their identity of origin is only a matter of philological inference.

The modern Danish is a daughter of the *Norse*, or ancient Danish, formerly called *Norræna* or *Donsh Tunga;* and it bears exactly the same relation to that language as Italian bears to Latin. In both cases we have the same curtailing, simplification, and abandonment of inflections, the same sacrifice of inversion and artificial construction, the same process of softening the idiom, and of substituting what is considered as beauty for energy and grandeur. The modern Danish is a much softer language than it is generally supposed to be. When a foreigner hears it spoken for the first time, he hardly perceives any sounds in it except the vocalic; and the consonants are so much softened in pronunciation that they scarcely appear. Of course the vocalic system of this language is very perfect. Rask has distinguished ten vowels in Danish, the sounds of all which are quite distinct.

University and schools.

The educational institutions of Denmark have reached a very high degree of perfection; indeed few countries, if any, can compete with Denmark in this respect. Most of the peculiar advantages in the Danish system seem to arise from this, that all schools, both grammar and other, have been put in a state of dependence on the university and under its control, whilst the university itself is particularly well managed. All educational institutions of the country are now managed by a royal college consisting of three or four assessors and a president, called the royal commission for the university and grammar-schools. This commission has no superior but the king, and reports to him directly. It appoints all professors in the university of Copenhagen (not those in Kiel, for that university belongs to another department), all rectors, co-rectors, and other teachers of grammar-schools in Denmark Proper (not in Holstein or Sleswick), and promotes these functionaries from lower to higher grades. Education is compulsory. Poor parents pay a nominal sum weekly for the education of their children at the government schools, so that almost all the lower class can read and write. Confirmation is also compulsory. Until that rite has been received, the youth of both sexes are *in statu pupillari*. Certificates of baptism, confirmation, and vaccination are indispensable before entering on service, apprenticeship, or matrimony.

Denmark.

Authors.

In Danish literary history the following names are particularly distinguished. Holberg, of Norwegian origin, was an eminent poet and historian; he was at once the Swift and the Hume of Denmark. Bartholin, Lungebeck, Suhm, Luxdorff, and Schjonning, were historians and antiquaries. Treschow is much admired as an eclectic philosopher. Both the Thorlaciuses, father and son, were very eminent scholars and critics; their works are chiefly written in Latin. The Danes have especially excelled in dramatic poetry. Their most eminent poets are Ewald, Wessel, Thaarup, Samsöe, Abrahamson, Ingemann, Johan Ludwig Heiberg, Adam Oehlenschläger, and Curo Bernhard. The two last are most popular. The two brothers Oersted are highly distinguished; Andreas as a lawyer and philosopher, and Hans Christian Oersted as a chemist, and for his discoveries in natural science. Among the antiquarians, the best known names are Suhm, Magnusen, Wormius, and Thomsen. As to philology, it will be enough to mention the name of Erasmus Rask.

The centre of literary activity is Copenhagen. Since the late war history has gained by the labours of Goerde and Schiern. The latter has published a work on the origin of the races of Europe. Last of all we have only to mention the memoirs of Oersted, the great jurisconsult and present minister, as well as a new poem, by Paludan Muller, the well-known author of *Adam Homo*.

The Danish language is spoken by three-fourths of the population: the remaining fourth, inhabiting Holstein, Sleswick, and Lauenburg, speak German.

The following is a list of the Kings of Denmark from the earliest times.

	Year.
Gormo, from 714 till	764
Sigefridus	765
Geltieus	809
Olaus III.	810
Hemmengius	812
Ringo Siwardus	817
Harald I. Black	843
Siwardus II.,	846
Eric I.,	847
Eric II.,	854
Canute I.,	873
Gormo II.,	897
Harald II.,	909
Gormo III.,	930
Harald III.,	980
Suenon I.,	1015
Canute II., the Great,	1036
Canute III. (Hardicanute),	1042
Magnus,	1048
Suenon II.,	1074
Harald IV.,	1080
Canute IV.,	1086
Olaus IV.,	1095
Eric III.,	1106
Nicolas,	1134
Eric IV.,	1139
Eric V.,	1147
Suenon III.,	1157
Waldemar I., the Grand,	1182
Canute V.,	1203
Waldemar II.,	1241
Eric VI.,	1250
Abel,	1252
Christopher I.,	1259
Eric VII.,	1286
Eric VIII.,	1320
Christopher II.,	1336
Waldemar III.,	1375
Olaus V.,	1387
Margaret, Queen of Sweden, Norway, and Denmark,	1412
Eric IX.,	1439
Christopher III.,	1448
Christian I.,	1481
John,	1513
Christian II.,	1523
Frederick I.,	1533
Christian III.,	1559
Frederick II.,	1588
Christian IV.,	1648
Frederick III.,	1670
Christian V.,	1699
Frederick IV.,	1736
Christian VI.,	1746
Frederick V.,	1766
Christian VII.,	1808
Frederick VI.,	1839
Christian VIII.,	1848
Frederick VII.	

(J. L—E.) (E. S—D.)

Dennis. DENNIS, JOHN, a celebrated critic, was the son of a respectable tradesmen in London, and born in the year 1657. He received the first branches of education at the great school of Harrow on the Hill, where he commenced acquaintance and intimacy with many young noblemen and gentlemen who afterwards made a considerable figure in public affairs. By these means he laid the foundation of a very strong and extensive interest, which, but for his own fault, might have been of infinite use to him in his future life. From Harrow he went to Caius College, Cambridge, where, as soon as he was of proper standing, he took the degree of bachelor of arts. When he quitted the university, he made the tour of Europe, in the course of which he conceived such a detestation of despotism, as confirmed him still more in those Whig principles which he had from his infancy imbibed.

On his return to England, he became early acquainted with Dryden, Wycherly, Congreve, and Southerne, whose conversation, inspiring him with a passion for poetry, and a contempt for every attainment that had not in it something of the *belles lettres*, diverted him from the acquisition of any profitable art, or the exercise of any profession. This, to a man who had not an independent income, was undoubtedly a misfortune. However, his zeal for the Protestant succession having recommended him to the patronage of the Duke of Marlborough, through that nobleman he obtained a place in the customs worth L.120 per annum. This he enjoyed for some years, till, from profuseness and want of economy, he was reduced to the necessity of disposing of it to satisfy some very pressing demands. By the advice of Lord Halifax, however, he reserved to himself, in the sale of it, an annuity for a term of years; which term he outlived, and hence, in the decline of his life, he was reduced to extreme necessity.

The following is an instance of the whimsical idea he had of his own importance:—In 1704 appeared his favourite tragedy *Liberty Asserted;* in which there were so many strokes against the French nation, that he thought they were never to be forgiven. He had worked himself into a persuasion that the king of France would insist on his being delivered up before consenting to conclude a peace; and, full of this idea of his own importance, when the congress was held at Utrecht, he is said to have waited on his patron, the Duke of Marlborough, in order to desire that no such article might be stipulated. The duke told him that he had really no interest then with the ministry; but that he had made no such provision for his own security, though he could not help thinking he had done the French as much injury as Dennis himself. Another story relating to this affair is, that being at a gentleman's house on the coast of Sussex, and walking one day on the sea-shore, he saw a ship sailing, as he fancied, towards him. He instantly set out for London, in the fancy that he was betrayed; and congratulating himself upon his escape, gave out that his friend had decoyed him down to his house in order to surrender him up to the French.

Dennis, partly through a natural peevishness and petulance of temper, and partly perhaps for the sake of procuring the means of subsistence, was continually engaged in controversy with his contemporaries, whom he always treated with the utmost severity; and though his observations were sometimes judicious, yet he conveyed them in language so scurrilous and abusive as destroyed their intended effect; and as his attacks were almost always on persons of abilities greatly superior to himself, as Addison, Steele, and Pope, their replies usually turned the popular opinion so strongly against him, that, by irritating his testy temper, they rendered him a perpetual torment to himself. Pope has pilloried him in the *Dunciad* and in the following epigram:—

> Should Dennis publish you had stabb'd your brother,
> Lampoon'd your monarch, or debauch'd your mother;
> Say, what revenge on Dennis can be had?
> Too dull for laughter, for reply too mad:
> On one so poor you cannot take the law;
> On one so old your sword you scorn to draw;
> Uncag'd then let the harmless monster rage,
> Secure in dulness, madness, want, and age

Denomination || Deodand.

At length, after a long life of vicissitudes, disappointments, and turmoils, rendered wretched by indiscretion, and hateful by malevolence, he was compelled to submit to the degrading humiliation of receiving obligations from those whom he had been continually reviling. In the very close of his days a play was acted for his benefit at the little theatre in the Haymarket, through the united interests of Thomson, Mallet, and Pope; the last of whom, notwithstanding the gross manner in which Dennis had calumniated him on many occasions, interested himself very warmly in his behalf, and even wrote an occasional prologue to the play, which was spoken by Cibber. Not long after this, on the 6th of January 1733, the unfortunate man died, in the seventy-seventh year of his age.

DENOMINATOR, in *Arithmetic*, that number placed below the line in vulgar fractions that shows the number of parts into which the integer is divided.

DENOMINATOR *of a Ratio*, is the quotient arising from the division of the antecedent by the consequent. Thus 6 is the denominator of the ratio 30 to 5; because 30 divided by 5 gives 6. This is otherwise called the *exponent of the ratio*.

DENSITY (Lat. *densitas*), compactness or closeness of constituent parts. It is opposed to rarity. A body is said to have double or triple the density of another body, when, the bulk being equal, the quantity of matter in the one is double or triple the quantity in the other. No body is absolutely dense; that is, all bodies contain interstices, or have a certain degree of porosity.

DENTAL (Lat. *dentalis;* from *dens*, a tooth), in *Grammar*, a term applied to an articulation or letter which is pronounced by placing the tongue against the upper teeth, as *d, t, th.*

DENTATUS, CURIUS, a renowned and highly disinterested Roman general, whose virtues render him more memorable than even his great military reputation, flourished 272 years B. C. He was thrice consul; he conquered the Samnites, Sabines, and Lucanians; and he gave each citizen forty acres of land, reserving no more for himself. The ambassadors of the Samnites, who paid him a visit, found Dentatus boiling turnips in a pipkin, and they hence inferred that he might be gained over to their interest by a bribe; but Dentatus told them that his design was not to grow rich, but to command those who were so. He defeated Pyrrhus near Tarentum, and received the honour of a triumph.

DENTIFRICE (Lat. *dens*, a tooth, and *frico*, to rub), any preparation for cleaning or preserving the teeth. Dentifrices very similar to those of the present day appear to have been in general use among the Romans.

DENTILS, in *Architecture*. See *Glossary* to ARCHITECTURE.

DENTITION, the breeding or cutting of teeth in children.

D'ENTRECASTEAUX'S CHANNEL, a strait on the south-east coast of Van Diemen's Land, from which it separates Bruny's Isle. It is about 35 miles in length, and contains several harbours and islets.

DENUNCIATION, a solemn publication or promulgation implying accusation or threatening.

DEOBSTRUENTS, in *Pharmacy*, such medicines as remove obstructions and open the natural passages.

DEODAND (*Deo dandum*, a thing to be given to God) has been used in England from very early times to denote any personal chattel which is forfeited because it has been the immediate cause of death to a human being. For ex-

ample, if a horse strike his keeper and kill him; if a man, in driving a cart, meet his death by falling under the wheel; if a tree, when felled, falls and kills a person: in the first case the horse, in the second the cart-wheel, cart, and horses, and in the third the tree, are forfeited to the king, to be applied to pious purposes, and distributed in alms by his high almoner. In general, however, the right to deodands—within certain limits—was granted by the crown either to individuals for an estate of inheritance, or as pertaining to lands. "Omnia quæ movent ad mortem sunt deodanda," says Bracton. This law probably was derived from that promulgated in Exodus xxi.—"If an ox gore a man or a woman that they die, then the ox shall be surely stoned to death, and his flesh shall not be eaten; but the owner of the ox shall be quit:" and afterwards the instrument came to be devoted to pious uses. Fleta (a pseudonymous commentator on English law in the reign of Edward I.) says that the deodand is to be sold, and the price distributed to the poor, for the soul of the king, his ancestors, and all faithful people departed this life. The rule has been, that when the instrument of death is at rest, and is composed of several parts, the particular part by which the person is killed shall alone be forfeited; as, for instance, if a man, in climbing up the wheel of a cart, falls and is killed, the wheel only is a deodand.

This ancient custom was abolished by act 9th and 10th Vict., cap. 62, which enacts that subsequent to September 1, 1846, there shall be no forfeiture of chattels in respect of homicide.

DEODHUR, a town of Hindustan, situated on the north-west frontier of Gujerat. Its population consists principally of rajpoots and coolies. It possesses a citadel 150 yards square, which is well fortified; and it is surrounded by a wall and deep ditch. The town labours under a great deficiency of water, and is hemmed in by the jungle, which comes up close to the houses. It is the principal place of a small independent territory, which pays no tribute to any government. Its ruler, nevertheless, acknowledges the supremacy of the British; but the paramount power exercises no interference in the internal administration of affairs. The town of Deodhur is in Lat. 24. 9. Long. 71. 49. (E. T.)

DEONELLA, or DEONHULLY, a town and fort of Hindustan, in Southern India, belonging to the rajah of Mysore. The place is unimportant, except from its association with historical recollections. It appears to have been the birthplace of Hyder Ali, and it was here that he made his first essay in arms. Here also, in 1753, was born his son, Tippoo Saib. It was taken by Lord Cornwallis in 1791. It is 19 miles N.N.E. of Bangalore. E. Long. 77. 46.; N. Lat. 13. 15.

DEPHLEGMATION, an antiquated term to denote the process of separating water from spirits or acids by evaporation or distillation. This is otherwise termed *concentration*, particularly when acids are the subject.

DEPHLOGISTICATED, in *Chemistry*, deprived of phlogiston, or the supposed principle of inflammability.

DEPHLOGISTICATED *Air*, an old term for oxygen gas.

DEPILATORY (Lat. *depilo, to pull out the hair*), any application for removing hair from the human skin without injuring its texture. Depilatories act either mechanically or chemically. The former are commonly mere plasters of pitch and resin, which, by their adhesive property, bring away the hair from the surface to which they have been applied. The true depilatories act by penetrating the pores of the skin, and destroying the bulbous roots of the hairs. Of these there are several kinds; but none can be compared for efficacy to the celebrated Oriental *rusma*, which is prepared as follows:—

"Mix two ounces of quicklime with half an ounce of orpiment or realgar (sulphuret of arsenic); boil that mixture in one pound of strong alkaline lye, then try its strength by dipping a feather into it, and when the flue falls off the rusma is quite strong enough. It is applied to the skin by a momentary friction, followed by washing with warm water. Such a caustic liquid should be used with the greatest circumspection, beginning with it somewhat diluted. A soap is sometimes made with lard of the above ingredients; or soft soap is combined with them: in either case to form a depilatory pomade. Occasionally one ounce of orpiment is taken to eight ounces of quicklime, or two to twelve, or three to fifteen; the last mixture being of course the most active. Its causticity may be tempered by the addition of one-eighth of starch or rye flour, so as to form a soft paste, which being laid upon the hairy spot for a few minutes, usually carries away the hairs with it. The rusma should never be applied but to a small surface at a time, for, independently of the risk of corroding the skin, dangerous consequences might ensue from absorption of the arsenic."—(Ure's *Dict of Arts, &c*)

However, a safer, and very effectual depilatory, is formed by impregnating cream of quicklime with sulphuretted hydrogen.

DEPONENT, in *Latin Grammar*, a term applied to verbs which have active significations, but passive terminations or conjugations; as *loquor*, I speak.

DEPONENT, in *Law*, one who gives a deposition or testimony on oath in a court of justice, or to be used as evidence.

DEPOSITION, in *Law*, the testimony given in court by a witness upon oath.

DEPOSITION also denotes the sequestrating or depriving a person of his dignity and office. See DEPRIVATION.

DEPRESSION OF THE POLE. When a person sails or travels towards the equator he is said to depress the pole, because as many degrees as he approaches nearer the equator, so many degrees will the pole be nearer the horizon. This phenomenon arises from the spherical figure of the earth.

DEPRESSION *of a Star*, or *of the Sun*, is its distance below the horizon, which is measured by an arc of a vertical circle intercepted between the horizon and the place of the star.

DEPRESSION *of the Visible Horizon*, or *Dip of the Horizon*, denotes its sinking or dipping below the true horizontal plane, by the observer's eye being raised above the surface of the sea, in consequence of which the observed altitude of an object is by so much too great.

DEPRIVATION, in the canon law, is of two kinds, namely, *a beneficio*, and *ab officio*.

DEPRIVATION *a beneficio* is, when for some great crime a minister is wholly and for ever deprived of his living or preferment; which differs from suspension, in that the latter is only temporary.

DEPRIVATION *ab officio* is, when a minister is for ever deprived of his order, which is the same, in reality, with what we otherwise call *deposition* and *degradation*. Deprivation is usually awarded for some heinous crime deserving death, and is performed by the bishop with solemn formalities. See DEGRADATION.

DEPTFORD, a parliamentary borough of England, in the counties of Kent and Surrey, at the junction of the Thames and the Ravensbourne, three miles from London, and contiguous to Greenwich. The lower town, next the river, consists of narrow irregular streets and ill-built houses; but the upper town is superior in these respects. By the Reform act, Deptford unites with Greenwich, &c., in returning two members to parliament. Pop. (1851) 27,896. It contains an extensive naval arsenal, victualling office, and dock-yards covering an area of 31 acres; private dock-yards; two large hospitals for decayed shipmasters and pilots, or their widows, well-endowed and regulated by the elder brethren of Trinity House; also, a well-endowed charity school, dispensary, barracks, savings-bank, and a royal naval school incorporated in 1840. See DOCK-YARDS.

DEPURATION (Ital. *depurare, to purge*), the act of freeing any fluid from heterogeneous matter. It is of three kinds: first, by decantation, when the feculent matter will be deposited at the bottom of the vessel; secondly, by despumation, effected by boiling or fermentation, and skimming, or by clarification; and, thirdly, by filtration.

Deputation || Derby.

DEPUTATION, a mission of select persons, out of a company or body, to treat with other parties in their name.

DEPUTY, a person employed to manage a particular business by some community or individual in authority. Also, one who exercises an office in another's right.

DERA GHAZEE KHAN, a large and populous town of Afghanistan, four miles from the right bank of the Indus, in N. Lat. 30. 5., E. Long. 70. 52. It has an extensive transit trade, and manufactures of silks, cottons, scarfs, and coarse cutlery. The bazaar contains 1600 shops. Pop. about 25,000, of whom nearly one-half are Hindus, the rest Mohammedans.

DERA ISMAIL KHAN, a considerable town of Afghanistan, built at a short distance from the right bank of the Indus, to replace the former town of that name, which, being only 100 yards from the river, was swept away by a flood so that not a vestige of it was left. N. Lat. 31. 50.; E. Long. 70. 58. It has a considerable transit trade, and extensive manufactures of white cotton cloth. Pop. about 8000.

DERBEND, or DERBENT (the ancient *Albana*), a fortified town of Russia, capital of the province of Daghestan, situated on the western shore of the Caspian, 135 miles N.N.W. of Baku. Pop. 1200. It is built in the form of a parallelogram, and extends from the shore to the declivity of a mountain ridge running N.E. from the Caucasus, and terminating about a mile from the Caspian. The walls which inclose the town on the north and south are of great antiquity, and very strong, being 8 feet thick and 26 feet high, and many of the stones are cubes of 6 feet. They are strengthened by numerous round and square towers; and the citadel in the upper part of the town is well fortified. It has little trade, owing to the poverty of the surrounding countries, but very fine saffron is cultivated in the neighbourhood. The harbour is one of the worst on the Caspian Sea. It had formerly a quay, which is now sunk under water. Derbend is a place of great antiquity. The celebrated khaliph Haroun-al-Raschid lived here at different times, and brought the town into great repute, by promoting commerce and the arts. In the convulsions of this part of Asia it has frequently changed masters. In 1722 it was taken possession of by the Russians, who retained possession of it until 1735, when it was restored to the Persians. In the war with Persia in 1796, it surrendered to the Russians, and has ever since remained in their possession.

DERBY, a municipal and parliamentary borough of England, capital of the county of that name, is pleasantly situated in a wide and fertile valley on the Derwent, which is navigable hence to its confluence with the Trent. Besides the Derwent the town is traversed by the Markeaton brook, both being crossed by several handsome bridges. On the east bank of the river, opposite to Derby, was the Roman station Derventio. The chief public buildings are, the town and county halls, the prison, jail, and county lunatic asylum. It contains seven churches, a Roman Catholic chapel, general infirmary, mechanics' institute, and a philosophical society founded by Dr Darwin, who here composed the greater portion of his works. Here are extensive manufactories of silk, cotton, and fine worsted stockings. The silk-mill is the first and largest of its kind erected in England. Derby also contains large porcelain works, and manufactories where all kinds of ornaments are made of the marbles, spars, petrifactions, &c., found in the neighbourhood All Saints' church contains numerous monuments of the Cavendish family. Richardson the novelist was a native of this town. A castle once existed at Derby; but the last remains of the building are said to have disappeared during the reign of Elizabeth. Several religious establishments were founded here at a very early period; but no vestiges of them now remain. Prince Charles Stuart advanced as far as Derby on his march into England, and the house in which he lodged is still pointed out. Through the munificence of Joseph Strutt, Esq., the working classes of Derby possess peculiar opportunities of enjoyment and gratification. This public-spirited individual appropriated nearly eleven acres of land, containing an extensive collection of trees and shrubs, for the recreation of the inhabitants and their families. This piece of land, called the Arboretum, was tastefully laid out, at the donor's expense, by J. C. Loudon, Esq. Five acres of ground have since been added and laid out in a similar manner. The Derby grammar-school is supposed to be one of the most ancient foundations of the kind in the kingdom. Flamsteed, the astronomer, received his early education in this school. It is governed by a mayor, 12 aldermen, and 36 councillors, and returns two members to parliament. Pop. (1851) 40,609.

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DERBYSHIRE was, in the time of the Britons, a portion of the district which constituted the kingdom of the Coritani. During the government of the Romans, it formed a part of Britannia Prima; and under the Heptarchy it was included in the kingdom of Mercia. It is situated nearly in the centre of England, and is bounded on the east by the county of Nottingham and a part of Leicestershire; on the west it is divided from Staffordshire and Cheshire by the rivers Trent, Dove, the Etherow, and Goyt; on the north it has Yorkshire and a part of Cheshire, and on the south Leicestershire. Its figure is very irregular, but approaches rudely to that of a triangle. The greatest length of Derbyshire from south-east to north-west is about fifty-six miles; its greatest width from east-north-east to west-south-west thirty-three. It contains 1029 square miles, or 658,803 statute acres.

This country is divided into the hundreds of High Peak, Scarsdale, Appletree, Repton and Gresley, Morleston and Littchurch, and the wapentake of Wirksworth. It contains fourteen market-towns, viz., Alfreton, Ashbourne, Ashover, Bakewell, Belper, Buxton, Chapel-en-le-Frith, Chesterfield, Cromford, Derby, Ilkeston, Tideswell, Winster, and Wirksworth. It consists of 132 parishes, besides parts of six others; is included as an archdeaconry in the diocese of Lichfield and Coventry; and is divided into six deaneries, viz., High Peak, Chesterfield, Ashbourne, Castillar, Derby, and Repington. This county returns four members to the House of Commons, and for that purpose it has been formed into two divisions. The northern part comprehends the whole of the hundreds of High Peak and Scarsdale, and so much of the wapentake of Wirksworth as is comprised in Bakewell division: the polling-place is the town of Bakewell. The southern part comprehends the hundreds of Appletree, of Repton and Gresley, of Morleston and Littchurch, and the remainder of the wapentake of Wirksworth, and the polling-place for the division is the town of Derby. Derby gives the title of earl to the noble family of Stanley, Chesterfield the same title to that of Stanhope, and Hartington affords the title of marquis to his Grace the Duke of Devonshire.

There is no English county which presents such a variety of scenery as Derbyshire. The surface of the southern district is, for the most part, pretty level, containing nothing remarkable in its hills, and consequently little of the picturesque. But the northern part abounds in hill and dale, and the scenery is in many places romantic and sublime. The county rising gradually from the south to the town of Wirksworth, and thence to the north, assumes a mountainous appearance, which it continues to possess to its extremity. These elevations are the commencement of that mountainous ridge which from thence divides the island and extends into Scotland. The highest points in the mountainous tract of Derbyshire are—Ax Edge, about three miles south-west of Buxton; Lord's Seat, near Castleton; and Kinderscout, near the north-western extremity of the county. About the town of Derby, and to the south of it, the country is flat and low. In the hilly districts some of the valleys

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are very beautiful, particularly those of Castleton and Glossop; but what constitutes the most picturesque and singular scenery of this county is the great number and variety of smaller valleys or dales with which the limestone district abounds. These may differ in extent and some particular circumstances, but the general characteristics of them are precipitous rocks of very singular and picturesque forms, with mountain streams and rivulets running through the lower parts of the dales, the sides of which are generally well wooded. The most celebrated of these are, Matlock-Dale, on the river Derwent; Monsal-Dale, the upper part of which is called Millers-Dale, on the river Wye; Middleton-Dale, Eyam-Dale, and Dove-Dale. In Matlock-Dale is a stupendous rock, called the High-Tor, rising almost perpendicularly from the river to the height of about 300 feet.

The soils of Derbyshire consist chiefly of clay, loam, sand, and peat, very irregularly intermixed. The southern part, which has been distinguished by the appellation of the fertile district, consists principally of a red loam, on various subsoils, which approaches to marl, clay, loam, sand, grit or gravel, according to the nature of the substratum, or its exposure to the atmosphere. Peat mosses are abundant in the northern part of the county, denominated High Peak. The substrata of most of the southern portion of the county consist of gravel, intermixed with large portions of red marl of very irregular forms, in several parts of which are beds of gypsum of considerable extent. The substrata of the other parts of Derbyshire consist of limestone of various kinds, and toadstone or trap; shale and sandstone, coal and indurated clay, resting on each other in alternate layers.

Derbyshire is a well-wooded county, and several of the noblemen's parks contain fine oaks of very noble appearance. Those of Kedlestone Park, the seat of Lord Scarsdale, are supposed to be the largest and oldest in the kingdom, several being thought to be eight hundred years old.

The atmosphere and climate of Derbyshire vary very much in different parts. From its northern situation, even the southern part of the county is colder, and more frequently visited with rain, than many of the other central counties. In summer, cold and thick fogs are frequently seen hanging over the rivers, and surrounding the bases of the hills, and hoar-frosts are not unfrequent even in the months of June and July. Owing to the great elevation of the northern parts, some kinds of grain will not grow at all in the Peak, and even that which is sown in the more sheltered places is seldom cut till late in the year. The winters are, in general, very severe; and the mountains by attracting the clouds in their passage over them, cause this region to be distinguished from the others by the greater quantity of rain that falls.

The chief rivers are, the Trent, the Derwent, the Wye, the Dove, the Etherow, the Earwash, and the Rother. The Trent does not intersect the county, but forms the boundary between it and Staffordshire on the south. The Derwent, which rises at the northern extremity of the county, has a course of 40 miles. It was formerly navigable from Wylne-Ferry up to Derby, but the navigation was abandoned when the Derby Canal was completed in 1795. The Wye has its origin a little to the north of Buxton, and falls into the Derwent near Rowsley. The Dove, which has its source in the High Peak, a few miles to the south of Buxton, is for many miles the boundary between Derbyshire and Staffordshire: it falls into the Derwent near Newton-Solney. The Wye and the Dove are celebrated for their trout and grayling fishing. The river Rother rises near Padley, and, after running by Chesterfield, enters Yorkshire near Killamarsh. The Earwash flows from the skirts of Sherwood Forest in Nottinghamshire, and falls into the Trent near Long Eaton. The Etherow rises amongst the hills at the northern boundary of the county, flows nearly due south, dividing Derbyshire from Cheshire, and, meeting the Goyt near Marple, assumes the name of Mersey. The lesser rivers are—the Amber, Barbrook, Burbage, Ecclesburn, Goyt, Lathkill, Maese, and the Morledge.

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Derbyshire has several canals intersecting it in different directions. The Trent and Mersey, or Grand Trunk Canal, communicating between Liverpool and London, and also with Bristol and Hull, was begun in 1776 by the celebrated Brindley, a native of the county, and completed in 1777 under his able successors Smeaton and Rennie. It passes through Derbyshire, from Burton to its termination at Wilden-Ferry, following the course of the Trent. The Chesterfield Canal was begun in 1771 by Brindley, and completed by his brother-in-law Mr Henshall in 1776. It enters the county at Killamarsh, and terminates at Chesterfield. The Langley Bridge, or Earwash Canal, begun in 1777 by Mr Jessop, commences in the Trent navigation, near Sawley, and terminates at Langley Mill. It runs parallel to the little river Earwash, and opens into the Cromford Canal. The Peak Forest Canal was commenced in 1794, and finished in 1800. It proceeds from the Ashton-under-Line Canal, near Dukinfield Bridge, and terminates at Chapel Milton, Derbyshire. The Cromford Canal was begun in 1789. Its line is wholly in Derbyshire, commencing at Langley Mill, where the Earwash terminates, and ending at Cromford. It was completed in 1794 by Mr Jessop. The Ashby-de-la-Zouch Canal, begun in 1793, but not finished until 1805, is connected with the southern part of Derbyshire; its line passing by Willesley and Measham. The line of the Derby Canal is entirely in this county: commencing in the Trent and Mersey Canal, north of Swarkstone, passing by Derby, with a branch to Little Eaton, and terminating in the Earwash Canal, half a mile south of Sandiacre. The Nutbrook Canal was made in 1793. It commences in the Earwash Canal, and, after running four miles and a half, finishes at Shipley Wharf. The Midland Railway traverses the county, and numerous branch lines connect the various points. One line from Ambergate proceeds up the beautiful vale of the Derwent through Matlock, to Rowsley, a little way from Haddon Hall. The High Peak Railway is intended to connect Buxton and Castleton with the south.

This county is celebrated for its metals and minerals. They are various and plentiful, particularly in the limestone strata. Lead ore is found in several forms, but most commonly as galena or sulphuret of lead. That species called slickenside, with a smooth glossy surface, is found in the Odin and Castleton mines. The amount of silver found in the Derbyshire lead is not sufficient to repay the trouble of separating it. Carbonate of lead sometimes occurs. Calamine, or carbonate and siliceous oxide of zinc, is found at Castleton, Cromford, Bonsall, and Wirksworth. It occurs in various colours and of different qualities; sometimes in nodules, in a botryoidal form, and in the ochreous state. Blende, or black-jack, another ore of zinc, is also obtained. Copper has been found in small quantities only. Pieces of considerable size, detached from any vein, have frequently been met with at Matlock and Bonsall; and a slender vein has been discovered between Tideswell and Buxton.

Iron ore is found in very great abundance in all those tracts of the county where coal has been discovered. It lies at different depths; and frequently, from the great dip of the strata, appears upon the surface of the ground. The beds of ore are from two to twelve inches thick, producing chiefly that of the argillaceous kind; but the carbonates, or sparry iron ores, of a fine brownish-red colour, sometimes bright yellow, scaly, or dirty brown, are found in amorphous masses near the surface, and filling detached cavities. The principal foundries and forges are Butterley Codnor, Morley Park, Wingerworth, Chesterfield, Riddings, and Stavely.

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The ore of manganese appears in various forms. The ores of arsenic and antimony are found in small quantities, united with lead ore, quartz crystals, various crystals of calcareous spar, and of fluor or fluate of lime, gypsum, selenite, and barytes, here called cauk. The most beautiful among the minerals of this county is that much admired fluor known by the name of Blue John, or Derbyshire spar, found in the fissures of the limestone, in the neighbourhood of Castleton. This substance, when polished, exhibits an infinite variety of blue, purple, red, and yellow shades; and from being transparent shows the colours to greater advantage. A considerable trade is carried on in Buxton, Castleton, Bakewell, Matlock, and a few other places, in the manufacture of various ornaments, as vases, cups, inkstands, and tables, from this spar, and the variously-coloured marbles. Petroleum, or mineral oil, is found in the black marble at Ashford. Elastic bitumen, a substance peculiar to this county, resembling in appearance the common Indian rubber, is also found in the cavities of the Odin mine.

Coal is very plentiful, abounding in large fields in several districts. It is of different degrees of hardness, comes out of the pit in long foliated masses of a shining fracture, burns with a brilliant flame and crackling noise, and leaves a reddish-white ash. The limestone of this county is of various colours, white, gray, yellow, blue, and black; and is of various qualities, some being soft, and some sufficiently hard to be polished into beautiful marble. A variety, of a deep red colour, similar to Rosso antico, has been found near New Haven. The Duke of Devonshire preserves it for particular purposes. Fine freestone, greenstone, shale, clunch, stalactitical concretions, and fuller's earth, are also found in different parts. Impressions of leaves and plants, a great variety of coralline bodies, fossil shells, and even a small alligator, have been found imbedded in the limestone of this county.

Springs.

The warm mineral and other springs have long been celebrated. The principal are those of Buxton and Matlock. The heat of the Buxton water is 82°, and never varies with the temperature of the atmosphere. The water is remarkably pure, being very slightly impregnated with saline particles. It is used both for bathing and drinking, and is chiefly recommended for gout, rheumatism, derangement of the biliary and digestive organs, and diseases of the urinary passages, for all of which it is of considerable efficacy. There are various public and private baths, both for ladies and gentlemen, and one open gratis to the poor. It appears from several remains discovered at different times that these waters were known to the Romans; and from their time to the present they have been resorted to by invalids.

The following analysis of the Buxton waters is by Sir Charles Scudamore.

Gaseous contents in a Gallon.	Cubic Inches.	Solid Contents in a Gallon.	Grains.
Carbonic acid	1·50	Muriate of magnesia	·58
Azote	4·64	——— soda	2·40
		Sulphate of lime	·60
		Carbonate of lime	10·40
		Extractive matter, &c.	·50
		Loss	·52
	6·14		15·00

Matlock water is not so warm as the Buxton, the thermometer seldom rising to more than 68° of Fahrenheit. The springs issue from between fifteen and thirty yards above the level of the river. Higher or lower the springs are cold, differing in nothing from common water. The water is very pure, and less impregnated with mineral substances than that of Buxton. There are also several baths at Matlock, which are much resorted to.

There is a tepid chalybeate spring at Bakewell, the temperature of which is about 59°. It is tonic, and recommended for indigestion, debility, and chronic rheumatism. Here there are good baths. At this place there is also a spring, which has been found to contain in sixty quarts thirteen cubic inches of sulphuretted hydrogen. The tepid spring at Stony-Middleton much resembles that of Matlock, but it is not so warm, being only 63°. There are several other tepid springs in the county. Among the sulphureous springs, that of Kedleston is the strongest. It is like the Harrowgate water, and is used externally for most cutaneous diseases, particularly for those of an ulcerous nature; while it is taken internally as an antiscorbutic and diuretic. There are cold and warm baths. Other sulphureous springs are also found in many districts. The most celebrated chalybeate water is at Quarndon, three miles from Derby, which is a good deal frequented.

Among the wonders of Derbyshire, all authors mention the intermitting spring at Barmoor, near Tideswell. It is generally called the Ebbing and Flowing Well; but the intermission is not regular, for in dry seasons the ebbing and flowing ceases for several weeks, and in wet weather it often ebbs and flows every ten minutes.

The southern and south-eastern parts of this county are the best cultivated; and great quantities of excellent wheat and barley are grown there. The arable lands in the northern parts are chiefly cultivated for oats, of which grain there is a great consumption, oaten bread leavened being the principal food of the lower classes. The dairy country is around Ashbourne and the south-western side of the county.

The breed of cows in this county has been very much improved of late years. They are in general horned, large, and handsome; yielding upon an average ten quarts of milk a-day, and three cwt. of cheese annually. They are most commonly speckled, with large well-turned horns, though of late the short-horned Lancashire breed has been introduced. The horses of Derbyshire are well adapted to the different regions of its diversified surface. In the northern districts the breed is small, of light and slender make; in the southern parts they are in general of a strong and heavy kind; and in the stables of the country gentlemen this beautiful animal may be found in the full perfection of its symmetry. The sheep also vary in size. Those that are bred on the borders of Leicestershire differ but little in weight from the breed of that county; but they gradually diminish in size as we proceed northwards, till they get as small as any in the kingdom. The stock consists of about 360,000, yielding about 9000 wool packs annually. The parks in the county are well stocked with fallow-deer.

The woollen manufactories, for which this county was formerly celebrated, are now confined to the worsted-spinning at Derby, Melbourne, and Tideswell, and to the weaving a few blankets at Chesterfield. The first silk-mill established in this kingdom was introduced into Derby in the beginning of the last century, and the improved machinery of it was brought from Italy by the celebrated John Lombe. This mill is still worked with the original machinery; but very great improvements have been made of late years in the construction of the spinning apparatus; and the facility attained in working the several articles of silk manufacture has contributed to the extension of this branch of business in a very eminent degree. The manufacture of stockings was introduced into Derbyshire about 1717; and this acquired additional celebrity by the ingenious discovery of Strutt, who introduced a machine for making ribbed stockings about the year 1755.

The manufacture of cotton was introduced in the year 1771, when Sir Richard Arkwright, the inventor, established one of the first cotton-mills on the improved principles; and in 1773 he, in conjunction with Mr Jedediah Strutt and Mr Need, made at Derby the first successful attempt to establish the manufacture of calicoes in this kingdom. This county, therefore, is the cradle of the most im-

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portant branches of the cotton trade; and, at the present moment, an immense capital is employed in the business, which is carried on to a great extent.

There are in several places manufactures of linen, and flax-spinning is carried on in others, but upon a small scale. White and red lead works, various manufactures connected with the iron trade, marble and spar works, a long established and celebrated porcelain manufactory, and grindstone mills, are found in different parts of the county. In the town of Derby there is a considerable quantity of jewellery goods prepared, of good taste and quality.

The real property was estimated in 1815 at L.883,370; in 1843 at L.1,379,025, of which L.1,024,204 was on railways, L.40,638 on mines, L.21,454 on canals, and L.6005 on iron works. The county income in 1848 was L.18,489.

Among the singular customs of Derbyshire may be mentioned that of rush-bearing (now nearly obsolete), a ceremony of strewing the churches on a certain day with rushes. It usually takes place on the anniversary of the dedication of the church, or on midsummer eve. The ancient custom of hanging up in the churches garlands of roses, with a pair of gloves cut out of white paper, which had been carried before the corpses of unmarried women at their funerals, still prevails in many parishes of the Peak; and that of dressing wells and fountains with flowers is still preserved at Tissington, where Holy Thursday is devoted to the festival. The country wakes are generally observed here, on the Sunday following the day of the dedication of the church or chapel, or on the day of the saint to whom it is dedicated.

The British antiquities of this county are druidical circles, tumuli of earth and stones, rocking-stones, rock-basins, and some rude military works in the uncultivated parts of the county. The Roman remains deserving of notice are, the altar preserved in Haddon-Hall, the inscribed pigs of lead now in the British Museum, and the silver plate found in Risley Park. Several Roman roads, the remains of which are still visible, passed through the county; and many stations of consequence may be easily traced.

The ecclesiastical edifices of this county exhibit the taste of different ages. Of the Saxon period is the crypt under Repton church, which is supposed to be the remains of the conventual church, destroyed by the Danes in the year 874. Melbourne church is a very perfect specimen of the massive style of architecture which prevailed in the eleventh century. The desecrated church of Steetly exhibits a very complete specimen of the latter and more enriched style of Saxon architecture on a small scale. Other and numerous remains of Saxon architecture are to be found in this county.

Specimens of the early Gothic style are not frequent; and those of the fifteenth and sixteenth centuries are inconsiderable, except the tower of All-Saints at Derby, which has been generally and deservedly admired. It is about 150 feet high, and richly ornamented with Gothic tracing.

The only monastic buildings in this county, of which any remains at present exist, are Dale Abbey, the arch of the east window of which still stands; Beauchief Abbey, now used as a church; part of the original Saxon monastery of Repton, and an ancient brick tower, which formed part of the prior's lodging.

The ancient castles of Derbyshire whose ruins now remain are those of Castleton, Codnor, Horsley, and Melbourne. Castleton was most probably erected by William Peverill, to whom the manor was given by William the Conqueror; Codnor was the ancient seat of the Grey family; Horsley was built in the beginning of the thirteenth century, by Ferrers, earl of Derby; and Melbourne existed as early as the time of Edward the Third.

The most remarkable mansion-house in this county, in point of antiquity, is Haddon-Hall, belonging to the Duke of Rutland. It has been erected at various times, but no part later than the middle of the sixteenth century. The manor-house of South Wingfield, a very splendid and spacious edifice, erected by Lord Ralph Cromwell in the reign of Henry VI., is now a mere ruin, having been suffered to fall into decay soon after the civil war in the seventeenth century.

Dercetis ‖ Derivative.

The noblemen's seats are—Chatsworth, the chief seat, and Hardwick, the occasional residence, of the Duke of Devonshire; Elvaston, the seat of the Earl of Harrington; Sudbury, that of Lord Vernon; Kedleston, the elegant mansion of Lord Scarsdale; Bretby, the seat of the Chesterfield family; Doveridge, that of Lord Waterpark; and Hassop, that of the Earl of Newburgh.

The population of the county in 1851 amounted to 296,084, of whom 147,737 were males, and 148,347 females, being an increase of 83 per cent. in 50 years. There were 288 persons to a square mile, and 2·2 square acres to a person. The inhabited houses were 59,371, uninhabited 2498, and those in the course of erection numbered 453, making a total of 62,322.

Belonging to the Church of England there are 250 places of worship, with 89,714 sittings; to other denominations 526 places of worship, with 105,481 sittings. Day schools 840, scholars 37,271; Sunday schools, 558, scholars 55,307. (J. B. D.)

DERCETIS, or DERCETO, a Syrian goddess. See ATERGATIS.

DEREHAM EAST, or MARKET-DEREHAM, a clean, well built, and pleasantly situated market-town of England, county of Norfolk, 16 miles W.N.W. of Norwich. The principal building is the parish church, an ancient cruciform edifice surmounted by a tower; and containing a rich antique font, many interesting relics, and a monument to the poet Cowper, who was interred here in 1800. The vicinity is highly cultivated, and has many gardens and orchards. Market-day Friday. Pop. (1851) 3372.

DERELICTS (from *de*, and *relinquo*, to leave), in the civil law, are such goods as are thrown away or relinquished by the owner.

DERG LOUGH. See DONEGAL.

DERHAM, WILLIAM, D.D., an English divine and natural philosopher of considerable eminence, was born at Stoughton near Worcester, in 1657. He received the rudiments of his education at Blockley in his native county, and was afterwards entered of Trinity College, Oxford, where he graduated with much distinction in 1679. Three years later he became vicar of Margrave in Berkshire; and in 1689 was preferred to the valuable living of Upminster in Essex. He had now leisure to devote himself to his favourite pursuits, and published his *Artificial Clockmaker*, a work which rapidly went through several editions. The best known of his subsequent works are his *Physico-Theology*, published in 1711-12; his *Astro-Theology*, 1714; and his *Christo-Theology*, 1730. For these services to science and theology he was first made a canon of Windsor, and ultimately received the degree of D.D. from Oxford. His last work, entitled *A Defence of the Church's right in Leasehold Estates*, was published a short time before his death, which happened in 1735. Besides the works published in his own name, Derham contributed largely to the periodical literature of his day; revised the *Miscellanea Curiosa;* wrote the notes for Albin's *Natural History;* and published some of the MSS. of Ray the botanist and Hooke the natural philosopher.

DERIVATIVE, in *Grammar*, a word which takes its origin from another word, called its *primitive*. Such is the word derivative itself, which takes its origin from the primitive *rivus*, a rivulet or channel, out of which lesser streams are drawn. Thus *manhood, deity, lawyer*, are *derived* from *man, deus, law*.

Dervis || Desaix de Voygoux.

DERVIS, DERVISE, or DERVISH, a name given to a kind of Turkish priests or monks, who lead a very austere life, and profess extreme poverty, though they are allowed to marry. The word is originally Persian, and signifies a beggar, or one who has nothing; and because religious persons, particularly the followers of Mevelava, pretend not to possess anything, the religious in general, and the Mevelavites in particular, are called *Dervises* or *Dervishes*.

The dervises called *Mevelavites* are a Mohammedan order of religious persons, the chief or founder of which was one Mevelava. They are now exceedingly numerous. Their chief monastery is situated near Cogna, in Natolia, where the general has his residence, and where the assemblies of the order are held; the other houses being all dependent on this, by a privilege granted to the monastery under Ottoman I.

The dervises affect a great deal of modesty, patience, humility, and charity. They go bare-legged and open-breasted, and frequently burn themselves with hot irons, in order to inure themselves to patience. They fast regularly on Wednesdays till after sunset; and on Tuesdays and Fridays they hold meetings, at which the superior of the house presides. One of them plays all the while on a flute, and the rest dance, whirling their bodies round with the greatest rapidity imaginable. This practice they observe with great strictness, in memory of Mevelava, their patriarch, having turned miraculously round, as they pretend, for the space of four days, without any food or refreshment, his companion Hamsa playing all the while on the flute; after which he fell into an ecstacy, in which he received wonderful revelations for the establishment of his order. They believe the flute an instrument consecrated by Jacob and the shepherds of the Old Testament, and that the latter sang the praises of God accompanied by this instrument. They profess poverty, chastity, and obedience, but seldom practise these virtues. For the most part they are either fools, fanatics, or knaves; most generally the last.

DERWENT, the name of several English rivers. See CUMBERLANDSHIRE; DERBYSHIRE; NAVIGATION, *Inland*.

DERWENTWATER See CUMBERLAND.

DESAGUILIERS, JEAN THÉOPHILE, D.D., a distinguished philosopher and mechanician, was born at Rochelle, March 12, 1683, and brought to England whilst yet an infant by his father, who was a French Protestant minister, and had left his native country at the revocation of the edict of Nantes. He received his education at Christ-Church, Oxford, where he ultimately succeeded Dr Keil in reading lectures on experimental philosophy at Hart-Hall. Dr Desaguliers became chaplain to the Duke of Chandos, who presented him to the living of Edgeware; and he afterwards was made chaplain to Frederick Prince of Wales. He continued to read lectures with great success till his death in 1749. To the Philosophical Transactions he communicated many curious papers. He also published a valuable *Course of Experimental Philosophy*, in 2 vols. 4to; and gave to the world an edition of Gregory's *Elements of Catoptrics and Dioptrics*, with an appendix on reflecting telescopes, 8vo. He was a member of the Royal Society, and of several foreign academies. The following lines of the poet Cawthorn depict the indigence and neglect into which he fell in his old age:—

> How poor, neglected, Desaguiliers fell!
> How he who taught two gracious kings to view
> All Boyle ennobled, and all Bacon knew,
> Died in a cell, without a friend to save,
> Without a guinea, and without a grave.

DESAIX DE VOYGOUX, LOUIS CHARLES ANTOINE, one of the most distinguished generals of the French republic, was born at Vegou, near Riom in 1768. The first engagement in which he took part was the battle of Lauterburg in which he was wounded; and when Moreau executed his masterly retreat through the Black Forest, Desaix contributed not a little to the success of that memorable exploit. After some gallant achievements, such as the repulse of the Archduke Charles at Rastadt, and the defence of the bridge of Kehl, he accompained Bonaparte to Egypt, where he dispersed the Arabs, and for his various services was made commander of Upper Egypt. On his return to Europe he found Bonaparte marching to the conquest of Italy. With a small squadron he hastened to join the first consul, whom he overtook at Marengo at the very moment when the Austrians had deemed themselves secure of the victory. His timely arrival changed the fortune of the day; but in the moment of victory he was shot through the heart and immediately expired, 14th June 1800. His body was embalmed at Milan, and finally deposited in the convent of Mount St Bernard, where a handsome monument is erected to his memory. Desault.

DESAULT, PIERRE JOSEPH, a distinguished French surgeon, was born at Magny-Vernais, a village of Franche-Compté, in 1744. He was descended of humble parents; received the early part of his education in a school of the Jesuits, and was destined for the church; but his own inclination tended to the study of medicine; and he was at length settled as an apprentice in the military hospital of Béfort. Here he acquired some knowledge of anatomy and surgery; and having previously made considerable progress in mathematical studies, he applied this knowledge, after the example of Borelli and others, to the investigation of physiological subjects. He early translated the work of Borelli *De motu Animalium*, and added notes and illustrations, which, although founded on wrong principles, gave undeniable proofs of zeal and industry.

He went to Paris when about twenty years of age, and opened a school of anatomy in the winter of 1766, which was soon attended by about three hundred pupils, a great proportion of whom were older than himself. His success excited the jealousy of the established teachers and professors, who exerted all the influence of authority to silence him; and although he was patronized and protected by some surgeons of great eminence, the strength of the opposition would have obliged him to renounce public teaching, had he not eluded all their efforts by the expedient of adopting the name of another as a sanction to his proceedings. His reputation was now greatly extended; but still he declined private practice, till he should be established in some distinguished public station. In 1776 he was admitted a member of the corporation of surgeons; and so limited were his finances at this time, that he was indulged by that body in paying his fees at his own convenience. He successively filled the honourable stations in the corporation and academy of surgery; and in 1782 he was appointed surgeon-major to the hospital *De la Charité*.

Desault was now regarded as one of the first surgeons of Paris. He succeeded to the next vacancy at the Hôtel Dieu; and, after the death of Moreau, almost the whole surgical department of that hospital was intrusted to him. Here he instituted a clinical school of surgery on a liberal and extensive plan, which attracted a great concourse of students, not only from every part of France, but also from foreign countries. An audience composed of about 600 students frequently met to hear his instructions; and most of the surgeons of the French army derived their knowledge from his lectures. He introduced many improvements into the practice of surgery, as well as in the construction of various surgical instruments.

In 1791 he published a work entitled *Journal de Chirurgerie*, the object of which was to record the most interesting cases which had occurred in his clinical school, with the remarks which he had made upon them in the course of his lectures. The editing of this work was intrusted to his pupils. But in the midst of his valuable labours he became

Descant ‖ Descent.

obnoxious to some of the prevailing parties of that turbulent period; and in 1792 he was, on some frivolous charge, denounced to the popular sections. After being twice examined, he was seized while delivering a lecture, carried away from his theatre, and committed to the prison of the Luxembourg. In three days, however, he was liberated, and permitted to resume his functions. When the school of health was established, he was appointed clinical professor for external maladies; and it was through his means that the Evêché was converted into an hospital for surgical operations.

The dreadful scenes of May 1795 made so deep an impression on his mind, that from the apprehension of a renewal of the horrors which he had formerly experienced, he was seized with an ataxic fever, accompanied with delirium, which put an end to his life June 1st of that year From the circumstance of his having attended the dauphin in the Temple, and his death having happened but a short time before that of the prince, an opinion was prevalent among the populace that he was poisoned because he had refused to do anything against the dauphin's life. This story seems to be without foundation; but it affords a proof of the opinion entertained by the public of Desault's integrity. A pension was settled on his widow by the republic. Fame, and not emolument, having always been the object of his ambition, he neglected many opportunities of acquiring wealth. His temper was ardent, and sometimes rather violent; but his sentiments were always elevated and noble, and hence his pupils called him *Le Bourru Bienfaisant*. The only work of which he is the sole author is entitled *Traité des Maladies Chirurgicales, et des Opérations qui leur conviennent*, in 2 vols. 8vo.

DESCANT, or DISCANT, an old musical term signifying what has since been called *counterpoint*.

DESCARTES. See CARTES, DES.

DESCENSION, in *Astronomy*, is either right or oblique.

Right DESCENSION is an arc of the equinoctial intercepted between the next equinoctial point and the intersection of the meridian, passing through the centre of the object, at its setting, in a right sphere.

Oblique DESCENSION is an arc of the equinoctial intercepted between the next equinoctial point and the horizon, passing through the centre of the object, at its setting, in an oblique sphere.

DESCENT (Lat. *descensus*), is the act of passing from a higher to a lower place. Thus, all bodies, unless otherwise determined by a force superior to their gravity, descend towards the centre of the earth.

DESCENT, or *Hereditary Succession*, in *Law*, is the title by which a man, on the death of his ancestor, acquires his estate by right of representation, as his heir-at-law.

Descent is either *lineal* or *collateral*. The former is that which is conveyed down in a right line from the grandfather to the father, and from the father to the son, and from the son to the grandson. The latter is that which springs out of the side of the line or blood, as from a man to his brother, nephew, or the like.

Descent of Dignities. A dignity differs from common inheritances, and goes not according to the rules of the common law; for it descends to the half-blood, and there is no coparcenership in it, but the eldest takes the whole. The dignity of peerage is personal, annexed to the blood, and so inseparable that it cannot be transferred to any person, nor surrendered even to the crown; it can move neither forward nor backward, but only downward to posterity; and nothing but corruption of blood, as when the ancestor is attainted of treason or felony, can hinder its descent to the right heir.

DESCENT, in *Genealogy*, the order succession of descendants in a line or family, or their distance from a common progenitor. Thus we say one descent, two descents, and so on.

DESERT (Lat. *desertum*, participle of *desero, to desert, to leave*), a large tract of barren country; a waste. Some deserts are sandy, as those of Lop, Xamo, Arabia, and several others in Asia; and in Africa those of Libya and Sahara; whilst others are stony, as the desert of Pharan in Arabia Petræa. It appears, however, that in all the *sandy* deserts of considerable extent there are large tracts of clayey soil, interspersed with hills of sandstone and limestone. (See Denham's *Travels*.)

Desert ‖ Designator.

DESHACHE, in *Heraldry*, is where a beast has its limbs separated from its body, so that they still remain on the escutcheon, with only a small separation from their natural places.

DESIDERATUM (Latin) is used to signify the desirable but not yet acquired perfection in any art, science, &c.: thus, it is a desideratum with the blacksmith to render iron fusible by a gentle heat, and yet preserve it hard enough for ordinary uses; with the glass-maker, to render glass malleable; and with the clockmaker to bring pendulums to be useful where there are irregular motions.

DESIGN (Fr. *dessein*, from Lat. *designo*), a scheme or plan; purpose, intention; a representation of a thing by an outline or sketch; &c.

DESIGN, in the manufactories, expresses the figures with which the workman enriches his stuff or silk, and which he copies after some pattern.

DESIGN, in *Painting*, is the first idea of a large work, drawn roughly; to be afterwards carefully executed and finished. See DRAWING, and PERSPECTIVE.

DESIGN, *Schools of*, are establishments for instructing pupils in the art of drawing. In some the instruction is confined to what is subservient to the fine arts; but in others, especially in the very admirable establishment at Edinburgh, under the Board of Trustees of Arts and Manufactures, not only is attention paid to the instruction of the painter and the sculptor, but design is taught, to perfect the mechanic in the principles of his art, wherever ornamental pattern is required. Such schools have been long opened in France, and various parts of Germany, from which important benefit has been conferred on the manufacturing industry of those countries. The Edinburgh School of Design appears to have been the first established in Britain for the express improvement of manufacturing industry. It is most ably conducted, and has found its pupils in demand for the chief seats of English manufacturing art. In England, besides the establishment at Somerset House, London, there is a branch school of design in Spitalfields that is well attended. Similar schools are now established in Birmingham, Manchester, Coventry, Nottingham, Leeds, York, Huddersfield, Sheffield, Norwich, Stoke-on-Trent, Newcastle-on-Tyne, Hanley, Glasgow, and Paisley.

DESIGN, in *Music*, is defined by Rousseau to be the invention and the conduct of the subject, the disposition of every part, and the general order of the whole.

It is not sufficient to form beautiful airs and a legitimate harmony; all these must be connected by a principal subject, to which the various parts of the work relate, and by which they become one. Thus unity ought to prevail in the air, in the movement, in the character, in the harmony, and in the modulation; and all these must indispensably relate to one common idea which unites them.

DESIGNATION (Lat. *designatio*, from *designo*, to *point out*, to *describe*), the act of marking or indicating and making a thing known. The designation of an estate is made by the tenants, butments, and boundings. Amongst the Romans there were designations of the consuls and other magistrates, some time before their election.

DESIGNATOR, in *Roman Antiquity*, an officer who assigned and marked out to each person his place and rank in public ceremonies, shows, processions, and the like; and who thus was a kind of marshal or master of ceremonies.

Desmoulins. There were designators also at funeral solemnities, as well as at the games, theatre, and shows.

DESMOULINS, Camille Benôit, the most highly gifted of all the literary men who took part in the first French Revolution, was born at Guise in Picardy in 1762. After a singularly brilliant career at school and college he adopted the profession of the law; but the frivolous levity of his manner precluded the possibility of his permanent success at the bar. He then began to take part in the political questions which at that time agitated France. Deeply versed in the literature of ancient Greece and Rome, he conceived that the social constitution of these countries might be applied to remedy the state of anarchy and disorder into which his native country had at this time fallen. With this idea he published his two first works, *La Philosophie au peuple Français* (1788) and *La France libre* (1789). On hearing of the dismissal of Necker he rushed to the Palais Royale, where he soon infected a large multitude of bystanders with the fanaticism with which he was himself inspired. Pulling some leaves off an adjoining tree, he fixed one in his own hat and distributed the rest among his hearers. This was the origin of the national cockade and the prelude of the insurrection. Desmoulins next began to publish, under the title of *Les Révolutions de Flandres et de Brabant*, a periodical which gave a strong impulse to the march of events. This work owed its success as much to the exaggerated sentiments and bold theories which it embodied as to the brilliant colouring and rapid energy of style which it displayed side by side with the most revolting cynicism. An example of this latter character may be found in the title which the author assumed as *procureur-général de la Lanterne*. In 1790, Desmoulins married a young French woman, by name Lucile Duplessis, with whom he received a considerable fortune. Of the sixty persons who attached their names to his marriage contract, there remained six months later only two, Danton and Robespierre; all the rest were either in exile or guillotined. The charge against Desmoulins of complicity in the September massacres has been now proved to be utterly devoid of foundation. At the trial of Louis XVI. Desmoulins voted for the king's execution, "though too late, perhaps," he said, "for the honour of the convention." He now threw the whole weight of his influence and genius into the cause of the Mountain against the Girondins; and, by his satirical pamphlet entitled *Histoire des Girondins*, contributed not a little to bring on the trial and secure the execution of these ill-fated men. But this was more than Camille had intended; and when he saw his twenty-two victims led to the scaffold, he cried out in accents of despair, "'Tis I who have brought them to the gibbet." From this time he greatly moderated the extravagance of his sentiments, though too late to benefit either his country or himself. In 1793 he published the first numbers of the *Vieux Cordeliers*, which produced an immense sensation. In his previous works he had undertaken the task of unfolding the abuses of the old régime; in this he set himself to expose the horrors of the new. Taking Tacitus and Juvenal for his models, he traced out, under the thin disguise of ancient forms, the crimes of the modern tyrants of France. He had even the boldness, in the face of decrees which inserted terror in the order of the day, to propose the formation of a committee of clemency. This ill-judged moderation drew down upon its proposer the fiercest execrations of the still formidable Mountain; and Desmoulins' haughty reply to the motion of Robespierre, that the published numbers of the Vieux Cordeliers should be burnt, made that all-powerful despot his mortal enemy. Soon afterwards appeared the seventh number of his journal, which concluded with the memorable words, "The gods are athirst." On the night of the 30th of March 1794, Desmoulins, along with his friend Danton, was arrested at the instigation of St Just; and shortly afterwards these two prime-movers of the Revolution perished on the same scaffold. On the evening before his death, Desmoulins wrote from his prison a letter to his wife, which, indeed, was never delivered to her, but which has come down to our days, a monument of sincere and ardent affection. This letter alone is sufficient to prove that Desmoulins' heart was not unsusceptible to impulses of high and virtuous thought, and makes us deplore that the faculties he possessed should have been so early and so completely abused.

Desna ‖ Desultor.

DESNA, a river of European Russia, rising in the government of Smolensk, flowing through those of Orel and Tchernigov, and falling into the Dnieper nearly opposite Kiev, after a course of about 600 miles. It is navigable during the greater part of its course.

DESPOT, an absolute sovereign; a tyrant. The word originally had the same signification as the Latin *herus*, and the English *master*; but in time it underwent the same change as the word *Cæsar* did with regard to Augustus; ΒΑCΙΛΕΥC answering to Augustus, and ΔΕCΠΟΤΗC, *despotes*, to Cæsar. Thus, Nicephorus having ordered his son Stauracius to be crowned, the son, out of respect, would only take the title of ΔΕCΠΟΤΗC, leaving to his father that of ΒΑCΙΛΕΥC. This delicacy, however, did not last long; for the following emperors preferred the quality of ΔΕCΠΟΤΗC to that of ΒΑCΙΛΕΥC, particularly Constantine, Michael Ducas, Nicephorus Botoniates, Romanus Diogenes, the Comneni, and some others. In imitation of the princes, the princesses likewise assumed the title of ΔΕCΠΟΙΝΑ. It was the Emperor Alexius, surnamed the Angel, who created the dignity of despot, and made it the first after that of emperor, and superior to that of Augustus or Sebastocrator and Cæsar. The despots were usually the emperors' sons or sons-in-law, and their colleagues or copartners in the empire, as well as their presumptive heirs. The despots who were sons of the emperors had more privileges and authority than those who were only sons-in-law. Under the successors of Constantine the Great, the title "Despot of Sparta" was given to the emperor's son or brother, who had the city of Sparta or Lacedæmon by way of appanage.

DESPOTICAL, in general, denotes anything that is uncontrolled and absolute; but it is particularly used for an arbitrary government, where the power of the prince is unlimited, and his will a law to his subjects.

DESPOUILLE, in *Heraldry*, the whole skin or slough of a beast, with all appurtenances, so that when filled and stuffed it looks like the entire creature.

DESPREAUX. See Boileau.

DESSAU, a city of Germany, capital of the duchy of Anhault-Dessau, the residence of the duke, and the seat of the government. It is situated on the left bank of the Mulda, about 3 miles from its confluence with the Elbe; and 67 miles S.W. of Berlin, with which it is connected by railway. The town is walled on three sides, while on the fourth or eastern it is bounded by the river, which is here crossed by a handsome bridge. It consists of an old and new town, and four suburbs (one of which is on the right bank of the river), and in 1846 had 12,000 inhabitants, of whom 800 were Jews. The ducal palace, originally founded in 1341, is a handsome building, containing a picture gallery and collections of art, with a fine pleasure garden attached. Among the other buildings are the palace of the duchess-dowager, town-hall, theatre, Amelia asylum, and the city church. The new cemetery is elegantly laid out, and contains many fine monuments. The schools and literary and scientific institutions are numerous. Mendelsohn the philosopher was born here in 1729.

DESSERT, a service of fruits and sweetmeats, usually served up last at table.

DESTINY, among philosophers and divines. See Fate.

DESULTOR, in *Antiquity*, the name given to a per-

Determinate Detroit.

son who leapt from one horse to another as a feat of dexterity. In the *Iliad* (xv. 679) a performer of this kind is represented keeping four horses at full speed and leaping from one to another like equestrian performers in the modern circus. These exhibitions were very popular among the Romans, who appear, however, to have used but two horses for the purpose. The Greeks and the Romans appear to have borrowed this kind of equestrian exercise from the Numidians, who, it seems, applied it to the purposes of war. Livy (xxiii. 29) mentions a troop of Numidian horse, of which each man was provided with two horses, which were used alternately as occasion required. The Scythians, Armenians, and some Indian tribes, were likewise noted for feats of this kind.

DETERMINATE PROBLEM, in *Geometry* and *Analysis*, is that which has but one solution, or a certain limited number of solutions; in contradistinction to an indeterminate problem, which admits of an infinite number of solutions.

DETERMINATE *Section*, the name of a tract or general problem, written by the ancient geometrician Apollonius. None of this work has come down to us, excepting some extracts, and an account of it by Pappus, in the Preface to the 7th book of his Mathematical Collections. He there says that the general problem was "To cut an infinite right line in one point, so that, of the segments contained between the point of section sought, and given points in the said line, either the square on one of them, or the rectangle contained by two of them, may have a given ratio, either to the rectangle contained by one of them and a given line, or to the rectangle contained by two of them."

DETERMINATION, in *Mechanics*, the tendency or direction of a body in motion. See MECHANICS.

DETINUE (Fr. *detenir*, to detain), in *Law*, a writ or action that lies against one who wrongfully detains goods or other things delivered to him, or in his possession.

DETMOLD, a small city of Northern Germany, capital of the principality of Lippe-Detmold, is situated on the Werre, 46 miles S.W. of Hanover. It is divided into an old and new town, the latter of which is well built, and contains the palace, a gymnasium, normal seminary, trades' school, hospital, orphan asylum, theatre, Bible society, and about 5000 inhabitants.

DETONATION (Lat. *detono*, to thunder), in *Chemistry*, an explosion or sudden report made by the inflammation of a combustible body, as that of *gunpowder*, *fulminating gold*, &c.

DETRANCHE, in *Heraldry*, a line bend-wise, proceeding always from the dexter side, but not from the very angle, diagonally athwart the shield.

DETRITUS (Lat. *detritus*, worn), a geological term denoting a mass of substances detached by attrition from solid bodies. It is applied to the finer portions of *debris*, which last generally comprises detritus, while detritus excludes the idea of the larger debris.

DETROIT, a city and port of entry of the United States of N. America, capital of the county of Wayne, Michigan, situated on the west bank of the Detroit strait or river, which connects lakes Huron, St Clair, and Erie. Lat. 42. 2. N., Long. 83. 2. W. The city extends along the river for more than a mile and a-half, its central point being 7 miles from Lake St Clair, and 18 from Lake Erie. The river is here about five-eighths of a mile in width, and its depth varies from 12 to 48 feet. The descent from Lake St Clair to Lake Erie is about 6 feet or 3 inches per mile; and the velocity of the current at the deepest part, opposite the city, is $2\frac{1}{2}$ miles per hour. Its shores on both sides are highly cultivated; and, from its outlet into Lake Erie to its origin at Lake Huron, resemble a continuous village with fine farms, pleasant villas, groves, gardens, and excellent roads. The town is well and regularly built, extending in the form of a rectangle for about 1200 feet from the river, and afterwards terminating in a triangle. Some of the principal streets are 200, others 120, and others 60 feet wide. These generally cross each other at right angles. The houses are mostly of wood, but many of them are of brick. The principal of the public buildings are—the old State House, the United States Buildings (of polished limestone), the state buildings for the supreme courts, public offices, county court-house, county jail, city hall and market, the new Catholic cathedral, and the cathedral of St Anne. There are numerous schools and churches, and several charitable as well as literary and scientific institutions. Detroit is well supplied with water from the river, by means of hydraulic machinery in the upper part of the town. Ship and boat building is a large and important branch of business; and there are several large steam saw-mills, iron foundries, &c. Detroit has a very extensive trade, for which it enjoys many advantages. The harbour is capacious and secure. It is connected by the Michigan Central railroad with Chicago *viâ* New Buffalo and Michigan city, a distance of 258 miles, and by the Pontiac, with the town of that name, 20 miles distant. The Great Western railway, about to be constructed through Canada, will bring it into direct communication with the New York and other eastern routes. The vessels cleared at the port in 1851 were 2611 of 920,690 tons; entered, 2582 of 905,646 tons. The periodical press of Detroit consists of 3 daily newspapers, 1 tri-weekly, 7 weekly, and 2 monthly. In 1802 the village of Detroit was incorporated; in 1810 the act of incorporation was repealed, and in 1815 it received its present charter of incorporation. The population in 1801 was only 770, and in 1830, 2222; in 1840 it amounted to 9193, and in 1850 to 21,057; while in the summer of 1853 it was 34,439. This, however, includes only those within the corporate limits; beyond which there is a numerous population, whose entire occupation and interests are in the city.

Deucaledonius Deucalion.

DEUCALEDONIUS OCEANUS (supposed to be derived from the Gaelic words *Duah Gael*, the *Northern Highlanders*), the sea on the north-west of Scotland.

DEUCALION, king of Phthia, in Thessaly, was the son of Prometheus and Clymene. The flood said to have happened in his time (B.C. 1500) is supposed to have been only an inundation of that country, occasioned by heavy rains, and an earthquake which stopped the course of the river Peneus at the place where it previously discharged itself into the sea. On these circumstances the fable of Deucalion's flood is founded. According to the tradition, Deucalion, being forewarned by his father of the impending deluge, built a ship, in which, with his wife Pyrrha, he was saved, when the rest of mankind perished in the flood. When the waters subsided, their ship was stranded on Mount Parnassus. The first care of Deucalion and his wife was to consult the oracle of Themis as to the means by which the earth was to be repeopled. The oracle ordered them to veil their heads and faces, to unloose their girdles, and to throw behind their backs the bones of their great mother. At this advice Pyrrha was seized with horror; but Deucalion explained the mystery by observing, that their great mother must mean the earth, and her bones the stones. The stones which Deucalion threw over his head became men, while those thrown by his wife became women. Some writers have supposed that Deucalion may be identified with the patriarch Noah; and that Deucalion's flood in Thessaly, as well as that of Ogyges in Attica, and of Prometheus in Egypt, were the same as the great deluge recorded in Scripture. Diodorus Siculus expressly says, that in the deluge which happened in the time of Deucalion almost all flesh died; and Apollodorus after mentioning how Deucalion took refuge, ἐν λαρνάκι, or *in the ark*, describes him as immediately after his deliverance sacrificing to *Zeus Phyxius*, Jupiter, the preserver of fugitives. The most minute account of the traditions concerning the deluge of Deucalion, is to be found in Lucian, a native of Samosata,

Deunx ‖ Deventer.

of Commagene, on the Euphrates. His narrative coincides with the Mosaic version to a surprising extent.

DEUNX, in *Roman Antiquity*, 11 ounces, or $\frac{11}{12}$ of the libra, and of other things.

DEUTEROCANONICAL, a term applied in modern times to those sacred books, originally denominated ecclesiastical and apocryphal, which were not included in the Jewish canon, but, being contained in the old Greek versions, were publicly read in the early Christian church.

DEUTERONOMY, the Alexandrian name of the Fourth Book of Moses. See PENTATEUCH.

DEUTEROPOTMI, or USTEROPOTMI, in *Grecian Antiquity*, a designation given to such persons as had been supposed dead, and, after the celebration of the funeral rites, appeared alive.

DEUTEROSIS, the Greek name by which the Jews designated their Mischnah or second law.

DEUX PONTS (German *Zweibrüken*), a town in the Bavarian circle of the Palatinate, on the Erbach, near its confluence with the Serre, 50 miles W. of Spires. It was formerly the capital of a duchy of the same name, originally governed by its own dukes, and which afterwards passed successively into the power of Sweden and of Bavaria. During the wars of the revolution this duchy was taken possession of by France, and confirmed to it by the peace of Luneville; but it was restored to Bavaria by the peace of Paris in 1814. The town is pleasantly situated and well built. The old palace of the dukes of Deux Ponts, formerly one of the finest in Germany, was in a great measure destroyed by the French, and part of it has been converted into a Roman Catholic church. It has a cathedral and two Lutheran churches; a gymnasium, lyceum, orphan asylum, hospital, and 7300 inhabitants. The principal manufactures are woollen, linen, and cotton stuffs; besides leather and tobacco. The town derives its name from two bridges, which here cross the Erbach. The well-known Bipontine edition of the classics was published here.

DEVA, the ancient name of *Chester*, which see; and also of the Dee, an estuary on which stood the town of Devana, near the modern Aberdeen.

DEVAPRAYAGA, a town of Northern Hindustan, in the native state of Gurwhal, situated at the junction of the Bhagarathi and Aluknunda rivers, the union of which forms that part of the Ganges held most sacred by the Hindus, who believe that bathing in its waters will purify them from all their sins. This is one of the five principal prayags, or holy points where two rivers meet, mentioned in the Shastras, and is considered as peculiarly sacred. The town stands on a spur of the mountain, about a hundred feet above the water. It contains only 250 houses, which are built of stone, two stories high, and covered with shingles. In the upper part of the town stands the celebrated temple of Ramachandra, constructed of large blocks of cut stone, piled up without mortar to the height of sixty feet. The presiding deity is an image about six feet high, cut in black stone, the lower part of which is painted red. The town is chiefly inhabited by Brahmins of different sects, who draw rich contributions from the superstition of the pilgrims; besides which they have an estate consisting of twenty-five villages. The town and temple suffered much by an earthquake in 1803. The latter was repaired at the expense of Dowlut Rao Scindia. Long. 78. 39. E.; Lat. 30. 8. N. (E. T.)

DEVENTER, a fortified town of Holland, province of Overyssel, on the right bank of the Yssel, where that river is joined by the Schipbeek, 18 miles S. by E. of Zwolle. This town is strongly fortified, and has a handsome town-house, a cathedral, seven churches, an athenæum, college with an extensive library and an observatory, and a large iron foundry. The chief manufactures are linen, carpets, hosiery, and iron ware; and it has a considerable trade in dairy and agricultural produce and in cattle. (Pop. 1850) 15,004.

DEVEREUX, ROBERT, Earl of Essex, the son of Walter Devereux, Viscount Hereford, was born at Netherwood, in Herefordshire, November 10, 1567. He succeeded to the title of Earl of Essex at the age of ten; and about two years afterwards was sent by his guardian, Lord Burghley, to Trinity College, Cambridge. He took the degree of master of arts in 1582, and soon afterwards retired to his seat at Lampsie, in South Wales. He did not, however, continue long in this retreat; for we find him, in his seventeenth year, at the court of Queen Elizabeth, by whom he was immediately honoured with singular marks of favour. Authors seem very unnecessarily perplexed to account for this young earl's gracious reception at the court of Elizabeth. But the reasons seem pretty obvious; he was her relation, the son of one of her most faithful servants, the son-in-law of her favourite Leicester, and a very handsome and accomplished youth. Towards the end of 1585, he attended the Earl of Leicester to Holland; and gave signal proofs of his personal courage during the campaign of 1586, particularly at the battle of Zutphen, where the gallant Sir Philip Sidney was mortally wounded. On this occasion the Earl of Leicester conferred on Essex the honour of knight banneret. Devereux.

In 1587, on Leicester's being appointed lord steward of the household, Essex succeeded him in the honourable post of master of the horse; and the year following, when the queen assembled an army at Tilbury to oppose the Spanish invasion, Essex was made general of the horse. From this time he was considered as the favourite of the queen; and if any mark was yet wanting to fix the opinion of the people in this respect, it was shown by the queen's conferring on him the honour of the garter.

It is not to be wondered at that so rapid an elevation should have affected the mind of the youthful earl, who henceforward showed a very high spirit, and often behaved haughtily to the queen herself. His eagerness about this time to dispute her favour with Sir Charles Blount, afterwards Lord Mountjoy and Earl of Devonshire, cost him some blood; for Sir Charles, thinking himself affronted by the earl, challenged him, and after a short contest wounded Essex in the knee. The queen, so far from being displeased with this occurrence, is said to have sworn a good round oath that it was fit somebody should take him down, otherwise there would be no ruling him. However, she reconciled the rivals, who, to their credit, continued good friends as long as they lived.

The gallant Essex, however, was not so entirely captivated with his situation as to become insensible to the allurements of military glory. In 1589, Sir John Norris and Sir Francis Drake having sailed on an expedition against Spain, the young favourite, without the permission or knowledge of his royal mistress, followed the fleet, which he joined as they were sailing towards Lisbon, and acted with great resolution in the repulse of the Spanish garrison of that city. The queen wrote him a very severe letter on the occasion; but, after his return, she was soon appeased. Yet it was not long before he again incurred her displeasure, by marrying the widow of Sir Philip Sidney. In 1591 he was sent to France with the command of 4000 men to the assistance of Henry IV. In 1596 he was joined with the lord high admiral Howard in the command of the famous expedition against Cadiz, the success of which is universally known. In 1597 he was appointed master of the ordnance, and the same year commanded another expedition against Spain, called the *Island Voyage*.

Soon after his return he was created earl marshal of England; and, on the death of the great Lord Burghley in 1598, elected chancellor of the university of Cambridge. This, however, may be regarded as the turning-point of his fortunes. His enemies, who had long looked with jealousy on his honours, now conspired together to effect his downfall. The first shock he received in the queen's favour arose from

Device || Devise.

a warm dispute in regard to the nomination of a viceroy for Ireland. The affair is related by Camden, who tells us that nobody was present except the lord admiral, Sir Robert Cecil, secretary, and Windebank, clerk of the seal. The queen wished Sir William Knolls, uncle of Essex, to be named as her representative; but Essex pressed the appointment of Sir George Carew. Unable to persuade the queen to approve his choice, Essex so far forgot his duty as to turn his back upon her in a contemptuous manner; and her Majesty resented the insolence by giving him a box on the ear, and bidding him go and be hanged. On this the earl put his hand to his sword and swore revenge. This violent storm, however, soon subsided, and they were again, to all appearance, reconciled.

A more disastrous result, however, followed his fatal preferment to the lord-lieutenancy of Ireland in the same year. For this appointment he was more indebted to the malice of his enemies than the confidence of his friends. In the midst of the disasters which attended his first efforts for the reduction of Ireland, an army was suddenly raised in England under the command of the Earl of Nottingham, on the pretext that Essex meditated an invasion of his native country, rather than the reduction of the Irish rebels. To justify his conduct and repel this insinuation, Essex quitted his post and came over to England without leave. On his arrival he burst into her Majesty's bed-chamber as she was rising, and was received with a mixture of tenderness and severity; but she soon afterwards deprived him of all his appointments except that of master of the horse; and he was committed to the custody of the lord-keeper, with whom he continued six months. No sooner had he regained his liberty than he plunged into the most reckless extravagancies, consulting nothing but the dictates of his own powerful passions. He first determined to obtain an audience of the queen by force; and afterwards refused to attend the council when summoned. When the queen sent the lord-keeper, the lord chief-justice, and two others, to learn his grievances, he confined them, and then marched with his friends into the city, in expectation that the people would rise in his favour. But in this he was completely disappointed. He was at last besieged and taken in his house in Essex Street; and after being committed to the Tower, he was tried, condemned, and executed February 25, 1601. The queen was long irresolute in the signing of the warrant for his execution, and doubtless had he appealed to her clemency, he would have been pardoned. Essex was an accomplished scholar, and a generous patron of literature. He perished in the thirty-fourth year of his age, leaving one son and two daughters.

DEVICE (in French *devise*), in *Heraldry*, *Painting*, and *Sculpture*, any emblem used to represent a certain family, person, action, or quality, with a suitable motto applied in a figurative sense. Thus a plough represents agriculture, and so forth.

DEVICOTTA, a fort and seaport-town in the south of India, and district of Tanjore, situated at the mouth of the Coleroon River. It was taken in 1749 from the rajah of Tanjore, and became one of the Company's principal factories on the Coromandel coast. The approach to the port is very dangerous owing to an extensive shoal which lies off it. Long. 79. 52. E.; Lat. 11. 22. N.

DEVIL (*diabolus*), an evil angel, one of those celestial spirits cast down from heaven for aspiring to be equal with God.

DEVINCTIO, in *Antiquity*, was applied to a love charm or incantation used to gain the affection of a person beloved. It was formed by tying knots, and is thus described by Virgil in his eighth Eclogue:

> Necte tribus nodis ternos, Amarylli, colores:
> Necte, Amarylli, modo; et, Veneris, dic, vincula necto.

DEVISE, in *Law*, the act by which a person bequeathes his real or personal estate by his last will or testament.

Devizes || Devonshire.

DEVIZES, a municipal and parliamentary borough and market-town of England, county of Wilts, on the Kennet and Avon Canal, 22 miles N. by W. of Salisbury. It is situated on an eminence near the N. limit of the Salisbury plain, and consists of several wide and well paved streets diverging from the market-place, in which is a large cross erected in 1815. It has two ancient parish churches, partly in the Roman and partly in the perpendicular style of architecture, with some curious monuments. There are dissenting places of worship belonging to the Presbyterians, Methodists, Independents, Quakers, &c.; a charity school; national and infant schools; savings-bank; and dispensary. The town-hall is a handsome modern building with a circular front and Ionic pillars. On the basement floor of this edifice a cheese-market is held. Devizes has also a large county jail, a union workhouse, and manufactures of silk, snuff, and malt. The market is held on Thursday, and is one of the largest in the west of England for corn. The town is divided into two wards, and is governed by a mayor, 6 aldermen, and 18 councillors. It returns two members to parliament. Pop. (1851) 6554.

DEVONPORT. See PLYMOUTH.

DEVONSHIRE, the British name of which was Dyvnaint, while the inhabitants were called Dyvnonwyn, or inhabitants of low lands, formed a part of the district included in the appellation of Damnonium. The Romans included it in the district called Britannia Prima; but under the Saxons it was constituted a part of the kingdom of Wessex.

The county of Devon is the second in size of all the English shires, being exceeded by that of York alone. On the N. and N.W. it is bounded by the Irish Channel, on the W. by the rivers Tamar and Marsland-waters, on the S. and S.E. it has the British Channel, and on the E. and N.E. it is conterminous with the counties of Dorset and Somerset. Its figure is very irregular, but something like that of a trapezium. Its greatest extent from N. to S. is about 71 miles, and from E. to W. 72; and its circumference is about 287; its area is 2585 square miles, being equal to 1,654,400 acres of land, of which about 1,200,000 are in cultivation; containing 33 hundreds, 465 parishes, and 36 market towns. The population in 1801 was 340,308; in 1841, 532,959; and in 1851, 567,098, being an increase of 66 per cent. in 50 years.

The county of Devon is in the see of Exeter, and is included in the western circuit. The assizes are held at the county-town, Exeter.

A county of so great extent as Devonshire must present a great variety of surface. The mountains in the vicinity of Dartmoor rise to 1500 and 1800 feet above the level of the sea. On the south and south-east are extensive wastes, the surfaces of which are covered with rough masses of detached granite and immense rocks. To the north and north-west are large tracts of swampy ground, and many peat bogs of great depth. But that part called the Vale of Exeter, a district the area of which is about 200 square miles, consists of some very fine land; and though the soils vary considerably, the most prevalent are a strong red loam, foliated clay intersected with veins of ironstone, and a mixture of sand and gravel. The district called the South Hams is frequently termed the garden of Devonshire, from its fertility. It is strikingly diversified by bold swells and luxuriant vales, and in many parts towards the north the scenery is picturesque and romantic. The surface and soil of West Devon are remarkably uniform, the latter consisting of polished slate-stone, rubble, and mud, intermixed with a portion of loamy mould. Here the cultivated lands are all inclosed, and villages and farm-houses are frequent. North Devon, or the country round Biddeforde, Barnstaple, and South Molton, contains much productive land, and is greatly diversified with beautiful scenery.

Climate.

Although the climate of Devonshire varies much in different districts, still, from its situation between two seas, its immediate exposure to the south-west winds as they blow from the ocean, and the elevated summits of the surrounding mountains, it is upon the whole much milder than that of the other English counties. The winters are exceedingly mild, and proverbially favourable to the cure of pulmonary complaints. The air is generally dry and warm, and the harvest earlier than in any other parts of the west. On the southern coast the myrtle flourishes in the open air.

Rivers.

The principal rivers of Devonshire are the Taw, the Torridge, the Tamar, the Dart, the Teign, and the Exe; and the lesser are the Tavy, the Plym, the Yealme, the Arme, the Aven, the Otter, the Sid, the Axe, and the Lyn. In some of them, particularly the Tamar and Tavy, the salmon-fishing is valuable. The royalty of the Tavy belongs to the Drake family, who have constructed a very large weir across the river, furnished with traps for taking the salmon on their way down after a flood. The Exe salmon is esteemed superior to that of any other river in this country. These streams furnish trout in great plenty; and plaice, the torpedo or electric ray, the opah or king-fish, and the sepia or cuttle-fish, are found in and at the mouths of these rivers.

The Grand Western Canal connects the south-eastern coast and the Bristol Channel. Its length is about 35 miles, traversing through part of this county, and passing the towns of Exeter, Tiverton, Taunton, &c. The Tamar Canal follows the course of the Tamar River, on the southern coast of Devonshire. Its northern extremity is considerably elevated. It greatly facilitates the import of coals, lime, and manures, and the export of agricultural products. It commences in the Tamar River, at Morewellham quay, and terminates at Tamarton Bridge. Tavistock Canal follows a north-eastern direction for about four miles and a half in this county. It commences where the Tamar Canal finishes, and reaches the town of Tavistock where it ends.

The Bristol and Exeter Railway enters this county at Beam Bridge. At Exeter the South of Devon line, 58 miles in length, commences, and proceeding in a south-easterly direction to Teignmouth, turns inland to Newton Bushel (whence there is a branch to Torquay), and keeps a south-westerly course to Totness, Plymton, and Plymouth.

The mineral waters, which are all chalybeate, are numerous, but inconsiderable. The principal of them are those of Gubb's Well near Cleave, Bella Marsh near King Steignton, Ilsington near Totness, Brook near Tavistock, and Brampton.

Minerals.

The ores of iron, lead, tin, and manganese, are found in considerable quantities in Devonshire; and gold, silver, copper, bismuth, antimony, and cobalt, have been sometimes discovered in small quantities. Ironstone is common in many districts, but it is not of a quality that yields much metal. It is supposed that the inhabitants of this county were in the habit of working the iron, as well as the other metallic mines, before the arrival of the Romans. The lead ore of this county is of many kinds, but principally of a grayish-blue colour. The potters' or tesselated ore is of a shining, rectangular, tabulated structure, always breaking into cubical granules; another kind is of a flaky, smooth, and glossy texture, breaking into ponderous fragments; and a third sort is more closely grained, with the fracture sparkling and uneven, and very rich in silver. The tin-works were anciently numerous and valuable; but the Cornwall mines being much more productive, those of Devonshire are nearly abandoned. Native silver has been found in different substances and in various forms. Cobalt, interspersed with numerous filaments of silver, has been found at Sampford in great abundance. Antimony of a dark lead colour, full of long, shining, needle-like striæ, has been discovered at Chudleigh, Hennock, and South Bovey. Limestone of almost every description is found in different parts of the county. In the eastern parts it has a good deal the appearance of chalk. In the neighbourhood of South Hams it is hard, beautifully veined, bears a fine polish, and resembles the Italian marble. In other districts it is manufactured into black marble, variegated with streaks of white; into a flesh colour, having streaks of brown; into a pale red, blue, and indeed into almost every variety of colours. Gypsum is found, but not in abundance, in the neighbourhood of Plymouth, Salcombe-Regis, and Exeter. Fluor spar is produced in great plenty in the mines of Beer-Ferris.

Among the argillaceous substances of the county are fine pipe-clay, found in great abundance at Wear-Gifford; potters' clay in the Vale of King-Steignton; and slate of an excellent quality near Slapton Sands and East Alwington. The siliceous clay of this county contains quartz crystals of a small size; and flints in great abundance, but particularly in the mountainous tract of Haldon. Freestone of various kinds is dug up in the parishes of Salcombe, Branscombe, and Beer. Whinstone, basalt, and a substance like the Derbyshire loadstone, are found in different parts of the county. Granite is met on Dartmoor, at which point commences the range which extends into Cornwall.

Coal of various sorts is found in Devonshire. That procured at Bovey-Heathfield, and thence called Bovey coal, is a singular production. Its strata extend about 9 miles in a southern direction, the uppermost of which rises to the surface, and is from 18 inches to 4 feet thick, but increases in thickness downwards, until the lowermost stratum of coal is 16 feet thick. This stratum lies on a bed of clay, under which is a sharp green sand, from which rises water of a vivid green colour, abounding in sulphur and vitriol, and as warm as some of the Bath springs. The exterior parts of this coal, which lie nearest the clay, have a great mixture of earth, and are generally of a dark-brown colour. The veins which lie nearer the centre are more compact and solid, and in colour and weight are like common pit-coal. The stratum called the wool-coal is a vein sometimes of chocolate colour and sometimes of black coal, consisting of a number of laminæ or thin splinters, which divide like whalebone, and is generally dug out in pieces of three or four feet in length. Pyrites, in globular balls of various sizes, are obtained in different parts of the county.

Agriculture.

A society for the improvement and encouragement of agriculture was established in Devonshire in the year 1791, and has been of considerable service in spreading a knowledge of the most improved modes of practice adopted in other parts of the kingdom. The forest of Dartmoor contains considerable tracts capable of much improvement; and the land in the vale of Exeter, which is the best in the country, is cultivated with wheat, barley, beans, peas, and some little flax. The pasture lands are chiefly appropriated to supply the dairy; but in some parts considerable attention is paid to breeding sheep and cattle. Orchards, and apple trees in hedges, are common in most of the farms; oats, turnips, and potatoes, are also cultivated in many districts. In West Devon two-thirds of the inclosed lands are employed alternately in raising corn and the grasses; red clover, rye-grass, and sometimes white clover and trefoil. Irrigation is common, and so is also peat-burning. In North Devon the soil is productive, the orchard grounds are extensive, and the inclosures tolerably large. The farms in Devonshire are held generally by a lease of three lives, or for ninety-nine years. As the lives drop, new ones are put in on payment of an adequate sum. Landed property seems to be more regularly divided in this county than in most others, there being very few large freeholds; and the inhabitants live sociably and independently upon their own moderate-sized tenements. Their principal manures are lime, sea-sand, seaweed, and dung. The pro-

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duce per acre of wheat varies from 16 to 25 bushels; and of barley from 35 to 50.

Besides the productions of Devonshire which it has in common with other counties, its cider deserves notice. It is traditionally said that the planting of orchards commenced between two hundred and three hundred years ago, at Buckland Priory. A great quantity of cider is now manufactured, and it is in general of a good quality; but differs according to the districts in which it is made; that of the neighbourhood of Exeter and the contiguous places being the most esteemed. The best orchards yield about 3½ cwts. of cider per acre.

In these parts also a considerable quantity of butter is made. The average produce from each cow is about a pound a-day. Cattle and sheep are bred and fattened here in great numbers. The stock of moor sheep averages about 630,000, the yield of wool being 15,500 packs. The fish which abound in the rivers and on the coast of Devonshire, besides the home consumption, afford considerable exports to the Bath and London markets. The oyster-beds in the neighbourhood of Lympstone are said to be a hundred acres in extent.

Devonshire cows are celebrated throughout the island. When in a state of the greatest purity, they are distinguished by a high red colour, without any white spots; by a light dun ring round the eye; by being fine in the bone and clean in the neck; by the horns being of a medium length, bent upwards; by the tail being small and set on very high; by being thin-skinned and silky in handling; and by the property of feeding at an early age. The North Devon variety is in high estimation for the fineness of the grain of the meat; and the superiority of the oxen over most other breeds, in possessing more activity, being better calculated for labour, and having more blood, is generally admitted. A good Devonshire cow will yield for the first twenty weeks after calving about three gallons of milk daily. The oxen weigh from 50 to 60 stone, and the cows from 30 to 40.

The native horses are small, but hardy, and much accustomed to the pack-saddle. The breed of sheep is various; mostly of the Dorsetshire kind as to weight of carcass and length of wool, but characterized by a great variety of heads, some having horns, some having none, and others having nobs. Leases of farms usually run from six to ten years. The extent of farms averages 100 to 200 acres.

Manufactures.

Devonshire was long a manufacturing county for thin woollen goods; but the trade has of late years rapidly declined. The greater part of the woollen trade with Spain was carried on from Exeter; but scarcely a vestige of it now remains, and that little is chiefly with Bilboa. The only article now demanded is a species of serge, known by the name of long ells, which is spun and woven at Collumpton, Crediton, North Tawton, and in the villages surrounding these towns. Of late years the manufacture of linen goods, and the spinning of linen yarn by machinery, has been introduced on the streams which had previously been applied to work fulling-mills. The riots of the Luddites in Nottinghamshire drove some capitalists from that county to Tiverton, where machinery upon a prodigious scale is in activity, producing lace and lace-net, for which there is a great demand in France, Germany, Italy, and most parts of the Continent. The great manufactory is, however, in the King's Dock-yard at Plymouth, where all the stores for building and equipping ships of war are prepared; and much private ship-building is carried on in other ports of the county. The number of persons employed in manufactures in 1841 was about 2448 in serges and other woollens, 763 in gloves, 398 in cotton, 355 in silks, and 1821 in lace; besides shoemakers, carpet-weavers, and others, amounting in all to 7000.

Antiquities.

Among the British antiquities of Devonshire are the numerous cairns on the eminence called Hall-down Hill, a cromlech at Drew-Steignton, and at a little distance from it a *logan* or rocking-stone. Several remains of British houses are scattered over Dartmoor.

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The ancient castles, now in ruins, are Berry-Pomeroy, built by Ralph de la Pomeroy, who came to England with the Conqueror; Compton Castle; Rougemont Castle, formerly the seat of the West Saxon kings, in the vicinity of Exeter, and, according to tradition, built by Julius Cæsar; the castle of Oakhampton, which stood about a mile south-west of the town; Plympton Castle, which was the residence of Richard de Rivers, earl of Devon, in the reign of Henry I. The same person was also in possession of Tiverton Castle, the ruins of which may still be seen, and of Totness Castle, erected by Judhael de Totnais, to whom the manor was given by the Conqueror.

The remains of the abbeys and monasteries of Devonshire are those of Buckfastleigh, near Ashburton; Buckland Abbey, on the eastern banks of the river Tay; Dunkeswell, near Collumpton; the Cistercian Abbey at Axminster, the property of Lord Petre; Hartland Abbey, part of the present house of Paul Orchard, Esq.; the ruins of a priory of Benedictines at Moodbury; and Tor Abbey, a portion of the modern seat of G. Cary, Esq.

The venerable and magnificent cathedral of Exeter demands the first notice among the ancient specimens of ecclesiastical buildings. The variety of the styles discovered in this edifice proves that it was erected at various periods. It is supposed that the part called St Mary's Chapel is the ancient Saxon church, erected prior to the year 868. It is likely that the first considerable cathedral was planned by Bishop Warlewart, before the year 1138. It consists of a choir with side aisles, a nave also with side aisles, and two short transepts; besides a chapter-house, ten oratories, and a consistory court. The height of the Norman towers is 130 feet, and that of the roof 69. The entire length of the cathedral from east to west is 408 feet, walls included. At Bishop's Seighton is a church in the early Saxon style. Teignmouth church is a specimen of the earliest Norman.

The island of Lundy belongs to this county. It is rather more than three miles in length, about one in breadth, and contains 2000 acres of land, of which only 400 are under cultivation.

The county returns four members to Parliament, viz., two for the northern, and two for the southern division; Barnstaple, two; Tiverton, two; Ashburton, one; Dartmouth, one; Devonport, two; Exeter, two; Honiton, two; Plymouth, two; Tavistock, two; and Totness, two. Total, twenty-two.

Annual value of real property assessed to property-tax 1850-1, L.2,736,361.

Places of worship belonging to the Church of England 549, sittings 221,989; other denominations, 748 places of worship, 157,898 sittings. Day-schools 1614, scholars 64,266; Sunday-schools 772, scholars 58,408.

The principal noblemen's and gentlemen's seats are, Castle Hill, seat of Earl Fortescue; Storar House, that of the Duke of Somerset; Endsleigh, that of the Duke of Bedford; Saltram, that of Earl Morley; Mount Edgcumbe, that of Earl Mount Edgcumbe; Bagtor, that of Lord Ashburton; Exeter Palace, that of the Bishop of Exeter; Bicton, that of Lord Rolle; Haldon Hall, that of Sir L. Palk, Bart.; and Escott, that of Sir J. Kennaway, Bart.

See Polwhele's *History of Devon*, and *Beauties of England and Wales*. (J. B. D.)

DEVOTION (Lat. *devotio*), a yielding of the heart and affections to God; devoutness; also the state of being consecrated or solemnly set apart for any particular purpose.

DEVOTION, among the Romans, was a kind of sacrifice or ceremony, by which a person consecrated himself to the service of some other.

Dew.

DEW is the humidity which the air, under certain circumstances, deposits, in the form of minute globules, on the surfaces of the bodies in contact with it. The Greek term δροσος was evidently derived from ὑδωρ, *aqua*, implying simply *watering* or *humifaction*. The Latin name *ros* is of the same descent. Our English word is obviously borrowed from the German *thau*, akin to the verb which signifies to *melt*, and conveying the idea therefore, in the Shaksperian phraseology, of air "*melting, thawing, and resolving itself into a dew.*" The Swedish term *dag* is no doubt of the same origin, though it likewise denotes low *mist* or floating vapour. It is remarkable that the French language, though certainly not remarkable for its copiousness, has two distinct terms for dew: *serein* for the humidity which collects in the evening; and *rosée*, for what appears accumulated in the morning; the latter being derived from the Latin word *ros*, and the former intimating that *clearness* and *serenity* of the sky which is most conducive to the formation of dew.

Etymology of the word.

When the atmosphere has a temperature below the point of congelation, the *dew* which might adhere to the substances exposed to it passes into the form of *hoar-frost*. This was called by the Greeks παχνη, from its *hard* or *consolidated* nature. The French term is exactly the same compound as our own, *white frost* or *gelée blanche*. But the German language has a simple and primitive word to denote it, *reif*; which, in the Swedish, has been slightly modified into *rim*, a word likewise adopted by the older English writers, and still retained in the Scottish dialect, or dilated into *rime-frost*, and thence probably corrupted into *raw-frost*.

As dew appears to collect only during fine clear nights, when the heavens glow with sparkling constellations, the ancients, in the infancy of science, imagined it to be actually shed from the stars, and, therefore, to partake of a pure and celestial essence. Hence the vulgar notion that *dew falls*, which has prevailed through all ages, and continues to tincture every language.[1] The mythologists described dew as the daughter of Jove and of the Moon;[2] and Plutarch asserts it to be most abundant in the time of full moon. The lunar beams themselves were supposed to contribute some influence, being of a cold nature, and therefore possessed of a humifying quality.[3] The moon, it was imagined, performed merely the office of an imperfect mirror, reflecting the softened lustre of the sun without any portion of his heat.

Ancient notions concerning dew.

The dew of heaven has always been regarded as a fluid of the purest and most translucid nature. Hence it was celebrated for that abstergent property which, according to the vulgar persuasion, enables it to remove all spots and stains, and to impart to the skin the bloom and freshness of virgin beauty. Like the elixir of later times, it was conceived to possess the power of extending the duration of human life; and Ammianus Marcellinus ascribes the longevity and robust health of mountaineers, in comparison with the inhabitants of the plains, chiefly to the frequent aspersion of dew on their gelid bodies. Dew was also employed as a most powerful agent, in all their operations, by the alchemists; some of whom pretended that it possessed such a subtile and penetrating efficacy as to be capable of dissolving gold itself. Following out the same idea, the people of remote antiquity fancied that the external application of dew had some virtue in correcting any disposition to corpulence. The ladies of those days, anxious to preserve their fine forms, procured this celestial wash, by exposing clothes or fleeces of wool to the humifaction of the night. It was likewise imagined that grasshoppers feed wholly on dew, and owe their lean features perhaps to such spare diet.[4]

Its abstergent quality.

Dew.

The philosophers of Greece, after genuine knowledge had illumined that interesting region, entertained far juster notions concerning the nature and formation of dew. Aristotle, whose universal genius ranged over both the physical and the intellectual world, studied facts closely, and sought to reason accurately from the phenomena actually observed. In his book *De Mundo*, he defines "dew to be humidity detached in minute particles from the clear chill atmosphere."[5] In his treatise of *Meteorology*, he states that "dew is only formed beneath a calm and cloudless sky, but never in windy weather."[6] He further subjoins, that it collects in low places, and not on the summits of mountains. Vapour, which, according to him, is only heat combined with water, rises in the atmosphere during the day; but when the cold begins to prevail at night it again discharges its humidity. This vapour, however, he thinks can never ascend high above the surface of the earth, both because it must soon lose its buoyant heat, and because in lofty situations it would be scattered and dissolved by the agitation of the air. Dew is hence most copious in fine weather, and in low damp situations. A north wind checks its production, but a gentle southern gale, charged with humidity, will occasion a copious deposit. When a more intense cold prevails in the atmosphere, the vapour precipitates its humidity in a congealed form, and the dew passes immediately into hoar-frost. Cold occasions this consolidation. Dew has hence the same relation to hoar-frost that rain bears to snow, the frozen mass of clouds constituting the one, and attenuated low vapour, seized by frost, forming the other. The heat of the sun's rays thus first raises the vapour from below; but, in all its subsequent changes and modifications, the moon and stars, contrary to the earlier and more popular notions, exert no sort of influence.

Opinion of Aristotle.

The Aristotelian opinions seem to have given place among the Romans to the ruder notions which prevailed in remote antiquity respecting the mode of its formation. Pliny invariably speaks of a dew as *falling* from the heavens; *cum ros cecidisset*. We might expect, therefore, that the poets would continue in their verses to perpetuate the same idea.

Opinions among the Romans.

Sparsaque cœlesti rore madebit humus. OVID, Fast. i. 312.

Vitreoque madentia rore,
Tempora noctis eunt. Id. Fast. iii. 880.

——— qua prata jacent,
Quæ rorifera mulcens aura,
Zephyrus vernas evocat herbas. SENECA Trag.

Hinc ubi roriferis terram nox obruit umbris. LUCRET. vi. 4. 64.

Virgil marks the cold which always accompanies the formation of dew, and which, when it becomes more intense, converts the lucid globules into spicular shoots of hoar-frost.

Cum primum gelidos rores aurora remittit. Eclog. viii. 15.

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[1] Gesner, Facciolatus, and other lexicographers, blend this idea in their definition of dew. Ros, *Humor cœlo defluens noctu, cum sudum est, et omnis aura quiescit; qui si gelu concrescat, est* PRUINA.

[2] Διος θυγατηρ ερσα τριψις και σελανας δια.

[3] Statius has the expression *rorifera luna*.

[4] *Rore aluntur cicadæ.* PLIN. xi. 26. *Dumque thymo pascentur apes, dum rore cicadæ.* VIRG. Eclog.

[5] Δροσος εστιν υγρον εξ αιθριας κατα συστασιν λεπτον.

[6] The same observation is repeated by Pliny, *Nat. Hist.* xviii. 29.—*Neque in nube neque in flatu cadunt rores*; and in another place, still more explicitly, thus: *Rores neque gelu, neque ardoribus, neque ventis, nec nisi serenâ nocte.* Id. ii. 70.

Dew.

Fancies of the alchemists.

The opinion that dew falls from the sky maintained its credit during the course of the middle ages. The alchemists even carried this idea so far as to fancy that, since the dew gradually evanishes in the progress of the day under the action of the solar rays, it then merely seeks by sympathy to regain its native seat in the highest heavens. Nay, some of those ingenious enthusiasts have not scrupled, in confirmation of their wild hypothesis, broadly to assert that a few drops of morning dew, being inclosed in an empty egg-shell, which is placed at the foot of a ladder resting against the roof of a house, the shell will become buoyant while the sun shines, and will mount along the ladder till it reaches the very top. The famous Van Helmont, who refined on the notions of the alchemists, considered the lights of heaven as of two distinct kinds, the one which flows from the sun and rules the day, being intrinsically warm, and possessing masculine virtue; the other, which rules the night, and emanates from the moon and stars, being of a feminine nature, and having a cool or refrigerating influence. This cold light, he imagined, produces the purest essence of water, which is stored in the moon, to recruit the waste of the nether world; and he supposed the allegory of Jacob's ladder might represent that perpetual ascent and descent of aqueous matter, by which the revolution of the system is constantly maintained. That the moon's beams are naturally cold, he thought sufficiently established by the prevailing belief of the common people, who carefully avoid sleeping in the open air, without some screen to protect them from the chilling impressions which are shot down upon the ground.

Baptista Porta asserted that air is actually converted into water from the accession of cold, and thought this transmutation proved by the fact that, on the approach of severe weather, the windows of an apartment have the inside of the panes of glass covered with moisture. Gaspar Schott, as late nearly as the middle of the seventeenth century, was so much persuaded of the coldness of the moon's rays, that he stoutly appealed to the effects of their concentration in the focus of a reflector. This experiment, however, was made sixty years before, and with an opposite result, by the famous Sanctorio, the founder of scientific medicine, and the inventor of the thermometer. He actually employed the air thermometer for the first time; but this very ingenious inquirer must have been deceived by some extraneous circumstances, when he saw the liquor sink so considerably as he asserts, under the calorific action of the moon's light. The philosophical ideas of Sanctorio were perhaps in some instances too refined for his age, and the vulgar notion concerning the production of dew continued afterwards, for more than an hundred years, to be still generally retained. But the progress of horticulture near the latter part of the seventeenth century brought out some unexpected facts, which seemed at variance with the popular belief. It was remarked that a bell-glass being placed in the evening over a plant, was in the morning profusely covered with dew on the inside, though scarcely any moisture appeared to adhere to the external surface. The humidity which formed the minute globules must therefore have risen from the plant or the ground, and adhered against the glass.

Drososcope.

Such, however, was the very slow advance of sound philosophy, that Perlicius, who proposed what he calls a *Drososcope*, consisting of an oblique balance playing in a soft rack, for indicating the quantity of dew accumulated in the absence of the observer, concludes the discourse which, under the direction of Professor Weidler, he delivered in scholastic form on taking out his degree at Wurtemberg in 1727, with the general inference that dew descends to us from the atmosphere of Jupiter, Venus, the Moon, Mars, and Saturn; but that, though it falls from the air, it by no means originates in this fluid. He had found in the month of August that 250 grains of dew formed on the surface of a square foot in the country, while only ninety-four, and at other times seventy-six, or even sixty-four grains, were deposited in the town.

Dew.

Ideas of Gersten.

The first person, however, who appears to have openly rejected the inveterate opinion of the descent of dew, was Gersten, another German professor, who made several experiments on the subject, and printed at Giessen, in 1733, an academical thesis, in which he advanced the opposite hypothesis. He found that all plants exhale, in various proportions, the moisture which forms the aqueous deposit; and remarked, that plates of copper exposed during the night have only their under surface bedewed. This dissertation led the celebrated Professor Muschenbroeck to repeat the same observations at Utrecht. Having obtained similar results, he communicated the main facts to his Parisian correspondent, M. du Fay, who planned immediately a series of experiments on a large scale. This ingenious philosopher caused two tall ladders to be set up, reclining against each other, in a vacant space, remote from all trees and lofty buildings; and on the 25th October 1736, at four o'clock in the evening, the weather being clear and calm, he laid panes of glass on the steps at the different heights of six, thirteen, seventeen, twenty-five, and thirty-one feet above the ground. These he visited at certain intervals during the progress of the night. By five o'clock a pane close to the ground had its under side completely wet, while its upper side was only slightly dewed. At six o'clock the pane, six feet above the surface, was covered with dew; and at seven o'clock the effect had reached the highest pane. During the whole night the dew continued to form; but it appeared always more copious on the lower panes.

Observations of Du Fay.

These facts might be deemed sufficiently conclusive; but M. du Fay sought likewise to ascertain the relative quantities of moisture deposited at different altitudes. He procured several rectangular bits of green cloth, cut six inches long and four inches broad, and adjusted all to the same weight. These he suspended in horizontal positions at four o'clock in the evening, one of them only half a foot above the ground, and the rest at the heights of six, thirteen, and twenty-five feet. On weighing them next morning he found that they had respectively imbibed fifty-three, sixty-six, fifty-six, and fifty-four grains of dew. The subsequent night having proved windy, they gained only seven, nine, ten, and six grains. It was evident, therefore, that dew is formed not only sooner, but more copiously, near the surface of the ground than at greater elevations.

To determine still more precisely the several quantities of moisture imbibed at different heights, M. du Fay took three linen towels, each three and a half feet long and two and a half broad, and having dried them thoroughly in the sun, he stretched them horizontally at one foot, and seventeen, and twenty-eight feet above the ground. After exposure during the whole night, the air being quite clear and calm, the lowest one was found to have gained 3060 grains, the next only 2346, and the highest 2742. There occurs some slight anomaly in this result; but on reducing the greatest effect to English measures, it corresponds almost exactly to a cubic inch of dew for each square foot of the surface. This might appear to be rather a low estimate for the climate of Paris in the autumnal season, since, at the same rate, it would give only a deposit of about two and a half inches during the whole year.

Discovery of Muschenbroeck

In the mean time, Muschenbroeck made observations on the humifaction of substances placed above the leaden platform of his observatory at Utrecht. The dew formed

Dew. in such a situation, he thought, could not have risen from the ground, but must have fallen from the atmosphere. But, pushing these experiments further, he was conducted to a most curious and interesting discovery. He found that dew forms in very different proportions on different bodies, and that it will scarcely adhere to a surface of polished metal, while it streams profusely over glass or porcelain. Even the colour of the substance appeared, in some instances, to alter the effect. Thus, a piece of red morocco leather acquired, by exposure through the night, twice as much dew as another piece of the same size, whether black or blue. A closer examination, however, convinced him that this modification was not caused by the mere colour itself, but was occasioned by the addition or infusion of the matter employed to produce it.

Extension by Du Fay. M. du Fay, on his part, repeated those experiments with the same success. He likewise performed others of a similar description. Electricity was at this period in high vogue, and he had distinguished himself in that department. It, therefore, struck M. du Fay that the disposition of certain bodies to attract or to repel dew was somehow connected with the distinction into electrics and conductors. In the prosecution of this idea he sought to compare the humifying action of vitreous with that of resinous substances. He took a tin basin, of the same shape and dimensions as one of glass, and having coated it on both sides with forty or fifty applications of a solution of shell-lac in alcohol, he exposed the two vessels during a fine clear night; but the surface of the glass was found to gather twice as much dew as the resinous coating. In the course of his researches, he likewise noticed another curious fact, the explication of which must be referred to a recent discovery. Having selected two large and equal watch-glasses, he set their convex faces horizontally, the one on a porcelain and the other on a silver saucer, and exposed them both, in this position, to the influence of the night-air; when the former was always observed to collect five or six times more dew than the latter. The metallic surface must have, therefore, in some way or other, contributed by its presence to check the precipitation of humidity, though its direct action is confined to a very narrow limit, since, under a resinous coating of only the hundredth part of an inch in thickness, the effect is precisely the same as with a cake of wax. In confirmation of this remark, having composed a square plate, by cementing at the edge a polished rectangle of brass, six inches long and three inches broad, to a similar piece of glass, he found, on exposing it to the atmosphere at night, the vitreous surface covered as usual with dew, while the metallic one was scarcely at all affected; but, on laying another slip of glass across these plates, the end which rested on the brass remained quite dry, while the other end soon became profusely wetted.

Results. It seemed to follow from the experiments of Muschenbroeck and Du Fay, that, strictly speaking, dew neither falls nor rises, but, according to the doctrine of Aristotle, only separates, under a certain change of circumstances, from the air, and attaches itself to some substances in preference to others. The theory of vapour, proposed afterwards by Le Roy of Montpellier, threw further light on the subject. Moisture is suspended in the atmosphere by a real chemical solution, in the same manner as nitre and other salts are dissolved in water. The solvent energy is in both cases augmented by the addition of heat. A rise of temperature enables the air to support a larger portion of humidity, while the decrease of it enfeebles the attractive power, and occasions a precipitation in the shape of mist or dew. This perspicuous explication, as we have seen, had been already anticipated, though but vaguely stated, by Aristotle.

A deposition entirely similar to dew or hoar-frost is hence formed, whenever the air becomes suddenly chilled, by touching any surface much colder than itself, and not consisting of polished metal. Thus the walls of long passages, vaults, or massive buildings, generally drip with wet during the early part of the summer, before the external heat has sufficiently penetrated. In like manner, it is observed, that when a severe and long-continued frost is succeeded by a thaw, the backs of houses are quickly incrusted with shoots of hoary icicles. Dew.

The formation of dew is hence easily produced artificially in a close room, without waiting for exposure under a clear nocturnal sky. If a caraffe, filled with water from a spring or well, be carried into a warm apartment, the outside of the glass will become soon covered over with an aqueous deposit, which must increase till the body of water has acquired nearly the temperature of the encircling air, and will afterwards gradually disappear. But if a piece of tin-foil be applied to the bottle, it will remain dry, while the rest of the surface appears humified with dew.

Various observations of Leslie. It is a curious fact, that air always begins to deposit its moisture on glass, even before it has reached the point of saturation, or become absolutely damp. This property, and the circumstances connected with it, Professor Leslie discovered, in the year 1798, by help of his hygrometer, which he had already brought nearly to a state of perfection. On exposing wine-glasses at the approach of evening, they were soon covered with dew, while this instrument still indicated several degrees of dryness. The difference was yet greater in summer than in winter. The hygrometer being inclosed within a small glass receiver, placed on a wetted plate likewise of glass, stood, after the whole internal surface had become lined with dew, at 5° in a very cold room, but at 15° when the apartment was kept warm.

The general observation is explained by Professor Leslie's researches into the propagation of heat. No adjoining substances can ever come into absolute contact; but air approaches much nearer to the boundary of glass, porcelain, or paper, than to a surface of polished metal. By an extension, therefore, of the principle of capillary action, the suspended aqueous particles, which have a strong adhesion to glass, to which they are brought so close, readily detach themselves from their union with the air. But the same particles being held back from the proximity of a metallic surface to which they have little attraction, are never deposited on it unless the air is actually overloaded with them. The hygrometer will accordingly reach the absolute zero when it is shut up within a case of polished tin.

Professor Leslie afterwards made several occasional observations relative to the production of dew, particularly during a series of clear warm days in the month of May 1801, at Easbury, in Dorsetshire, where he placed his instruments both on the lawn and on the balustrade of a tower sixty feet in height. Without entering into details, it may be sufficient here to mention the principal results. The periodical variations, both of the hygrometer and thermometer, were much greater near the surface than at some elevation. On the approach of sunset the thermometer on the ground sunk rapidly; the hygrometer relapsed to about five degrees, and the dew began to form on the blades of grass. During the night, the thermometer descended still lower, the hygrometer indicated absolute humidity, and the lawn was covered with a profusion of dew. But a little after sunrise, the thermometer again mounted, the hygrometer began to act, and the sheet of moisture gradually exhaled. In the progress of the day the heat and dryness increased; and, about two o'clock, the thermometer and hygrometer, both of them screened from the

Dew.

direct action of the sun, stood generally, the former at 75°, and the latter at 85°. But, on the top of the tower, all those changes were less violent. The thermometer, which at that altitude seldom rose in the course of the day to 70°, or the hygrometer to 65°, indicated, as night again closed, a depression, though very moderate in comparison with what was shown at the surface of the ground. The thermometer stood several degrees higher than below, the hygrometer remained at a dryness of 15° or 20°, and no dew was deposited on the balustrade. But similar differences of effect, although on a smaller scale, were exhibited at very moderate heights. On lifting those instruments in the evening only a foot from the ground, the thermometer would rise a degree or two, and the hygrometer mount from the verge of moisture to perhaps 10°. At an elevation of four feet those changes were nearly doubled. The dew thus always began, as in Du Fay's experiments, to form at the surface of the earth, and continued to mount upwards with the progress of the night.

Explication of the phenomena.

It is hence easy to explain the general phenomena of dew. "In fine calm weather, after the rays of the declining sun have ceased to warm the surface of the ground, the descent of the higher mass of air gradually chills the undermost stratum, and disposes it to dampness, till their continued intermixture produces a fog, or low cloud. Such fogs are, towards the evening, often observed gathering in narrow vales, or along the course of sluggish rivers, and generally hovering within a few inches of the surface. But in all situations, these watery deposits, either to a greater or a less degree, occur in the same disposition of the atmosphere. The minute suspended globules, attaching themselves to the projecting points of the herbage, form dew in mild weather, or shoot into hoar-frost when cold predominates. They collect most readily on glass, but seem to be repelled by a bright surface of metal."[1] The unequal heating of the surface during the day thus occasions, on statical principles, a perpetual interchange between the higher and the lower atmosphere, which is prolonged through the night, the warm portions of air still continuing to ascend, and leaving their place to be occupied by the descent of similar cold portions of that fluid. This vertical play is a provision of nature for the attempering of the diurnal vicissitudes of climate. "In clear and calm weather, the air is always drier near the surface during the day than at a certain height above the ground, but it becomes damper on the approach of evening, while, at some elevation, it retains a moderate degree of dryness through the whole of the night. If the sky be clouded, less alteration is betrayed in the state of the air, both during the progress of the day and at different distances from the ground; and if wind prevail, the lower strata of the atmosphere, thus agitated and intermingled, will be reduced to a still nearer equality of condition."[2]

Curious experiments of B. Prevost.

The descent of chill air caused by superior density, explains the formation of dew in low situations, and its progressive elevation as the cold accumulates. But some further explication was wanted to reconcile the concluding observations of M. du Fay. The subject was in consequence resumed by M. Benedict Prevost, who performed a curious set of experiments, described in a Memoir read before the Philosophical Society of Montauban in 1803. The results are certainly perplexing, and would almost seem anomalous. 1. Tin or copper foil, and gold or silver leaf, being applied to plates of glass, and exposed to dew, were observed, as before, to remain generally dry, while the vitreous surface became bathed with moisture. 2. After exposure to the night air, not only a dry border appeared, extending a little way beyond the film of metal, but the side opposite to that coating continued still dry, though all the rest of the glass was profusely wetted. 3. A piece of glass, being laid above the metallic leaf, destroyed its effect. 4. A rectangular piece of tin-foil being pasted on the inside, at the top of a pane of glass, in a window having a northern exposure, and a similar piece applied at the bottom on the outside; when the dewing began first against the inside, the interior coating appeared wetter than the naked surface, and the portion of this immediately behind the exterior coating seemed always drier than the rest. The facts were exactly reversed when the dewing commenced on the outside of the window. 5. Opposite to the middle of a rectangular leaf of metal, a similar but smaller piece being applied on the outside of the pane, when the dew began to form within the apartment, the space behind the exterior coating still remained dry. 6. In all cases, whether on the inside or the outside of the pane, on covering the metallic leaf with a piece of glass of the same dimensions, the effect was exactly the same as if no metal had been interposed. 7. Similar appearances were produced by combining gilt paper or quicksilvered glass, the results depending wholly on the nature of the extreme surfaces, according as they consisted of metal, or of glass or paper.

Dew.

On reviewing these curious facts, M. Prevost was struck with their apparent analogy to the phenomena of electricity. He thought they might all be comprised under a single proposition: *That glass which separates two masses of air of unequal temperatures attracts or repels humidity according as it is armed with metal on the hot or on the cold side.* To account for these very singular yet interesting facts, he proposed a random and strained hypothesis, grounded on some loose notions of chemical affinities. But we need not stop to examine it.

Theoretical views.

Dr Thomas Young, in his *Lectures on Natural Philosophy*, published in 1806, concludes a short abstract of the experiments of Prevost with suggesting, that they would derive their explication from Professor Leslie's *Discoveries on Heat.* The anticipation was perfectly just, though the discoveries themselves required then a little further extension to embrace the whole phenomena. Professor Leslie had carefully investigated the laws which modify the propagation of hot or cold pulses through an aërial medium from a solid or a liquid boundary. But he did not contemplate the pulsation excited at the conterminous surface of two strata of air having different temperatures. It was indeed impossible to devise an experiment in which the opposite layers of fluid could be kept distinct, for the warmer portions of air would seek always to rise, while its colder and denser portions would endeavour to sink downwards, and thus form, by insensible shades, a vertical gradation of temperature. But though the pulsatory action excited at each successive horizontal stratum might singly escape observation, it seemed probable that the accumulated impressions transmitted from numerous boundaries would become very sensible. Accordingly, in a close heated room, the *pyroscope*, or differential thermometer, having one of its balls gilt, which is susceptible of such pulses only, marks, near the floor, perhaps four or five degrees of calorific impression, yet, when lifted higher, it indicates an effect always diminishing in proportion to the proximity of the ceiling. The entire action exerted, or the amount of the intermediate energies, was therefore, as the excess of the temperature of the stratum of air next the ceiling above that of the stratum in which the instrument happened to be placed. Carried out of doors in clear and

[1] Leslie *On the Relations of Air to Heat and Moisture*, p. 132.

[2] *Ibid.* p. 92.

Dew. calm weather, after the sun had withdrawn his beams, it betrayed a much stronger tendency the contrary way, and marked a copious frigorific impression, evidently produced by the coldness which must pervade the upper regions of the atmosphere. But to fit the pyroscope for making observations during the day, it was converted into the *Æthrioscope*, in which the influence of light is neutralized; a combination of great delicacy, and, therefore, a valuable acquisition to meteorological science. (See the article CLIMATE.) The application of this new instrument has not only ascertained the existence, but measured the intensity, of the cold pulses which are at all times darted downwards from the successive strata of air, though often partially intercepted by clouds, or more completely obstructed by low fogs. But since the spheroidal cup, which concentrates the various oblique impressions on the upper ball of the æthrioscope, can do little more than double the direct action against a horizontal surface, it may hence be computed that, in fine bright evenings, those cold pulses rained from the sky are sufficient alone to depress the temperature of the ground, according to the seasons, sometimes eight degrees, but generally about three degrees, by Fahrenheit's scale. The blades of grass, thus chilled from exposure, cool in their turn the damp air which touches them, and cause it to drop its moisture. For the same reason, the naked ball of the æthrioscope, as it is still more cooled, appears much sooner affected, being commonly covered with profuse liquid globules long before the dew has begun to form on the surface of the ground.

Anomalies explained. All the difficulties and seeming anomalies of the observations of Du Fay and Prevost now vanish away. The various phenomena proceed chiefly from the cold induced by exposure under a clear sky; but other causes will often essentially modify the results. 1. The impression received on a plate of polished metal scarcely amounts to the tenth part of what is communicated to a surface of glass, wood, cloth, paper, earth, or grass. 2. When the action continues the same, the corresponding depression of temperature yet depends on the slowness with which the cold is subsequently dispersed. In calm weather a plate of glass, or a sheet of paper, if covered on both sides with a leaf of metal, will gain or lose heat twice as slow as before, and if coated only on one side, its progress will be a half slower. But high winds greatly assist the dispersion of heat, and often reduce the effects of external impressions to the third or the fourth part of their ordinary measure.

Hence the reason why scarcely any dew is formed in windy weather, though the sky be clear; for the frigorific pulses must then have little efficacy, not cooling the ground perhaps more than one or two degrees. In the last observation of Du Fay, the slip of glass laid across the rectangle, composed of alternate bars of glass and of brass, being greatly chilled by exposure, had by contact communicated its coldness to the matter under it, and thus enabled the metal to assist in the deposition of dew. In Prevost's second experiment, the metallic leaf, being scarcely affected by the frigorific impressions, checked by its presence the progress of cold along the vitreous surface, and therefore maintained a dry border all around it. Hence, in his third experiment, a piece of glass covering the metal received the entire impressions, and restored the former effect. The application of a metallic coating against the inside of a pane, must, in the fourth experiment, have augmented by one half the efficacy of the external pulses of cold, and thus made the dew to attach more profusely. For a like reason, while a leaf of metal on the outside of a pane became, in the fifth experiment, slightly dewed, the addition of a smaller metallic leaf against the inside increased the effect, by promoting the accumulation of cold.

The remarkable experiments which the late Dr Patrick Wilson, professor of practical astronomy in the university of Glasgow, performed during the severe frost of January 1780, are easily explained on the same principles. In the declivity of a garden, a thermometer laid, in a clear starlight, on the surface of the snow, stood from eight to ten degrees lower than when suspended at the height of a few inches. This excessive cold was evidently not occasioned by evaporation; for, on blowing with bellows against the bulb when it lay on the snow, so far from sinking more, the mercury actually rose two degrees higher than its station in the free air. The intensity was no doubt in part owing to the low position of the snow; for a thermometer suspended at a pole projecting from a window twenty-four feet above the surface indicated four degrees less cold than below. But, besides the accumulating action of the descent of cold air, the snow must have been also chilled extremely by the frigorific pulses darted from an azure sky. This inference, though not perceived at the time, or, indeed, likely to have been admitted then as philosophical, is distinctly supported by an experiment of Dr Wilson. Having screened a spot of the garden by a sort of sharp roof formed with two inclined sheets of brown paper, and laid a thermometer under it on the surface of the snow, the instrument soon marked six degrees of less cold than before, or than another exposed at only a short distance. But this open screen, since it could not impede the mere descent and influx of cold air, must have intercepted a more powerful frigorific influence.

Dew. Wilson's observations on hoar-frost.

Dr Wilson afterwards performed other similar experiments, which are detailed in his paper on hoar-frost, drawn up in 1788, and inserted in the first volume of the *Transactions of the Royal Society of Edinburgh*. He made the important remark, that during a fog there was no difference of temperature between the surface of snow and the incumbent air. But he neglected to pursue the consequences, and was disposed, from the various facts which he had observed, to conclude vaguely that hoar-frost is always accompanied by a production of cold.

Six's observation on dew. About the same time Mr Six of Canterbury, the inventor of the self-registering thermometer, employed that very useful instrument in making similar but more extensive observations. He found, in a clear summer evening, his thermometer, when laid on the grass, to sink five degrees lower than when suspended freely near the surface. But he had occasion afterwards to remark still greater differences. On a clear and still night in winter, the thermometer which had been supported in the air fell no fewer than thirteen and a half degrees when placed flat on a meadow. He likewise noticed, as Dr Wilson had done, that thick fogs always impede, and often wholly prevent, the peculiar cooling of the ground.

It seemed therefore ascertained that, in the absence of the sun, the surface of the earth, and especially its projecting herbage, acquire, in calm weather, from the mere aspect of a bright and unclouded sky, a very notable degree of cold. This cold appears likewise connected evidently with the formation of dew. But what is the nature of that relation? Is the coldness contracted by substances on exposure to the nocturnal air to be considered as the effect or as the cause of their dewing? The former opinion, we have seen, was espoused by Dr Wilson, though sound theory should make us expect that the deposition of dew, or the conversion of humidity from a gaseous to the liquid state, must, on the contrary, occasion a small extrication of heat. But constant experience shows that cold bodies, not sheathed with metallic lustre, become always sprinkled with minute aqueous globules, from the contact of damp air. The simplest truths, however, are very seldom the soonest perceived, and the late ingenious

Dew.

Discovery of Dr Wells.

and learned Dr Wells has the merit of being the first who distinctly attributed the formation of dew to the previous cold induced on the ground from the aspect of the sky. He had early conceived an opposite idea, but a closer examination of the subject led him to adopt juster views. Being once engaged in the research, he prosecuted his observations with assiduity and ardour for upwards of two years, at a friend's villa on the skirts of London, in spite of his professional avocations, and at the evident risk of his precarious health. The numerous facts thus collected are detailed in his *Essay on Dew*, which appeared in 1814, and immediately attracted a very considerable share of public notice. This little work, however, does not add much to our stock of accurate information, but it is rendered interesting by the variety of collateral objects which it embraces. The experiments themselves rarely display address or delicacy; and Dr Wells, without ever employing the hygrometer or the pyroscope, instruments which he could have then easily procured, generally contents himself with stating merely rude approximations. Fortunately, such coarse results were sufficient to support the main principle, for otherwise they would have required much correction. But we must still regret that the worthy author should have frequently trusted to conjectural reasoning, instead of appealing to direct experiment.

Abstract of his observations.

The chief observations collected by Dr Wells may be reduced to a narrow compass. The coldness of the objects exposed was always found to *precede* the formation of dew, which continued, in favourable circumstances, to accumulate somewhat progressively during the whole night, so that, from midnight to sunrise, the deposition was even greater than from sunset to midnight. Dew was more abundant in the spring and autumn than at other seasons, and it was always very copious when the atmosphere inclined to humidity; for instance, in clear nights succeeding to misty mornings, or in clear mornings succeeding to misty nights.

The coldness which bodies contract from exposure must be augmented by every circumstance which retards the communication of heat. Hence loose and spongy materials are mostly affected. Thus, in a clear night the grass was twelve degrees colder than the garden mould, and sixteen and a half degrees colder than a hard gravel walk. In another bright evening, the surface of snow being nine degrees colder than the air, a piece of swandown laid on it became still four degrees colder. Again, a lock of wool placed on a small table in the garden became nine and a half degrees colder than the air, while swandown, in the same situation, acquired a coldness of eleven and a half degrees.

The quantities of dew which attach to different substances appear to follow the proportions of their relative coldness. Parcels of wool, each weighing ten grains, being teased out into flattened balls of two and a half inches diameter, and laid on a grass plot, on a gravel walk, and on fresh garden mould, acquired, during a clear calm night, respectively, sixteen, nine, and eight grains of humidity. In another favourable night ten grains of wool laid on the table attracted sixteen grains of dew, while another similar parcel, suspended at the same height in the free air, acquired only ten grains; but the former must have also been much colder than the latter, since its confined situation, unlike the open exposition, would check the dissipation of the frigorific impressions. Hence dew is always denser on grass than on the leaves of shrubs.

But the cooling of substances from exposure, though one great source of dew, is not the only cause of its formation. In low fogs, while the ground is scarcely colder than the incumbent bed of air, the humidity yet settles profusely on all bodies, even on the polished surface of metals. From Six's experiments, it appears that, from the height of 200 feet, the temperature of the atmosphere, in fine evenings, decreases regularly about ten degrees, the colder and therefore denser portions being always thrown down to the surface. Hence the reason of the ancient remark, that dew is more copious in low vales than on the tops of hills. But the observations of Dr Wells serve to confirm the general statement. A lock of wool exposed on a table, imbibed, during a clear night, sixteen grains of dew; but a similar parcel, placed immediately under the table, and consequently screened from the aspect of the sky, attracted four grains. In the latter case, the mere accumulation of cold air below must have occasioned the aqueous deposition.

Dewas ‖ De Witt.

Coldness of the surface not the sole cause of dew.

It might perhaps have been judged sufficient if Dr Wells had contented himself with assuming the coldness induced on the ground as merely an experimental fact. At any rate, we cannot help regretting that he should have sought the explication of this primary phenomenon from the very loose, cumbrous, and visionary hypothesis of M. Prevost of Geneva, concerning what is gratuitously called *radiant heat*. We are at a loss indeed to conceive how a speculation so repugnant to all the principles of sound philosophy should at this time have procured any favour, unless it proceeds from the blind admiration which the multitude are prone to entertain for whatever lulls the reasoning faculty, and appears cloudy and mysterious. See METEOROLOGY. (J. L.)

DEWAS, in Hindustan, a town, the principal place of a small native principality, situated in the province of Malwa, between Lat. 22. 30. and 23. 2., Long. 75. 53. and 76. 27., and containing an area of 256 square miles. The authority by which this petty state is ruled deserves notice from its singular character. The territory appears to have been originally granted to two brothers, and it still continues to be held conjointly by two princes of the Puar or Pramara rajpoots. Although these chiefs were personally on good terms, it was found that their principal servants, in conducting the administration of affairs, came frequently into collision; and at length an arrangement was effected under which the two rajahs agreed to act by a union of authority, and to carry on the government by means of one public minister. By the provisions of a treaty concluded in 1818, British protection has been extended to this petty state, and the rajahs in return are bound to maintain a military force to be at the disposal of the British government. The revenue of the state amounts to about L.40,000 per annum, and its population is estimated at 25,000. The town is in Lat. 22. 58., Long. 76. 4. (E. T.)

DE WITT, JOHN, one of the greatest statesmen of Holland, was born at Dort in 1625. From his father, who had been a member of the states of Holland, he inherited a sleepless jealousy and suspicion of the power and influence of the house of Orange: and when in 1652 he was made grand-pensioner of Holland, he used all his efforts to break up that plurality of office which had hitherto been vested in the princes of that family, and had made them, in the capacity of stadt-holders, almost the equals of kings. The last stadt-holder had died in 1650, and his son, afterwards William III. of England, was at this time a mere infant. Availing himself of the opportunity thus presented, De Witt caused the office of stadt-holder to be abolished, and the power of the states-general to be declared supreme. In 1654 he concluded a treaty with Cromwell, in a secret article by which, provision was made that no member of the Orange family should in future hold the highest offices of state. On the restoration of Charles II., the grand-pensionary sought the alliance of France. England, alarmed at this, declared war against Holland; and though her arms were at first successful, she was ultimately obliged to sue for peace.

Dewsbury || Deyrah.

the more especially as De Ruyter had appeared with a powerful fleet at the mouth of the Thames, and burnt the shipping in the Medway. Soon afterwards the aggrandizing policy of Louis XIV. of France began to assume a definite form against Holland, and De Witt hastened to seek the assistance of Sweden and England. The treaty with these powers was concluded in great haste, so that it was not submitted to the federal council of each province, but was ratified at once by the states-general. This measure, which was perfectly justifiable in the emergency, was afterwards brought up against the grand-pensionary. Meanwhile De Witt was organizing the internal policy of Holland, regulating the finances, and carrying out his scheme of excluding the Orange family from any share in the government. But his plans were defeated by the intrigues of Louis XIV., which resulted in a coalition of France and England against Holland. The armies of France entered Holland in 1672, laid waste the country, and advanced to within a few miles of Amsterdam. At this crisis the people rose against the grand-pensionary, whom they believed to have neglected the necessary precautions against an invasion, put the young Prince of Orange at the head of the army, and expelled the grand-pensionary's brother Cornelius. De Witt himself immediately resigned his office; and as he and his brother were retiring into the country, the mob rose against them and murdered them in cold blood, under circumstances of the most revolting cruelty.

DEWSBURY, a market-town in the west riding of Yorkshire, situated at the foot of a hill rising from the left bank of the Calder, and on the line of the Manchester and Leeds railway, eight miles S. by W. of Leeds. Pop. (1851) 5033. This town, though ancient, owes its present importance to the extensive manufactures which are carried on there. These consist chiefly of blankets, carpets, druggets, and an inferior woollen cloth made from rags, which, by powerful machinery, are reduced to wool, and afterwards re-spun and made into the cloth known as *shoddy*. Dewsbury is connected by canals with Hull and Liverpool. The town is pleasantly situated and generally well built. Part of the principal church is of great antiquity. It was rebuilt in the latter half of the last century in conformity with the original plan, and a great part of the interior was preserved. Dewsbury has a new court-house recently erected, a blanket hall, market cross; also a charity school, free-school, mechanics' institute, and several subscription libraries and news-rooms.

DEXTANS, in *Roman Antiquity*, ten ounces, or $\frac{10}{12}$ of the libra, or of anything else.

DEXTER, in *Heraldry*, right as opposed to left in a shield or coat of arms; as *bend-dexter*, *dexter-point*, &c.

DEXTRINE. See BREWING, vol. v., p. 320; and CHEMISTRY.

DEXTROCHERE, or DESTROCHERE, in *Heraldry*, is applied to the right arm painted in a shield, naked or clothed, or adorned with a bracelet, and sometimes armed, or holding a moveable member used in the arms.

DEY, the title of the former sovereigns of Algiers, under the protection of the Grand Signior. The sovereignty and the title ceased to exist when Algiers became a colony of France.

DEYNSE, a town of Belgium, province of East Flanders, arrondissement of Ghent, and nine miles S.W. of the town of that name, on the left bank of the Lys, and on the Ghent and Courtrai railway. It is celebrated for its manufacture of gin. Pop. (1851) 3661.

DEYRAH, a town of Northern Hindustan, and the principal place of the British province designated the Deyrah Doon. It is populous and well built, and its position is favourable for commerce, as it stands at the intersection of the road from Hurdwar to Sirmoor with that from Suharunpore to the Sanatarium of Mussouree. The valley of the Deyrah Doon is 45 miles in length, with a varying breadth of from 15 to 20. It lies between Lat. 30. and 30. 32., Long. 77. 43. and 78. 24., and contains an area of 673 square miles, with a population of 32,083. This tract formerly belonged to the rajah of Gurwhal, from whom it was wrested by the Goorkhas in 1803. During the Nepaul war in 1815, the Deyrah Doon became the scene of military operations, and acquired a mournful celebrity by the obstinate defence made by the Goorkhas at Kalunga or Nalapani, in the siege of which the British lost a considerable number of men, including their gallant commander General Gillespie. (E. T.)

Dezphoul || Dhoolpoor.

DEZPHOUL, a town of Persia, in the province of Kuzistan, situated in a beautiful plain, on the eastern bank of the Abzal, 28 miles W. from Shuster. Its only ornament is an elegant bridge, erected by the command of Sapor, a prince celebrated both as the destroyer and the founder of cities. This bridge is 450 paces in length, 20 in breadth, and about 40 in height. The piers are of large stones, and the arches and upper parts of brick. Pop. of Dezphoul nearly 15,000.

DHAR, in Hindustan, a town, the principal place of the raj or petty native state of the same name, is situate 33 miles west of the British military station of Mhow, in the territory of Indore. It is defended by a fort erected on an eminence rising 40 feet above the plain. The raj, of which this town is the capital, contains an area of 1070 square miles, and a population of 104,860. By the provisions of a treaty concluded in 1819, Dhar was taken under the protection of the British government; in return for which the rajah ceded certain tributes, and moreover entered into the usual engagements of subordinate co-operation and friendly alliance. The town of Dhar has an elevation of 1908 above the level of the sea, and is situated in Lat. 22. 35., Long. 75. 20. (E. T.)

DHARWAR, in Hindustan, a town, the principal place of a British collectorate of the same name, subject to the jurisdiction of the presidency of Bombay. The town, which is situate to the south of the fort, is further protected by a wall and ditch. The fort is strong, though not built on the strict plan of a regular fortification, and the ditch is from 25 to 30 feet wide and nearly as many in depth. This place has often changed masters. In the year 1685 it was taken from the king of Bejapore by the armies of the emperor Aurungzebe; and soon after the decease of that monarch it fell into the hands of the Mahrattas, from whom it was taken by Tippoo Sultan in 1784. It was retaken in 1791 by the Mahrattas, aided by the British, after a siege of tedious duration, in the course of which it was almost totally destroyed. Upon the fall of the Peishwa in 1818, the town, with all the possessions of the Mahratta leader, fell to the disposal of the British. The collectorate, of which this town is the capital, extends from Lat. 14. 16. to 15. 50., and from Long. 74. 50. to 76., and contains an area of 3837 square miles, with a population of 754,385. In most parts of the district the soil is fertile and peculiarly adapted to the growth of American cotton, the cultivation of which has spread with extraordinary rapidity within the last few years. The experimental cultivation of the New Orleans species commenced in 1842 in farms established by the British government; and its superiority over the indigenous cotton is now universally recognised throughout the district. Lat. of town 15. 28., Long. 75. 4. (E. T.)

DHOOLPOOR, in Hindustan, a town, the chief place of the raj or native state of the same name, is situate about a mile from the left bank of the river Chumbul. It is a place of great antiquity, and contains several fine mosques and mausoleums. Baber, in his autobiography, adverts to its surrender to him in 1526. The territory of Dhoolpoor extends from Lat. 26. 30. to 26. 57., and from Long. 77. 32. to 78. 20., and contains an area of 1626 square miles. It is governed by a chief of the Jaut tribe, whose ancestors ruled over Gohad, and subsequently became masters of the fort of Gwalior and the adjacent country. Some of these possessions had been wrested from the ruling family by the Mahrattas; and under the provisions of a treaty con-

Diabetes || Dialling.

cluded in 1804 between the Rana and the British, the latter engaged to establish the Rana in his hereditary dominions. Owing to the opposition of Scindia, it was subsequently deemed inexpedient to carry out this engagement. A modification of the treaty was thereupon agreed to, in conformity with which the Rana consented to relinquish the possessions guaranteed to him by the British, and to accept in lieu thereof the territory of Dhoolpoor and its dependencies. A military force consisting of 2000 men is maintained by the Rana. The town of Dhoolpoor is in Lat. 26. 41., Long. 77. 58. (E. T.)

DIABETES (Greek, from διά *through*, and βαινω *to go*), an immoderate flow of urine. There are two varieties of this disorder; one a mere superabundance of the ordinary discharge; the other, termed *diabetes mellitus*, in which the urine becomes highly charged with saccharine matter, and which usually, if not always, terminates fatally.

DIACAUSTIC CURVE, a species of the caustic curves formed by refraction.

DIACHYLON (Greek, διά and χύλος, *juice*), a name given by the ancient Greek physicians to an emollient plaster, composed of the resinous juices of certain herbs. The term is retained in modern pharmacy, to denote a plaster prepared by boiling hydrated oxide of lead with olive oil.

DIACOUSTICS, called also DIAPHONICS, the consideration of the properties of refracted sound, as it passes through different media. The word is formed from the Greek δια. *through*, which intimates a passage, and ἀκούω, *I hear;* the consideration of the passage of the sounds which we hear. See ACOUSTICS.

DIACRII, in *Antiquity*, was the name of the oligarchic party or faction at Athens, as distinguished from the *pediaci* or democratic party. They derived their names, the former from inhabiting the upper part of the city, and the latter the lower quarters. The laws of Solon designed that Peisistratus should be the chief of the diacrii; though the scholiast on Aristophanes's comedy of *The Wasps* affirms that Pandion distributed the quarter of the diacrii among his sons, and put Lycus at their head.

DIADEM. See CROWN.

DIÆRESIS (Gk. *separation*), in *Grammar*, the division of one syllable into two; which is usually noted by two points over a letter, as *aulai* for *aulæ*.

DIÆTETÆ, or arbitrators at Athens, were of two kinds: the *cleroti* and *diallacterii*. The former were public arbitrators, chosen by lot to determine all causes exceeding ten drachms within their own tribe; and from their sentence an appeal lay to the superior courts. The latter were private arbitrators, from whose sentence there lay no appeal; and accordingly they always took an oath to administer justice with impartiality.

Diagnosis || Dialling.

DIAGNOSIS (from διαγώσκω, *to discern* or *distinguish*), in *Medicine*, the diagnostics or the signs of a disease. They are of two kinds, namely, the adjunct and the pathognomonic. The former, being common to several diseases, serve only to point out the difference between diseases of the same species; but the latter, being those which always attend the disease, distinguish it from all others.

DIAGONAL, in *Geometry*, a right line drawn across a quadrilateral figure, from one angle to another; sometimes called the *diameter*, and also the *diametral*, of the figure.

DIAGORAS, of Melos (fl. 458-415 B.C.), a poet and philosopher, who in ancient times obtained the surname of the Atheist. He is said to have been a scholar of Democritus, and to have exchanged the superstition of his early dithyrambics for an undisguised system of atheism. Having been defrauded by a man to whom he had intrusted one of his writings, he was provoked to deny the existence of a God on account of the violation of justice in permitting the villain to go unpunished. Despite the religious susceptibilities of antiquity, perhaps he might have succeeded in living peacefully had he only endangered the truths of natural religion; but he went farther, and boldly assailed the popular religion. At Athens, with Alcibiades and others, he ventured to ridicule the Eleusinian mysteries. For this offence he was tried, and was compelled to seek safety in flight; since a price was fixed upon his head to any one who should bring him dead or alive. He escaped, however, to Corinth, where he died in peace.

DIAGRAM, in *Geometry*, a scheme for explaining and demonstrating the properties of any figure.

DIAGRAM, among ancient musicians, a musical scale.

DIAL. See DIALLING.

DIALECT (δια and λέγω, *to speak*); the form or idiom of a language peculiar to a particular province, state, or kingdom. The ancient Greek language possessed four dialects, the Attic, Ionic, Æolic, and Doric.

In Great Britain, besides the grand diversity of English and Scotch, almost every county has a dialect of its own, all differing considerably in pronunciation, accent, and tone, although one and the same language.

DIALECTICS, in the literary history of the ancients, that branch of logic which taught the rules and modes of reasoning. See LOGIC.

DIALLING.

DIALLING, sometimes called *Gnomonics*, is a branch of the mixed mathematics, which treats of the construction of sun-dials. Its foundation is the astronomical theory of the sun's apparent motions; and from these its rules and operations have been deduced by the aid of geometry and trigonometry.

It may be supposed that in the early ages men would be satisfied with the divisions of the day marked by the rising and setting of the sun, and his greatest elevation above the horizon. When the gnomon, an upright pillar, the first of all astronomical instruments, had been applied to astronomy, the angular motion of its shadow might suggest that it was applicable to the division of the day.

The earliest mention that is made of a sun-dial is in the Bible. We read in the thirty-second chapter of Second Chronicles, that when Hezekiah was sick, he prayed to the Lord, and "He gave him a sign:" what that sign was is particularly told in Isaiah, chap. xxxviii. verse 8, "Behold I will bring again the shadow of the degrees which is gone down in the *sun-dial* of Ahaz ten degrees backward. So the sun returned ten degrees, by which degrees it was gone down." This was about 700 years before the Christian era.

The Chaldeans, among the earliest astronomers, as well as the other nations of Asia, divided the day into sixty parts. They had also a division of the day into twelve hours. The earliest of all sun-dials of which we have any certain knowledge was the *Hemicycle* or Hemisphere of their astronomer Berosus, who probably lived about 540 years B. C. This was the most simple and natural of all sun-dials, and therefore must have preceded the others. It has been the most generally used, but it could never be of any considerable dimensions, and was not susceptible of much accuracy. It, however, required no mathematical theory for its construction; a distinct notion of the spherical motion of the heavens was sufficient. To understand this dial, let us suppose a concave hemisphere, placed horizontally in an open place, with the concavity turned towards the zenith, and let a

Dialling. globule be suspended or fixed in any way at its centre; when the sun's centre rises above the horizon the shadow of the globule will enter the hemisphere, and throughout the day the shadow will trace on its inside the sun's diurnal parallel. Now, let the lines described by the shadow on the solstitial and equinoctial days be traced on the inside of the sphere, and also on as many intermediate days as may be, but in fact the tropical paths of the shadow will be sufficient; let each of these be divided into twelve equal parts, and let curve lines be drawn through corresponding points of division. These will be sensibly great circles on the inside of the hemisphere, and will two and two converge towards points in the meridian more or less distant. Here then is a sun-dial which will divide the period between sunrise and sunset into twelve portions, called *temporary hours*. The hours indicated by this dial were from its nature unequal, and varied from day to day. This defect, however, was not of much consequence when there were no machines for dividing time: a knowledge of geometry would have served to construct the dial so as to divide time equally, but at that remote period geometry was not known as a science.

The difference between the equinoctial hours, which were equal, and the unequal temporary hours, might not be at first observed, or might have been disregarded by a people who inhabited a climate where the elevation of the pole was small, and who, besides, attended only to the rising and setting of the sun, and, it may be, his passing the meridian, which at all times divided the day into parts nearly equal. They probably first divided each half of the day, as well as they could by estimation, into three equal parts, and these again each into two. The dial of Berosus, although imperfect, was a great step towards improvement in the division of time, and was not at variance with the conjectural divisions, because in both ways the twelve hours had the same bounding limits, the rising and setting of the sun.

It would have been easy to have passed from the temporary to equal hours, which were marked by equal arcs on the equator; it was only necessary to describe semicircles through these points of division which should cut each other in the poles of the world: these would have divided the parallels into arcs of fifteen degrees each: by carrying the divisions into fifteen degrees upon the summer tropic from the six o'clock hour circle to sunrise and sunset, there would have been got the excess of the longest above the equinoctial day. Thus a more exact notion of the length of the day and night at all seasons would have been obtained. But this would have appeared a great innovation, and not likely to have been adopted: every one knows how obstinate the common people are in adhering to old habits. Accordingly the construction of Berosus descended beyond the time of Hipparchus and Ptolemy. We find it in the year 900 among the Arabians, who followed it in the construction of their dials, as appears from the work of Albategnius; and it is only since the invention of mechanical instruments for dividing time that it has altogether disappeared.

It is doubtful whether the Chaldeans had any mathematical theory for their dial, although it was of great simplicity. The facility, however, of its construction has probably made it the best known. Four have, in modern times, been recovered in Italy. One was discovered in the year 1746, at Tivoli. It has been supposed that this belonged to Cicero, who in one of his letters says that he had sent a dial of this kind to his villa near Tusculum. P. Zuzzeri, a Jesuit, has made this dial the subject of a memoir published at Venice. The second and third were found in 1751; one at Castel-Nuovo, and the other at Rignano; and a fourth was found in 1762 at Pompeii. It differs from the others in respect that the tropics are not expressly marked, and the equator alone is seen. G. H. Martini, the author of a dissertation, in the German language, on the Dials of the Ancients, supposes this last to be the oldest of the four, and that it is probably the primitive dial, such as was known to Berosus. Delambre, however, in his *Histoire de l'Astronomie Ancienne*, expresses himself of a contrary opinion, because it was more difficult to construct such a dial without than with the tropics. Martini says that the dial was made for the latitude of Memphis; it may therefore be the work of Egyptians, if it was not constructed in the school of Alexandria. It may be ascribed to the Egyptians, however, without attributing to them much knowledge in geometry; a terrestrial globe, on which were traced the equator and tropics, divided into degrees, and with its pole elevated to the latitude of the place, was all that was necessary. This being cut into two hemispheres horizontally, and great circles traced through the corresponding points of the two tropics, would furnish two convex models of the dial, from which any number of concave ones might easily be formed. The convex spherical model might even have had the parts cut away which were not to be shown on the concavity, and thus the construction of the dial might be a purely manual operation performed by an artist. Dialling

When the first dial was constructed, it was easy from that to make others. Thus, by the side of a Chaldean dial let a plane be fixed in any position, with a perpendicular gnomon; mark on the plane the position of the top of the shadow from hour to hour on the solstitial and equinoctial days, and join the corresponding horary points by lines, and it will appear that the three analogous points are always in a straight line; and thus there might be formed, without any theory, temporary dials of all kinds.

It may be supposed that every nation that cultivated astronomy had found means to divide time. It appears that the Egyptians had found in the heavens the means of attaining this object, but no sun-dial has been found among the antiquities of Egypt, and their sculptures give no indication of any having existed; they may, however, be buried in the sands, or overwhelmed in the midst of the vast ruins of their cities. It has been supposed that the numerous obelisks found everywhere in Egypt were erected in honour of the sun, and employed as gnomons. The famous circle of Osymandias might have determined the azimuths of the heavenly bodies, and thus have given the hours of the day or night.

Herodotus has recorded that the Greeks derived from the Babylonians the use of the pole and of the gnomon, and the division of the day into twelve parts: the pole was an instrument that showed the hour of the day. The Greeks by their geometry were in full possession of the means of constructing dials; and the Syntaxis of Ptolemy treats of their construction by means of his *Analemma*, an instrument by which the various problems of astronomy might be resolved.

The dials of the ancients marked the hour of the day by the shadow of a gnomon, but they had neither centres nor axes, and in some respects this was an advantage. The nature of their hours, which varied with the season, made it necessary to give such directions to the horary lines as prevented them from meeting in a point; they therefore were satisfied with finding the position of three points in each, although two would have been sufficient, for the lines were sensibly straight in all plane dials; the diurnal paths of the extremity of the shadow were hyperbolas, which intersected the horizon in the points of rising and setting, and of these there might be any number, but in general they were limited to the arcs of Cancer and Capricorn; the line for Aries and Libra was always straight, and furnished a middle point in the hour line.

Dialling. The constructions given by Ptolemy were sufficient for regular dials, the only ones he treats of. It is certain, however, that the ancients constructed vertical declining dials, for eight are yet in existence on the Tower of the Winds at Athens. Probably a part of the book of the Analemma is now lost, otherwise it would be remarkable that after Ptolemy had announced, in commencing, that he proposed to facilitate the construction of dials, he should not say a single word on the applications which may be made of his obscure methods and graphical operations, the object of which can hardly be seen, or the principles understood.

The ancient hours were called *hectemoria* by the Greeks, because they were sixth parts of the semidiurnal arc. It does not appear that the nature of the hectemorial hour lines was ever considered by the ancients, indeed, practically, their precise nature was of little importance to them, and of no use in tracing their dials. On the sphere, when the pole is not considerably elevated, the lines which divide the semidiurnal arcs into equal parts differ not much in appearance from arcs of great circles, as has already been remarked; and that they are not exactly so was first suggested by Clavius. Delambre has treated of them in his *History of Astronomy*, and in the *Connoissance des Temps* for 1820. Mr Cadell has treated the subject at considerable length in the eighth volume of the *Transactions of the Royal Society of Edinburgh*, and, again, Mr Davis in the twelfth volume of the same work.

The most interesting monument of ancient gnomonics is the Tower of the Winds, which is yet in existence, and is figured and described by Stuart in his *Antiquities of Athens*. This is a regular octagon, on the faces of which the eight principal winds are represented, and over them are eight different dials; four regular, viz. east, west, north, and south; the other four have the intermediate directions. Vitruvius has described the Tower in the sixth chapter of his first book; but he has not said any thing of the dials. This is remarkable, because he has described all the dials known in his time, and these are in every way more important than those of which he has mentioned the inventors. His silence gives reason to believe that the dials on the Tower have been an after thought, and are of a date later than his time, and much posterior to that of Andronicus Cyrresthes, author of the monument. It is impossible to say any thing with precision as to the time when these eight dials were erected. From the impaired purity of style in the architecture of the Tower, it has been judged to be later than the time of Pericles and Anaxagoras. In their day the science of gnomonics was too little advanced to have served for the construction of the dials; however, as far as mathematical science was required, they might have been made in the time of Hipparchus, or later. It is certain they must have required a science of gnomonics, and therefore a trigonometry, unless they were made empirically by the help of the concave hemisphere of Berosus.

These dials, as described by Stuart, have the forms of those in the commentary given by Commandine on the Analemma of Ptolemy; everywhere the style is wanting, but the hole in which it had been inserted is visible in the marble. Its vertex is rarely in the axis of the hole, even in the regular dials, which are four in number. However, the height and the foot of the style are not indispensable data; they may be discovered from the principal dimensions of the dial. By a careful examination, Delambre ascertained that the south dial, the most important, was remarkably accurate, and that the height of the style was ten and a half English inches. The hours are not numbered, but they are temporary, and reckoned from sunrise to noon, and thence to sunset. The north dial is but a supplement of the south, on the same scale, and with the same style. There appear only two evening and two morning lines; and these, instead of being horary, are truly azimuthal; they only indicate the direction of the shadow. Two of these four lines are even a little too long, because that, instead of the hyperbolic arc, which should limit them, a straight line has been drawn. These slight defects are of no real importance. Dialling.

The east dial is as exact as the south. It is very narrow, although it has a style double the length, almost nineteen and a fifth inches. The south-east presents the same agreement in all its parts. The height of the style is about twenty-five and a half inches. The inclination of the equinoctial to the horizontal line is 42° 40′, such as calculation makes it.

The north-east dial does not appear to have been traced with so much care, or at least success; the style is only about six and a half inches. The horary lines, three in number, are very oblique. The artist, however, may be excused, because the least error in the graphical operations might alter sensibly their length. Besides, this dial is the least important of them all; there is nothing which cannot be determined with more certainty on some one of the neighbouring dials. The three remaining dials, viz. the south-west, the west, and the north-west, are merely the counterparts of their opposite, and have not been figured in Stuart's book. The whole give the same general view of the ancient gnomonics as had been previously acquired by an examination of a dial found at Delos, and described by Delambre in the class of mathematical sciences of the Institute for 1814. They are however larger and better executed than that dial, and in their original position. Altogether they form the most complete monument of the practical gnomonics of the ancients.

There is another remarkable combination of dials in Athens, known by the name of the dials of Phædrus. They are four in number, and are traced on the same block of pentelique marble. It bears the following inscription: φαιδρος ζωιλου παιανιευς εποιει. From the form of the letters, M. Visconti, who communicated the designs of these dials to Delambre, has inferred that the monument may be of the second or third century of our era. Delambre described and carefully verified all the parts of these dials (*Hist. de l'Astron. An.* vol. ii.), and everywhere he found, if not all the conformity which he desired, at least as much as he could expect. The dials by themselves confirm what is manifest from those on the Tower of the Winds, that the Greeks had geometrical methods for vertical, and also for declining dials.[1] To the ancient dials which have been here noticed we may add a singular one found at Portici in 1755, and described by the academicians of Naples. It has the figure of a bacon ham, and, like all the others, shows temporary hours. The theory of this dial is simple, but, considering the imperfect trigonometry of the Greeks, its construction by calculation might be laborious; probably it was made by the simple process, already described, from the Chaldean dial. The epoch of this dial is not known, nor is any dial of this kind noticed by Vitruvius, to whom we owe all the knowledge we have of other ancient dials. Vitruvius has attributed to Berosus the hemicycle hollowed in a square cut according to the inclination of the place (a description which Delambre says is incorrect). He has added, that Aristarchus of Samos invented the horologium called *scaphe* (boat), or the *hemisphere*. This may have been the hemisphere of Berosus which Aristarchus taught the Greeks. He attributes also to him the *disk in a plane*. This may have been an equinoctial or a horizontal dial; these the Greeks could execute graphically without calculation. Vitruvius gives precepts for the construction of this dial, which are not, however, very intelligible now. He goes on to say, that

[1] These interesting dials are now in the British Museum; Elgin Saloon, No. 186.

Dialling. the *aranea* is due to Eudoxus, or, according to others, to Apollonius. This appears to have been a horizontal dial, on which circles of altitude were traced. Scopas of Syracuse invented the *plinth* or *lambris*, and he assigns to Parmenion the invention of an universal dial; and he goes on to speak of many others, the nature of which can only now be guessed. He indicates dials of suspension intended for travellers; these may have been like our ring-dials, but he does not explain them particularly. In concluding, he says that, *to comprehend the theory of dials*, it was necessary to know that of the *Analemma*.

The first sun-dial erected at Rome was in the year 290 B. C. Papirius Cursor had taken it from the Samnites. In 261 B. C. Valerius Messala placed in the forum a dial which he had taken at Catania, the latitude of which is five degrees less than that of Rome. In 164, Q. Marcius Philippus caused the first dial to be constructed; it was probably the work of a foreign artist, for no Roman has written any thing on gnomonics. We have seen that the dial found at Pompeia was made for the latitude of Memphis, consequently it was less adapted to its position than that of Catania was to Rome. These facts prove that mathematical knowledge was not cultivated at Rome or in Italy.

It appears that sun-dials had been common in the days of Plautus. In a fragment of one of his comedies (*The Bœotian*) preserved by Aulus Gellius in his *Attic Nights*, he makes a parasite declaim against sun-dials in these terms:

> Ut illum dî perdant, primus qui horas reppert,
> Quique adeo primus statuit hic solarium.
> Qui mihi comminut misero articulatim diem,
> Nam me puero uterus erat solarium
> Multo omnium istorum et verissimum,
> Ubi iste monebat esse, nisi quum nihil erat.
> Nunc etiam quod est, non est, nisi Soli lubet.
> Itaque adeo jam oppletum est oppidum solariis.
> Major pars populi aridi raptant fame.
>
> The gods confound the man who first found out
> How to distinguish hours! Confound him, too,
> Who in this place set up a sun-dial,
> To cut and hack my days so wretchedly
> Into small portions. When I was a boy,
> My belly was my sun-dial; one more sure,
> Truer, and more exact than any of them.
> This dial told me when 'twas proper time
> To go to dinner, when I had aught to eat.
> But now-a-days, why, even when I have,
> I can't fall-to unless the sun give leave.
> The town's so full of these confounded dials,
> The greatest part of its inhabitants,
> Shrunk up with hunger, creep along the streets.
>
> *Translation of Plautus by Thornton and Warner.*

The Arabians, as they drew their knowledge of astronomy from the Greeks, so they also adopted their system of gnomonics without any material alteration. They studied the Analemma of Ptolemy, and found means of simplifying and diversifying his solutions. No nation attached more importance to gnomonics. Indeed, when there was no other way of knowing the hours, dials were in great request, particularly in southern climes; for in northern countries the shortness of the day for a great part of the year, and the uncertainty of sunshine, diminished much their utility. Abul-Hassan, who lived about the beginning of the thirteenth century, and one of their most modern writers, introduced among them equal hours, and taught how to trace them on dials; but he made but little use of them, and it does not appear that his invention was supported. He was also the author of a new way of describing the arcs of parallels. He invented a dial called *khaphir*, a word which means the hoof of a horse; the Greeks had no such dial. He made various others, to which particular names were given. He taught how to trace the progress of the shadow on plane, cylindrical, conic, and spherical surfaces. The Greeks, however, had preceded him in the construction of dials on conic surfaces. Dialling.

The writings of Abul-Hassan present a theory not to be found in the gnomonics of the Greeks, or any other Arabian writer, or in that of the moderns. He employed the properties of the conic sections to describe the arc of signs. It is true, Commandine and Clavius have also traced their arcs of signs by means deduced from the theory of these curves; but their mode of proceeding, very obscure, is not that of the Arabian. We do not find among them the universal dial of Regiomontanus, nor the analemmatic dials, which give the hour by the sun's altitude; nor had they any idea of the angles at the centre of different dials. We find these angles and different other novelties in the first European authors who have written on gnomonics; but these geometers do not say that they were the inventors of these happy innovations. There is therefore in the history of gnomonics a blank which cannot now be filled up. We see a marked progress, without knowing precisely to whom we owe the obligation. These discoveries probably preceded the invention of printing. The original works are lost, but tradition has handed down to us what was most useful in them. The oldest of these writers, Munster and Schoner, have affected to imitate the Arabs, in suppressing all demonstrations, as had been done by Albategnius and Ebn-Jounis. They have given constructions resting on principles nowhere demonstrated, and hence has arisen an obscurity not easily to be dissipated.

Among the first of the moderns who have treated of gnomonics may be reckoned John Stabius, Andrew Stiborius, and John Werner, astronomers of the fifteenth century. Their works however have never been printed. To these may be added John Schoner, an astronomer of the sixteenth century, who gave in 1515 a work entitled *Horarii cylindri Canones*, in which he treats of the construction of cylindrical dials. His other works on dialling were afterwards published by Andrew Schoner, his son. Some notions on modern gnomonics were given in a treatise on the Roman calendar, printed in 1518. This writer treats of a general horary square, after Regiomontanus, which supposes equal hours; so that these appear to have been established in the middle of the fifteenth century, and probably earlier. It appears from Stoffler, that in his time a new system of gnomonics had been formed, the author of which however is unknown.

Sebastian Munster, a cordelier, who had embraced the opinions of Luther, published at Basle, in 1531, a work with this title, *Compositio Horologiorum in plano muro, truncis, anulo concavo cylindro, et variis quadrantibus*, &c.; and again, in 1533, *Horologiographia post priorem editionem*. The author was born at Ingelheim in 1489, and died of the plague at Basle in 1532. He employs equinoctial hours, and supposes great circles to pass through the pole of the world perpendicular to the equator, dividing it into twenty-four equal parts. A plane which cuts all these circles shows the hours by its intersection with the different planes. Here then is a complete revolution in the theory of dialling; and doubtless the change had subsisted for some time; for he speaks with contempt of these vulgar constructors who, without any theory, blindly followed the rules and tables which had been given to them. It is very remarkable that so total a change should have taken place without the author being known; and not less so that the first author who printed a book on gnomonics should have given all his precepts without demonstration. Equinoctial hours were now substituted for temporary hours, a centre was given to the dial, an axis was substituted for the perpendicular style; centres and dividing

Dialling. radii were now introduced; all these changes could only have been made by a skilful geometer. Among the inventions of Munster was a moon-dial. It is not certain that he was the author of all the inventions which he describes, but at any rate he was the first to publish them.

The next writer to be noticed was Andrew Schoner. His book has the date 1562, with this title: *Gnomonice Andreæ Schoneri Noribergensis, hoc est de descriptionibus horologiorum sciatericorum omnis generis, &c. omnia recens natu et edita.* By the concluding words, the author seems to assert that all contained in his book was his own invention. This, however, could not be true of any thing contained also in the first or second edition of Munster's book, which preceded his by twenty-nine years. Schoner speaks of many learned men that had gone before him in the same science, and regrets that their labours were unknown. He cites Regiomontanus and others, but he does not name Munster. He was an enthusiast on his particular subject, and affirmed that dials could no more be dispensed with than meat and drink. He was an obscure writer, and communicated nothing new, unless in treating of inclining-declining dials, of which no mention is made by Munster, nor among the ancients. In the same century there came out other treatises on dialling, as by Benedict in 1574, Elie Vinet in 1564, John of Padua in 1582, and Valentino Pini in 1598. These do not seem to have added much to what was previously known.

In the following century we have a work on dialling by an astronomer, La Hire. The first edition came out in 1682, another in 1698. Montucla pronounces this book obscure, and Delambre agrees in his opinion; for La Hire merely indicates his demonstrations, and his constructions are so complicated that they are with difficulty understood. He never employs calculation, unless indeed in an appendix, which might be left out, without altering the character of the work. All his operations may be performed without any idea of even plane trigonometry. He employs only compasses, the rule, and the plumb-line. A dial may be traced by his directions, without knowing whether it be horizontal, vertical, east, west, declining, or inclining, and without the latitude of the place or the sun's declination being known. This plan is not the best for practice; but it was new, and therefore remarkable and deserving of notice. His constructions are often ingenious; but they have the essential fault of not admitting of much accuracy.

There is a treatise on gnomonics by Ozanam, of date 1693. It also forms a part of his *Cours de Mathematiques*, printed in 1697. This, in the opinion of Delambre, is a perspicuous work, and much superior for practice to that of La Hire.

The subject of dialling was greatly agitated in the course of the seventeenth century by all writers on astronomy. Thus a quarto volume of 800 pages, entirely on gnomonics, forms a part of the works of Clavius, printed in 1612. This may be supposed to contain all that was known before his time, as well as his own inventions. In this work he has demonstrated both the theory and practice, after the manner of the ancient mathematicians.

The eighteenth century produced some writers on dialling; but clocks and watches had by this time superseded sun-dials: their theory was well known and explained in all works on astronomy. The art of constructing them was now considered as a mathematical recreation. At this point we shall conclude their history.

The principal writers on dials and dialling are the following:—Ptolemy, restoration of his work on the *Analemma*, by Commandine; Vitruvius, in his *Architecture;* Sebastian Munster, in his *Horologiographia;* Orontius Fineus, *De Horologiis Solaribus*, &c.; Mutio Oddi da Urbino, *Gli Horologi Solari nelle Superficie Piane;* Dryander, *De Horologiorum varia Compositione;* Conrad Gesner's *Pandectæ;* Andrew Schoner's *Gnomonicæ;* F Commandine, *De Horologiorum Descriptione;* Joan. Bapt. Benedictus, *De Gnomonum Umbrarum Solarium Usu;* Joannes Georgius Schomberg, *Exegesis Fundamentorum Gnomoncorum;* Solomon de Caus, *Traité de Horologes Solaires;* Joan. Bapt. Trolta, *Praxis Horologiorum;* Desargues, *Manière Universelle pour poser l'Essieu et placer les Heures et autres Choses au Cadrans Solaires;* Ath. Kircher, *Ars magna Lucis et Umbra;* Hallum, *Explicatio Horologii in Horto Regio Londini;* Joan. Mark, *Tractatus Horologiorum;* Clavius, *Gnomonices de Horologiis;* the treatises of Deschales, Ozanam, Schottus, Wolfius (in his *Elementa*), Picard, Lahire, Walper, with additions by Sturmius, &c. In the German language there are treatises by Paterson, Michael, and Müller. Of English writers there are, Foster, *Horolographia* (in his works); Wells, *The Art of Shadows;* Collins, Leadbetter, Jones, Leybourn, and others. At a later period we have treatises by Emerson, by Ferguson in his Lectures, and others. Dialling.

The theory of dialling has sometimes been treated as a branch of perspective, as by Gravesand in *Essai de Perspective*, and Dr Horsley in his *Tracts on the Projection of the Sphere;* also, as a branch of analysis, by Kæstner in his *Gnomonica Universalis Analytica;* by MM. Sejour and Godin, in *Recherches Gnomoniques*, &c. Lastly, it has been referred to descriptive geometry, by Hachette, *Cours de Géométrie Descriptive.* Lefrançois, *Journal d'Ecole Polytéchnique*, 2d cahier. Delambre has treated of the subject in different parts of his *Histoire de l'Astronomie*, and in his *Astronomie Théorique et Pratique.* Biot has added a tract on it by Berroyer to his *Astronomie Physique.*

General Principles of Dialling.

1. The theory of dialling, to be fully understood, requires an acquaintance with some of the more simple doctrines of astronomy; also of the elements of geometry and plane and spherical trigonometry. However, a less extensive knowledge of pure mathematics will be sufficient for the construction of the more simple and common dials. A correct notion of the nature of an angle, and a knowledge of the elementary problems of practical geometry, viz. the drawing of parallels, perpendiculars, &c., and how to make an angle of any proposed number of degrees, also to measure an angle, will suffice for the mere geometrical construction of dials. The instruments required are compasses, a scale of chords, or a protractor for measuring angles, and a straight-edged rule. A globe is useful in giving distinct notions of the doctrine of the sphere, but may be dispensed with in the practice of dialling. A dialling scale facilitates the practice; and therefore instructions will be given by which it may be constructed.

2. The preliminary astronomical knowledge has been delivered in the article Astronomy. To avoid repetition; we must direct the attention of the reader to that article. He will find it in the first and second chapters of the Second Part; but it is only the definition of the circles of the sphere, and the description of the apparent motions, to which we shall have occasion to refer.

3. The apparent diurnal motion of the starry heavens is perfectly uniform. The sun's apparent diurnal motion about the earth's axis, however, deviates a little from perfect equality, by reason of his unequal angular motion in the ecliptic, and its obliquity to the equator; but these need not be attended to in the construction of a sun-dial. Their joint effect produces *the equation of time*, a correction which must always be applied to the time it indicates. We have given a table of its quantity for every day in the year at the end. Atmospheric refraction likewise might be taken into account, but in practice it is neglected. The construction of a dial is a graphical operation, subject to

Dialling. the imperfection of instruments and their application. The object in view is a practical method of finding a measure of time for the ordinary affairs of life; and for this, extreme accuracy is not required.

4. The mean distance of the earth from the sun is 23,984 times its semidiameter. Hence we may infer that all the phenomena of the solar motions, as seen from any part of the earth's surface, will be almost exactly the same as if they were seen from its centre, the difference being inappreciable by the nicest instrument; just as the apparent position of a spire or other object four miles distant, in respect of neighbouring objects, will not be in the least altered by a change of a foot in the position of the eye to either side of the point from which the object was first viewed. Hence it follows, that if we place in sunshine a globe on which the circles of the sphere are delineated, or, instead of a globe, a skeleton sphere, such as is represented in figs. 1 and 2 of Plate CC. formed of twenty-four equal wire circles, which all pass through the extremities of a common diameter P*p*, formed of some solid matter; and if these circles, in radiating from their intersections P, *p*, make equal angles round these points, just as the meridians do on the common terrestrial globe; then, if the axis P*p* be placed parallel to the earth's axis, the shadow projected by the axis will fall on the wires one after another at intervals of an hour, because the apparent angular motion of the sun about the axis P*p* will be uniform, just as it is about the imaginary axis of the earth.

This very simple instrument, if correctly made, and placed in a fixed position, with its axis directed to the pole of the world, which is near the pole star, and, moreover, with one of its circles in the plane of the meridian (that is, in a direction due north and south), would serve to divide the day into twenty-four equal portions. This is the most natural and elementary of all dials.

5. We have supposed our dial to be composed entirely of wires or material circles; and although the hour of the day will be known if the shadow of the axis be observed to fall on one of the circles, there will be an uncertainty as to the exact time when the shadow is passing between two circles. To remedy this, let us suppose that a plane ABCD, fig. 1, or AFCG, fig. 2, of some solid matter, is placed within the sphere, and passes through E its centre. The shadow of the axis PE will now be projected on this plane surface, and will be seen at all times in its progress from wire to wire. If now straight lines be drawn from the centre E to the points in which the plane DAB meets the wire circles, and the hours be marked on them as in the figures, it will be noon when the shadow falls along the line E XII., and eleven in the forenoon when it falls on E XI., and one in the afternoon when it falls on E I., and so on throughout the day. As the shadow on the plane will always be visible, any time intermediate between two hours may be guessed at nearly by the position of the shadow in respect to the lines on which it falls at the preceding and following hours.

6. It is evident that the plane BAD may have any position whatever within the sphere; the dial will still indicate the hours, supposing always that the axis P*p* is directed towards the north and south poles of the heavens. We may assume that the plane DAB is horizontal; then the lines drawn on the plane from the centre to the points in which it cuts the wires will constitute a *horizontal dial*. Such a dial, constructed as has been explained, for London, in latitude 51½°, is shown by fig 1. On the longest day the sun's centre rises at London forty-four minutes before four, and sets seventeen minutes after eight; therefore the extreme hours marked on the dial are IV. and VIII.

7. If again we suppose the plane AFG to be vertical, as in fig. 2, and that it faces the south, then we have a *south dial*. In this case the plane of the dial cannot be illuminated before six in the morning, nor after six in the evening; therefore these are the extreme hours marked on it. Dialling.

8. If the plane, which we have supposed to be in the inside of the sphere, were perpendicular to the axis, it would then pass through the equator in the heavens, and the result would be an *equinoctial dial*. In this case, the circle which forms the circumference of the dial would evidently be divided into equal parts by the wire circles; therefore the shadow would move with an uniform angular motion about the centre, just as the hour-hand of a watch does; and, moreover, it would be illuminated on the north side only in the summer, and on the south side in the winter. In the same way, by giving different positions to the plane, the student of this subject may get an exact conception of every other kind of dial.

9. It is sufficiently obvious, that when the points in which the circles cut the plane BAD (fig. 1) or FCG (fig. 2) have been once determined, and lines drawn from them to the centre, the circles are no longer necessary to the dial, which is then simply a plane; and although we have employed the hypothesis of material circles to represent the circles of the sphere, as being a convenient way of treating the subject, yet the intersection of the circles and the plane of the dial may be determined either by a geometrical construction or a numerical calculation.

10. It will now be proper to define certain terms which will frequently occur in treating this subject.

The plane ABCD (fig. 1), on which the lines that indicate the hours are drawn, is called the *plane of the dial*.

The material line PE, which rises out of the plane of the dial, and projects a shadow on it, and thereby indicates the hours, is called the *axis* of the dial. Instead of being a line or rod, it is sometimes the edge of a thin flat plate (as in fig. 3, 4, &c.) fixed on the plane of the dial; it is sometimes called the *gnomon*, also the *style*, of the *dial*.

The circles P*ap*, P*bp*, P*cp*, &c. also the circles of the celestial sphere which they represent, are *hour circles* (Astronomy, Part II. chap. 1). Of these, that which passes through the sun at noon is the *meridian*; the others are named from the hours, as the six o'clock hour circle, &c.

The lines E XI. E XII. E I. &c. which are the intersections of the hour circles and the plane of the dial, are called *hour lines*; that in the plane of the meridian, which indicates the hour of noon, is the *meridian line*.

The common intersection of the hour lines is called the *centre* of the dial. The angles which the hour lines make with the meridian lines are the *hour angles at the centre of the dial*; and the spherical angles which the hour circles make with the meridian are the *hour angles* at the pole. These are the same as the angles which the planes of the circles make with the meridian.

A *horizontal dial* is that which is delineated on a horizontal plane.

A *vertical dial* is that on a vertical plane. These may be *north*, *south*, *east*, or *west*, according to the quarter which they face.

Vertical declining dials are such vertical dials as do not face any of the cardinal points.

Inclining or *oblique dials* are those traced on planes which make oblique angles with the horizon. They are *reclining* when they lean backwards from an observer, and *proclining* when they project forward.

An equinoctial dial is that whose plane is parallel to the equator, or perpendicular to the earth's axis.

A polar dial is that traced on a plane perpendicular to the meridian, and passing through the poles.

Construction of Horizontal Dials by a Globe.

11. The manner in which the general principles of dial-

Dialling. ling have been explained shows directly how a dial may be constructed by means of a terrestrial globe. Let PE*p* be the axis of a globe (fig. 1), XII. E XII. the equator, and BAD its horizon. Suppose now the globe to be rectified for the latitude of any place, London for instance, which is in latitude 51½°; this is done by placing it in such a position that the arc of the brazen meridian between the pole and horizon is equal to the latitude. Then it is manifest, that if at London the brazen meridian of the globe be placed in the plane of the celestial meridian, its axis will point to the poles of the world; and if any one of the meridians on the globe be brought under the brazen meridian, all the meridians, supposing there are twenty-four, will correspond to hour circles in the heavens. In short, the meridians on the globe will correspond to the sphere formed of wire circles, its wooden horizon to the plane inserted within the sphere formed by the circles, and its axis to the axis of that sphere. Assuming now the line drawn from E, the centre of the globe, to the north point on the horizon as the twelve o'clock hour line, the angle XII. E I. which the one o'clock line makes with it at the centre of the dial, will have for its measure the arc of the horizon between the arc of the meridian P XII. and the arc P I. of the next hour circle. This will be about 11⅔°. In the very same way the hour angle XII. E II. at the centre will be measured by the arc of the horizon between the brazen meridian and the arc P II. of the two o'clock hour circle, and so on. The angles made by the forenoon hour lines and the meridian line are equal to those made by the corresponding afternoon hour lines and the meridian line; that is, the angle XI. E XII. to the angle I. E XII. and X. E XII. to II. E XII. &c. The morning and evening hour lines for VI. will both be perpendicular to the meridian; and it is easy to see that the morning hour line for V. will be the continuation of the afternoon hour line for V.; and that the hour lines for IV. and III. in the morning will be the prolongations of the lines for the same hours in the afternoon. In the same way the evening hours after VI. are determined from the morning hours.

12. If the globe have more than twenty-four circles (some have thirty-six), place the first meridian, which is that of London, under the brazen meridian, and set the moveable hour index to XII. at noon; then turn the globe westward until the index points successively to I. II. III. IV. V. and VI. in the afternoon, or until 15°, 30°, 45°, 60°, 75°, and 90° of the equator pass under the brazen meridian; and it will appear that the first meridian of the globe cuts the horizon in the following number of degrees from the north toward the east, viz. 11⅔°, 24¼°, 38 1/12°, 53½°, 71 1/15°, and 90°; these are the respective distances of the above hours from XII. on the plane of the horizon.

13. To transfer these and the rest of the hours to the plane of a horizontal dial (Plate CC. fig. 3), draw parallel straight lines *ac*, *bd*, distant from each other by the thickness of the style or gnomon; these, or the space between them, will mark the meridian or twelve o'clock line on the dial. Cross the double meridian line by the perpendicular *gabh*, and this will be the hour lines for VI. in the morning and evening.

About *a* and *b* as centres, with any convenient radius, describe quadrants of circles *eg*, *fh*, and divide each into ninety equal parts or degrees, as in the figure.

Because the hour lines are less distant from each other about noon than in any other part of the dial, it is convenient to have the centres of these quadrants at some distance from the centre of the surface on which the dial is delineated, to admit of more space for the hour lines about noon.

Lay a rule over *b*, and draw the hour line of I. through 11⅔° in the quadrant; the hour line of II through 24¼°; of III. through 38 1/12°; of IV. through 53½°; and of V. through 71 1/15°. Again, lay the ruler to the centre *a* of the quadrant *eg*, and through the like divisions or degrees of that quadrant, viz. 11⅔°, 24¼°, 38 1/12°, 53½°, and 71 1/15°, draw the forenoon hours of XI. X. IX. VIII. and VII. Extend the hour lines of IV. and V. in the afternoon through *b* across the dial, and the prolongations will be the hour lines of the same morning hours. In like manner, the prolongation of the hour lines of VIII. VII. of the morning hours through *a* will give the hour lines of the same evening hours. Dialling.

To form the style, draw a line from *a* through that degree of the quadrant *eg* which is the latitude of the place, in the present case 51½°. This line will determine the elevation of the style, which is represented in the figure by the shaded triangle, supposed to be of solid matter, and lying on the surface of the dial. The thickness of the style must be equal to *ab*, the breadth between the meridian lines. Let it now be placed truly upright on the dial, so as to stand on the space between them, and the dial will be finished. The style should be of such a height that its shadow at midsummer shall reach to the space on which the hours are marked.

Note. The trouble of dividing the quadrants will be avoided if you have a scale of chords, or protractor, and know how to lay down by them an angle of any given number of degrees. This is one of the simplest problems of practical geometry.

To construct a direct South Dial by a Globe.

14. Let PB*p*DF (fig 2. Plate CC.) be a globe on which twenty-four meridians or hour circles are marked, P and *p* being the north and south poles, and XII. E XII. the equator. Suppose now P*p*, the axis of the globe, to coincide with the axis of the world; and some one meridian on it, as PFD*p*, with the meridian of the place for which the dial is to serve; then if the globe be cut through the centre E, by a vertical plane AFCG, in an east and west direction, it is manifest that straight lines drawn from the centre to the points on which this plane meets the hour circles on the globe will be the hour lines of a south or north dial. The figure shows a south dial on the lower half of the circle, which is the common section of the circle and cutting plane, the hour lines being E VI. E VII. &c.; and E*p*, the southern half of the axis of the globe, is the axis of the dial. A north dial would just be its counterpart on the upper and opposite side of the plane.

15. By a comparison of fig. 1 and 2, it will appear that, as in fig. 1, the angle which the axis PE makes with DAB, the plane of the dial, is the latitude of the place; so in fig. 2, the angle which the axis *p*E makes with the plane FAGC is the complement of the latitude, or what it wants of 90°. Hence it follows that *a south dial for any given place will serve as a horizontal dial at a place whose latitude is the complement of that of the given place*, and *vice versa*. Indeed it is easy to see that, *if a dial be correctly constructed on any given plane for a given place, there will be some other place, which may be found, where that dial will serve as a horizontal dial.* And the reason is this; whatever be the position of a plane, there must be some place on the earth whose horizon is parallel to that plane. Now all dials whose planes are parallel, wherever they be situated on the earth's surface, have their axes parallel; therefore, at the same instant the angular motion of the shadow will be the same on them all. If the planes of dials which are parallel be perpendicular to the same meridian, they will indicate the same hour at the same instant. If they are not, the difference between the hours they indicate at any instant will be different, because of their difference of longitude.

16. From what has been explained, it is evident how the

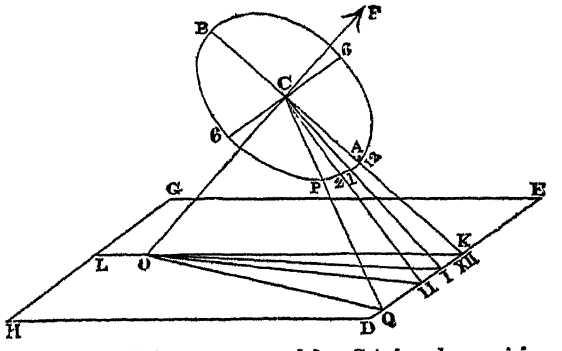
Dialling. south dial (fig. 7) is to be constructed for a given place, London for instance. Draw two vertical lines *ac*, *bd*, on the plane of the dial, for the twelve o'clock hour lines, so that the distance between them may be exactly the thickness of the style; cross them perpendicularly by the line VI. *a* VI.; this is the six o'clock hour line. On *a* and *b* as centres with any convenient distance describe quadrants, and divide each into ninety degrees. Rectify now the globe for the complement of the latitude of the place; bring a meridian or hour circle on the globe to the north point of the horizon, and (supposing there are twenty-four hour circles) note the degrees reckoned from the north on the horizon, in which it is intersected by the hour circles; these will be the angles which the hour lines make with the double meridian line at *a* and *b* the centre of the dial. Proceed in laying them down exactly as in making a horizontal dial; and it will only be necessary to lay down the hours from noon to six in the evening and the morning, because a vertical plane facing the south can never be illuminated earlier nor later.

17. We have explained the application of a globe to the construction of dials, less with a view to recommend it in practice, than to elucidate the theory. Other methods are better, because, with the best mounted globe, the hour angles at the centre of the dial cannot be determined with much accuracy. It will be better to compute the angles and lay them down from a scale of chords; or we may use a geometrical construction; or, lastly, we may lay down the hour lines by means of a dialling scale, the easiest method of any.

Geometrical Theory of Dialling.

18. It has been shown (art. 3 and 4) that if at any place a straight rod or wire be parallel to the earth's axis, in which position it may be considered as coinciding with the axis of the heavens, the angular motion of the sun about that rod will appear to be perfectly uniform throughout the day, and therefore the shadowy space within which the sun's light is wholly or in part intercepted by the rod will also turn uniformly about it. Hence, to construct a sun-dial, it is only necessary to place the rod so that its shadow may fall on a surface of any kind, and to trace on that surface, at any equal intervals of time (hours for instance), the line shown on the surface by the shadow at the instants which separate these intervals. These lines, numbered according to the hours, will serve to show time by the shadow at all seasons. This is the most simple way of constructing a dial, but it supposes that we have the means of dividing time into equal intervals, a thing indeed easy since the invention of clocks and watches.

To reduce the subject to a geometrical theory, let us suppose that, in the adjoining figure, OCF is the rod (considered as a material straight line) which projects the shadow, and that it is perpendicular to the plane of a



circle APB at C its centre, and let CA be the position of the shadow on the circle at noon. Then, if the circumference be divided into twenty-four equal parts, beginning Dialling. from A, as at 1, 2, &c., and lines be drawn from the centre through the points of division, it is manifest that the shadow will fall on the lines at the hours marked on them, and the circle will serve as a dial. And since its plane coincides with that of the equator in the heavens, it is an EQUINOCTIAL DIAL.

Equinoctial Dial.

19. To construct this dial (Plate CCII. fig. 6), on C, a point in the middle of its face, as a centre, describe a circle ABDE; divide the circumference into twenty-four equal parts, and from the points of division draw straight lines to the centre; these will be the hour lines; mark the hours on them as in the figure; fix a thin and straight wire in the centre, perpendicular to the face of the dial, for its style, and place it with the style directed to the pole, and the twelve o'clock hour line in the plane of the meridian; and when the dial is illuminated by the sun, the hours will be indicated by the shadow of the style.

20. In our climate the superior side of an equinoctial dial is illuminated when the sun is on the north side of the equator, and the inferior or opposite when he is on the south side. On the equinoctial days neither side will be illuminated, because the sun is in the plane of the dial. However, if it have a ledge rising a little above the opposite sides, and the hour lines be continued on the ledge, the shadow will fall on its inside, and indicate the hour, although the direction of the sun's rays be almost parallel to its face.

21. To set up an equinoctial dial, direct the straight edge of a vertical plane towards the polar star, which is about one degree thirty-six minutes from the pole of the world; it will then nearly coincide with the axis of the sphere; but for greater accuracy the edge may be directed to the star when highest or lowest, and a line drawn on the plane, making with its edge the above angle. This will be in the true direction of the axis of the dial, the plane of which must be placed perpendicular to the line so determined, and the six o'clock hours in a horizontal line: the dial will then be properly placed.

22. An equinoctial dial may be set up about the time of either solstice without knowing either the latitude of the place or the direction of the meridian, from this property, that when truly placed, the extremity of the shadow of the axis will then describe a circle on the plane of the dial, the centre being the common intersection of the hour lines. If, therefore, the dial be placed nearly in a true position, with the six o'clock hour line exactly horizontal, by observing the line which is the extremity of the path of the shadow, it will be seen in which way the deviation from the true position lies, and by repeated adjustment it may be truly placed. About the equinoxes the daily path will deviate somewhat from a circle, by reason of the quick change in the sun's declination.

Horizontal Dial.

23. Let GEDH (see the adjoining figure) be a horizontal plane on which a dial is to be delineated, and let LOK be a meridian line on this plane; let OCF be a material line or rod in the plane of the meridian, which meets the horizontal plane in O, and makes with OK an angle equal to the latitude of the dial: this rod will be directed to the pole, and will be the axis of the dial. Let BAP be an equinoctial dial, having OCF for its axis, and C for its centre; and let CA, the meridian line on this dial, meet the meridian line on the horizontal plane in K. As has been explained, the plane of the shadow will turn uniformly about the axis OCF, meeting the equinoctial plane in some line CPQ, and the horizontal plane in a correspond-

Dialling. ing line OQ. Let C1, C2, &c. be the hour lines after noon on the equatorial dial, and O I. O II. &c. the corresponding hour lines on the horizontal dial; the former will make with the meridian line OAK angles proportional to the time from noon, and will be known when the hour is given, 15 degrees being reckoned an hour. The plane of the equinoctial dial being supposed extended to meet the horizontal plane in the line QK, which will be at right angles to the meridian lines CK, OK, the problem to be now resolved is, to find the hour angle KOQ at the centre of the horizontal dial corresponding to any given angle KCQ at the centre of the equinoctial dial, which measures the time from noon.

The triangles CKQ on the equinoctial plane, and OKQ on the horizontal plane, have a common side KQ, and each a right angle at K; therefore, by trigonometry,

CK : KQ = rad. : tan. KCQ,
and KQ : OK = tan. KOQ : rad.,
therefore *ex. æq.* CK : OK = tan. KOQ : tan. KCQ.

But in the triangle COK, right angled at C,

CK : OK = rad. : sin. OCK,
therefore rad. sin. OCK = tan. KOQ : tan. KCQ.

Hence we have this general theorem or rule for computing the hour angles at the centre of a horizontal dial: *As radius to the sine of the latitude, so is the tangent of the hour from noon (reckoning* 15° *to an hour) to the tangent of the hour angle at the centre of a horizontal dial;* or, putting x for the hour from noon in degrees, y for the hour angle at the centre of the dial, L for the latitude of the place, Dialling.

$$\tan. y = \frac{\tan. x \sin. L}{\text{rad.}} \quad \text{.....(1.)}$$

We have supposed GHDE to be a horizontal plane, but the formula evidently applies to any plane whatever perpendicular to the meridian: all that is required for its application is the angle which the axis OF makes with the meridian line OK on the plane.

As an example, let it be required to find the hour angle at the centre of a horizontal dial for XI. or I. o'clock for the latitude of London 51½°. In this case the hour angle from noon at the pole is 15°.

As rad.....	10·00000
To sin. 51° 30'.....	9·89354
So is tan. 15°.....	9·42895
	19·32159
To tan. 11° 51'.....	9·32159

Here we have found that the hour lines of XI. and I. must each make an angle of 11° 51' with the meridian line at the centre of the dial.

24. In this way the following table has been computed for every half degree of latitude from 50° to 59° 30', which are the limits of Britain.

Table of the Angles which the Hour Lines on a Horizontal Dial make with the Meridian for every half degree of latitude from 50 *to* 59½°.

Latitude.	Mor. H. XI. Af. H. I.	Mor. H. X. Af. H. II.	Mor. H IX. Af. H. III.	M. H. VIII. Af. H. IV.	M. H. VII. Af. H. V.	M. H. VI. Af. H. VI.
50° 0'	11° 36'	23° 51'	37° 27'	53° 0'	70° 43'	90 0
50 30	11 41	24 1	37 39	53 12	70 51	90 0
51 0	11 46	24 10	37 51	53 23	70 59	90 0
51 30	11 51	24 19	38 3	53 35	71 6	90 0
52 0	11 55	24 28	38 14	53 46	71 13	90 0
52 30	12 0	24 37	38 25	53 57	71 20	90 0
53 0	12 5	24 45	38 37	54 8	71 27	90 0
53 30	12 9	24 54	38 48	54 19	71 34	90 0
54 0	12 14	25 2	38 58	54 29	71 40	90 0
54 30	12 18	25 10	39 9	54 39	71 47	90 0
55 0	12 23	25 19	39 19	54 49	71 53	90 0
55 30	12 27	25 27	39 30	54 59	71 59	90 0
56 0	12 31	25 35	39 40	55 9	72 5	90 0
56 30	12 36	25 43	39 50	55 18	72 11	90 0
57 0	12 40	25 50	39 59	55 27	72 17	90 0
57 30	12 44	25 58	40 9	55 36	72 22	90 0
58 0	12 48	26 5	40 18	55 45	72 28	90 0
58 30	12 52	26 13	40 27	55 54	72 33	90 0
59 0	12 56	26 20	40 36	56 2	72 39	90 0
59 30	13 0	26 27	45 45	56 11	72 44	90 0

In this table the angles which the hour lines of V. IV. III. make with the meridian are not put down, because they are the same as those of the like hours in the afternoon, the former being the continuation of the latter; a similar remark applies to the hour lines of VII. VIII. IX. in the evening, which are the continuation of the like morning hours.

The use of the table is obvious. For example, if the angles of the hour lines at the centre of a dial for 56° of latitude be required, the table shows that the hour lines of XI. and I. make angles of 12° 31' with the meridian, and the hour lines of X. and II. angles of 25° 35', and so on. If the latitude is not exactly contained in the table, proportional parts may be taken, without any sensible error. Thus, if the hour line angles of a horizontal dial for 55° 42' be required, the table gives 12° 27' for the angle of the XI. or I. o'clock line in lat. 55° 30', and 12° 31' in lat. 56°: the difference of the angles corresponding to 30' difference of latitude is 4'. Now the proposed latitude exceeds the least of these two by 12', therefore we state this proposition 30 : 12 = 4' : $\frac{4 \times 12}{30}$ = 1'·6. Hence we find that 12' of addition to the latitude gives 1'·6, or nearly 2 of addition to the hour angle, which will therefore be 12° 29'.

Dialling.

Geometrical Construction of a Horizontal Dial.

25. The formula of art. 23, namely, that the tangent of the angle which any hour line makes with the meridian line is a fourth proportional to radius, the sine of the latitude, and the tangent of the hour angle at the pole (that is, the hour from noon in degrees), reduces the construction of a dial to this geometrical problem.

Having given any angle, to find another whose tangent shall have to that of the former a given ratio. This problem may be resolved graphically in various ways, and in as many ways may the hour lines on a dial be determined.

First Construction.

26. Draw two parallel straight lines CM, C′M′ (Plate CC. fig. 5) at a distance equal to the thickness of the style for the double meridian line, and cross them at right angles by the six o'clock hour line VI. C′C VI. Make a right angled triangle HCK (fig. 6), having K a right angle, and C equal to the angle which the axis of the dial is to make with its plane, that is, to the latitude of the place, which for London is $51\frac{1}{2}°$. About C and C′ (in fig. 5) as centres with a radius equal to CH, the hypothenuse of the triangle CKH (fig. 6), describe the quadrants M6, M′6; and about the same centres, with a radius equal to HK, the side of the triangle opposite to C, describe concentric quadrants, as in the figure; divide these each into six equal parts at the points 11, 10, 9, &c. on one side of the meridian line, and at 1, 2, &c. on the other side. From the points of division in the inner quadrant draw lines parallel to the meridian line, and from those in the outer quadrant draw lines parallel to the six o'clock line, so that the lines drawn from the corresponding divisions in the concentric quadrants may meet, viz. those from 11 in *a*, from 10 in *b*, &c. on one side, and those from 2 in *a*, from 3 in *b*, &c. on the other side; draw straight lines C′ XI. C I. through the points *a* and *a* on each side of the meridian line, and these will be the hour lines of XI. and I. In like manner, draw straight lines C′ X. C II. through *b* and *b*, and these will be the hour lines of X. and II. and so on. Extend the morning hour lines of VII. VIII. and IX. across the dial, and the prolongations will be the hour lines of the same hours in the evening; and in like manner form the hour lines of V. IV. III. in the morning from the same afternoon hours. The style CLM (fig. 6) must have the angle at C equal to the latitude, and may be formed from the triangle CHK (see art. 23).

27. To demonstrate the truth of this construction, let CB (fig. 5) be any one of the hour lines determined by the intersection of DB a parallel, and EBA a perpendicular to the meridian line, drawn from corresponding points D, E in the concentric quadrants. The points C, D, E will be in a straight line; and from similar triangles,

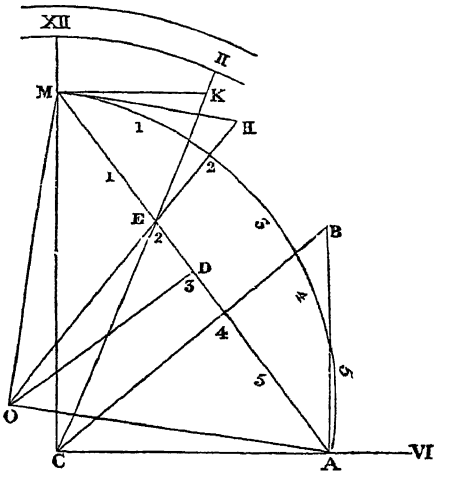
$$AE : AB = CE : CD = CH : HK \text{ (fig. 6).}$$

Now AE is to AB as the tangent of ACE, the hour from noon (in degrees) to the tangent of ACB, the angle made by the hour line and the meridian, and CH is to HK as radius to the sine of the latitude: Therefore (art. 23) the hour line is rightly determined.

Second Construction.

28. In the following figure let C be the centre of the dial, CM the XII. and CA the VI. o'clock hour lines. Make the angle MCB equal to the latitude of the place. Take CB of any length, and draw BA perpendicular to CA; make CM equal to CB, and join MA; bisect MA in D; draw DO perpendicular to MA, and equal to DM or DA; join OM, OA; and about O as a centre, with OM or OA (which are equal) as a radius, describe the quadrant M3A, and divide it into six equal parts at the points 1, 2, 3, 4, 5. These are to correspond to hours; but each may be subdivided into quarters, or other smaller parts of an hour.

Dialling.



Now, to determine any hour line, for example, that of II. o'clock; draw a straight line OH from O to the division 2 of the quadrant, meeting MA in E; next draw a straight line CK from C through E, and this will be the hour line for II. Exactly in the same way all the other hour lines for the afternoon, and by a like construction on the other side of the meridian those for the forenoon, may be found.

29. To demonstrate this construction, draw MK perpendicular to CM, meeting CE in K, and MH perpendicular to OM, meeting OE in H. The triangles OAE, HME, are manifestly equiangular; so also are the triangles CAE, KME;

$$\text{therefore } MH : OA = ME : AE = MK : AC.$$

Now, by trigonometry, making MO radius,

$$MH : OA = \text{tan. } MOH : \text{tan. } OMA.$$

And making MC radius; MK : AC = tan. MCK : tan. AMC.
Therefore tan. MOH : tan. OMA = tan. MCK : tan. AMC.
And by alter. tan. MOH : tan. MCK = tan. OMA : tan. AMC.

That is, because tan. OMA = radius,

$$\text{tan. MOE} : \text{tan. MCE} = \text{rad.} : \text{tan. AMC.}$$

But rad. : tan. AMC = CM or CB : CA = rad. : sin. CMA; therefore, radius is to the sine of CMA, the latitude, as the tangent of MOA, the hour angle from noon, to the tangent of MCE; hence (art. 23) CE is the hour line required.

30. If OD be made the radius of a circle, DE will evidently be the tangent of the hour angle, reckoned from three o'clock; and in general, the segment between the middle of AM and the point in which any hour line cuts it, will be the tangent of the interval in time between that hour and three o'clock. If therefore these tangents be laid down on a scale, which may be called the *scale of hours*, it will serve for the construction of all dials whatever.

It has been shown that CM is to CA as radius to the sine of the latitude; but CM is to CA as radius to the tangent of CMA, therefore the tangent of CMA is equal to the sine of the latitude; so that the latitude being known, the angle CMA may be found by inspection in the trigonometrical tables. Let this angle be v, then AC $= AM \times \frac{\text{sin. } v}{\text{rad.}}$ is known. From this formula, a second scale, which shall show the length of AC for every degree of latitude, may be formed; this may be called the *scale*

Dialling. *of latitudes*, and, with the scale of hours, will serve for the construction of all dials.

Construction of Dialling Scales.

31. Scales for the construction of dials may be either made entirely by a geometrical construction, or their divisions may be computed by trigonometry, and laid down from a scale of equal parts.

If a geometrical construction is used (Plate CC. fig. 8), divide AD a quadrant of a circle into six equal parts, at 1, 2, 3, &c., each of these may be again divided into four (these, however, are not shown in the figure). Draw a straight line from E, the centre, to 3, the middle point of division, and draw *r*3*s* perpendicular to E3; also straight lines from the centre through A, D, the extremities of the quadrant, meeting the perpendicular in *r* and *s*; and against these marks put XII. and VI. Draw straight lines from E through the intermediate division 1, 2, &c. and where they meet *rs* mark I. II. III. IV. V. The line *rs* thus divided is the *scale of hours*.

32. Divide CD, another quadrant of the circle, into 90 equal parts (only every tenth division is shown), and from the points of division draw perpendiculars to the radius EC; these cut off distances E10, E20, &c. which are equal to the sines of 10°, 20°, &c. and EC is a *line of sines*.

33. Draw straight lines from D through 10, 20, &c. the bottoms of the perpendiculars on EC, and produce them to meet the circle in *a*, *b*, &c.; transfer the chords of the arcs B*a*, B*b*, &c. to the line BC, and mark the divisions 10, 20, &c.; there will thus be formed the *scale of latitudes* BC.

34. Transfer the chords of the arcs D10, D20, &c. or of A10, A20, &c. arcs equal to them, to the line AB, thus forming a *scale of chords* AB. The scales of hours, latitudes, and chords, are shown together in fig. 9.

35. The dialling scales may also be constructed by laying down the divisions from a good scale of equal parts, and the numbers in the two following tables, of which the first gives the distances of the divisions on the scale of latitudes, in thousandth parts of the whole length of the scale; and the second gives, in the same equal parts, the distances of the divisions on the scale of hours, from the beginning, XII. to every fifth minute of each hour.

Distance of Divisions from beginning of Scale of Latitudes.

D.	Parts.	D.	Parts.	D.	Parts.	D.	Parts.
1	24·7	22	496·1	43	796·8	63	940·8
2	49·3	23	514·6	44	806·7	64	945·4
3	73·9	24	532·8	45	816·5	65	949·6
4	98·4	25	550·5	46	825·9	66	953·9
5	122·8	26	567·8	47	834·8	67	957·8
6	147·0	27	584·6	48	843·6	68	961·5
7	171·1	28	601·0	49	851·9	69	965·1
8	194·9	29	616·9	50	860·0	70	968·5
9	218·6	30	632·5	51	867·8	71	971·6
10	241·9	31	647·5	52	875·3	72	974·5
11	265·0	32	662·2	53	882·5	73	977·4
12	287·9	33	676·4	54	889·5	74	980·1
13	310·4	34	690·2	55	896·2	75	982·5
14	332·5	35	703·6	56	902·6	76	984·8
15	354·3	36	716·6	57	908·8	77	986·9
16	375·8	37	729·2	58	914·7	78	988·8
17	396·9	38	741·4	59	920·3	79	990·6
18	417·6	39	753·2	60	925·8	80	992·4
19	437·8	40	764·7	61	931·1	85	998·2
20	457·7	41	775·8	62	936·0	90	1000·0
21	477·3	42	786·5				

Distance of Divisions from beginning of Scale of Hours. Dialling.

Hours and Minutes.	Parts.	Hours and Minutes.	Parts.	Hours and Minutes.	Parts.
XII. 0	0·0	II. 0	517·7	IV. 0	896·5
5	30·3	5	534·1	5	913·1
10	59·1	10	550·4	10	930·0
15	87·0	15	566·4	15	947·1
20	113·8	20	582·4	20	964·5
25	139·6	25	598·3	25	982·0
30	164·5	30	614·0	30	1000·0
35	188·8	35	629·6	35	1018·3
40	212·0	40	645·2	40	1036·9
45	234·6	45	660·8	45	1055·8
50	256·7	50	676·3	50	1075·2
55	278·0	55	691·7	55	1095·0
I. 0	298·8	III. 0	707·1	V. 0	1115·4
5	319·2	5	722·5	5	1136·2
10	339·0	10	737·9	10	1157·5
15	358·4	15	753·4	15	1179·6
20	377·3	20	769·0	20	1202·2
25	395·9	25	783·6	25	1225·4
30	414·2	30	800·2	30	1249·7
35	432·2	35	816·0	35	1274·6
40	449·8	40	831·9	40	1300·4
45	467·1	45	847·8	45	1327·2
50	484·8	50	863·8	50	1355·1
55	501·1	55	880·1	55	1383·9
				VI. 0	1414·2

Construction of a Horizontal Dial by the Scales or the Tables.

36. Draw two parallel straight lines *ac*, *bd*, at a distance equal to the thickness of the style of the dial (Plate CC. fig. 4), for the double meridian line, and across them, at right angles, draw *fabe*, the six o'clock hour line. Supposing the dial is to be for London, in latitude 51½°, make *be* and *af* each equal to the distance from 0 to 51½ on the scale of latitudes (fig. 9), and place between the points *e*, *f* and the meridian lines, straight lines *ed*, *fc*, each equal to the whole length of the scale of hours, viz. from XII. to VI.; make *c*1 and *d*1 each equal to the distance from XII. to I.; and through the points 1, 1 draw *a*XI. and *b*I. for the eleven and one o'clock hour lines. In like manner, make *c*2 and *d*2 equal to the distance XII. II., and draw the hour lines *a*X. *b*II. and so on, for the remaining hour lines; the quarters and lesser divisions are to be laid down in the same way. The lines for the hours before VI. in the morning, and after VI. in the evening, are to be drawn as directed in art. 26.

37. If a common scale of equal parts and the tables be used, then make *be* and *af* each equal to 871·5 equal parts, this being the mean between the numbers for 51° and 52° in the table for the scale of latitudes; the lines *ed* and *ac* must in all cases be each 1414·2 from the same scale; and the distances *d*1 and *c*1 each 298·8; and *d*2, *c*2 each 517·7, these being the distances for 1 and 2 from the beginning of the scale (see Table). The distances of 3, 4, 5 from *c* and *d* must be 701·7, 896·5, and 1154·4 equal parts respectively, as appears by the table; and in this way the points in *de*, *cf*, through which the hour lines pass, also the lines for every fifth minute, may be readily found, and the corresponding divisions transferred to the circumference of the dial.

Vertical North and South Dials.

38. These dials are represented in figs. 1 and 2 of Plate CII. It has been explained in par. 15 that south and north dials for a given latitude would be horizontal

Dialling. dials if carried to a place whose latitude is the complement of that latitude; so that a south dial for latitude 51½° would be a horizontal dial for 38½°. This principle, first discovered by the Arabian writers on gnomonics, enables us to apply all that has been here taught concerning horizontal dials to those directly facing the south and north.

39. If we put x to denote the hour angle in the heavens, reckoned from noon either way, and y for the angle which any hour line on a north or south dial makes with the meridian line, and L for the latitude; the formula for determining trigonometrically the hour lines on a north and south dial will be

$$\text{tan. } y = \text{cos. L tan. } x \ldots\ldots\ldots\ldots (2.)$$

In north latitudes, a north dial can only be illuminated when the sun has north declination, that is, from about 21st March to 22d September; and the nearest times to noon which can be shown by it are those at which the sun crosses the prime vertical on the day of the summer solstice. A south dial can never be illuminated before six in the morning, nor after six in the evening; because when the sun rises earlier and sets later, he never crosses the prime vertical so early as six in the morning, nor so late as six in the evening. It will therefore be needless to describe on either more hours than can be wanted.

40. Supposing a dial to be traced on a thin material plane, it is easy to understand that a direct north dial is only the back of a direct south one; so that if the hour lines of one of them were cut through it, and extended, they would form on the opposite side the hour lines of the other, and the style of the one dial produced would form the style of the other dial.

Vertical East and West Dials.

41. These are described on vertical planes facing due east and west; therefore their planes coincide with the meridian, and pass through the poles of the world. Fig. 8 and 9, in Plate CCII. represent east and west dials. In fig. 8, let HR be a horizontal line on a plane facing due east, and *ab* a line in the direction of the earth's axis crossing it at *c*. Through this point draw EQ perpendicular to *ab*, then EQ will be in the plane of the equinoctial circle in the heavens.

Suppose now that at any two points *a*, *b* in the line directed to the pole there are wires of equal length fixed perpendicular to the plane of the dial, and that their tops are joined by a third wire, so as to form a rectangle A*ab*B (see fig. 10), one side of which *ab* is on the face of the dial, and the opposite side AB is parallel to it and directed to the pole. The earth's radius being as nothing when compared with the sun's distance, it follows that the angular motion of the sun about the line AB will be uniform, just as it is about the earth's axis, and therefore that the shadow of the line will turn uniformly about it as an axis, and its projection on the dial will always be perpendicular to the line EQ. It will now be easy to understand, that at six in the morning the shadowy plane will be perpendicular to the plane of the dial, and will fall on the line *ab*; and that, as it turns uniformly about its axis, it will cut off from *c*Q lines which will be the tangents of the angles generated by the shadow, that is, the tangents of the hour angles from six.

The same will be true of a west dial (see fig. 9); the hour lines of both will be perpendicular to EQ, the line in which the plane of the equator intersects the plane of the dial; and if d be put for the height of the rod AB above the dial, x for the hour angle from six o'clock, and y for the distance of the hour line reckoned on EQ either way from *c*, then, supposing radius = 1, the formula for the dial will be

$$y = d \text{ tan. } x \ldots\ldots\ldots\ldots (3.)$$

Geometrical Construction of Vertical East and West Dials. Dialling.

42. On the east and west vertical plane (fig. 8, 9) draw the horizontal line HR, and at an assumed point *c* in that line draw a straight line *acb*, so as to make with it an angle equal to the latitude of the place, and directed, in each dial, towards the north. This line is to serve as the six o'clock hour line, over which the rod or wire AB is to be placed on its supports, A*a*, B*b*, as the style of the dial. In the line *acb* take *cb* equal to B*b*, the height of the style. About *b* as a centre, with a radius equal to *bc*, describe a semicircle, and divide each quadrant into six equal parts: draw E*c*Q perpendicular to *bc*, and from *b*, through the points of division of the circle, draw straight lines, producing them until they meet the line EQ. Through the points of intersection draw perpendiculars to EQ, which will be the hour lines; against these the hours are to be written as in the figures. At the points *a* and *b* erect the supports of the style perpendicular to the plane of the dial, and each equal in length to the line *bc*, and over them place the rod AB, and the dial is finished.

43. The east dial will show the hours from sunrise until near noon, and the west dial from a little after noon until sunset; but neither can indicate the exact time of noon by a shadow, because then it goes off parallel to their planes.

Polar Dial.

44. This dial is shown in fig. 3, Plate CCII. It is described on a plane perpendicular to the meridian, and passing through the poles. It has a great affinity with east and west dials; for if a prism with six rectangular faces were placed with its axis directed to the pole, and two of its faces due east and west, the remaining two would form planes for polar dials, and the face directed to the pole would serve as the plane of an equinoctial dial.

45. The style of a polar dial, like that of an east or west dial, must be parallel to its face, and may have the same form (see fig. 10). To construct it, draw *ab* in the plane of the meridian for the twelve o'clock hour line, and cross it at right angles by the horizontal line HR. The hour lines are to be found exactly as in the east and west dials, and marked with the hours as in the figure.

A polar dial may, if it be of sufficient extent, show time from a little after six in the morning to a little before six in the evening. At the hours of six the sun is in the plane of the dial, and the shadow parallel to its face.

Putting x to denote the hour from noon, and y for the distance of the hour line from the meridian line, and d for the height of the style above the plane of the dial; the formula for a polar dial is

$$y = d \text{ tan. } x \ldots\ldots\ldots\ldots (4.)$$

Vertical Declining Dials.

46. It seldom happens that an upright wall faces exactly one of the cardinal points; therefore, in general, a dial described on the plane of a wall will be a vertical declining dial.

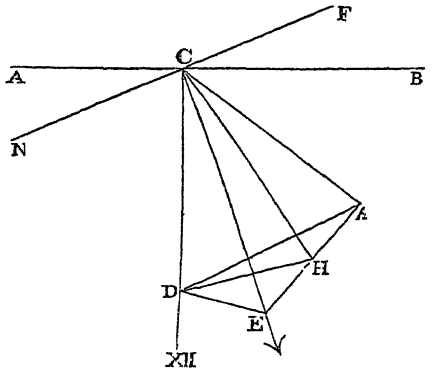
47. The *declination* of a plane is an arch of the horizon between the plane and the prime vertical; or it is the arch between the meridian and a plane perpendicular to the dial plane, and is always reckoned from the south or north.

48. The *meridian* of a plane is the meridian perpendicular to the plane of the dial. This differs from the meridian of the place, which is the meridian that is perpendicular to the horizon.

The *substyle* of a dial is the common section of its plane and the plane of its meridian, or it is the line in which perpendiculars drawn from every point in the axis of the dial meet its plane. In horizontal and in vertical south and north dials, the substyle coincides with the twelve o'clock hour line; but not in declining dials.

Dialling. The *difference of longitude* of a dial plane is the angle which the plane of its meridian makes with the meridian of the place.

The *latitude* of any dial plane is the angle which the axis makes with the plane; which is also the latitude of the place where the dial would be a horizontal one.



49. In the adjoining figure let AB be a line drawn on a vertical plane, a wall, for instance. It may have any aspect, but, to fix our ideas, let us suppose it to face some point between the south and west; let CE be the style or axis fixed at C in the wall in the direction of the earth's axis; draw the vertical line CD on the plane, and from E, the extremity of the style, draw ED perpendicular to CD; the plane of the triangle CDE will manifestly coincide with the meridian, and CD will be the twelve o'clock hour line on the dial.

Let NCF be a horizontal line passing through C due east and west; conceive a plane to pass along NF and the vertical line CD; this will coincide with the prime vertical in the heavens. Let us now suppose that at some hour, for example two in the afternoon, the horary plane (that is, the plane passing through the sun and the axis CE) meets the plane of the dial in the line CH, and the plane of the prime vertical in C*h*; the first of these lines will be the hour line of two on the dial to be constructed, and the second the line of the same hour on the prime vertical, that is, on a vertical south dial. Now by the theory of that dial (art. 38) the angle DC*h* will be known; it is, however, the angle DCH that is required in order to construct the dial under consideration.

50. Suppose a horizontal plane to pass along ED, and meet the horary plane in the line EH*h*, the plane of the dial in DH, and the prime vertical in D*h*; the plane ED*h* may now be regarded as that of a horizontal dial, of which EC is the axis, E the centre, and ED the meridian line; and on this dial EH will be the hour line of two; but for any given hour, the angle DEH will be known by formula 1, art. 23. And because the horizontal lines DE, D*h* lie, one in the plane of the meridian CDE, and the other in the plane of the prime vertical CD*h*, which is perpendicular to the former, the angle ED*h* will be a right angle; now the angle HD*h*, or its equal BCE, is the declination of the dial plane (art. 46), and therefore is given, or may be found; therefore the angle EDH, its complement, is known; and hence

51. All the angles of the triangle DEH are known.

Let L denote the latitude of the place for which the dial is to be made; D, the angle HD*h* or BCE, the declination of the plane; and E the angle made by the meridian ED of the assumed horizontal dial, and EH the hour line; then, in the triangle DEH we have the angle at E (denoted by E), the angle EDH = 90 — D, and therefore the third angle DHE = 180 — (E + 90 — D) = 90° — (E — D).

In the right-angled triangles CDE, CDH (which have CD, one of the sides about the right angle, common to both), by trigonometry, Dialling.

DE : DH = tan. DCE or cot. DEC : tan. DCH.

But in the triangle DEH,

DE : DH = sin. DHE : sin. DEH = cos. (E—D) : sin. E;

therefore, cos. (E — D) : sin. E = cot. DEC : tan. DCH.

Now the first three terms of this proposition are known, because the angles E and D are given, and also the angle DEC, which is the latitude; therefore the fourth term, viz. the tangent of DCH, is known; and hence the angle DCH, between the hour line CH on the dial and the meridian line CD, is known. Thus may all the angles made by the hour lines and the meridian of the dial be determined by plane trigonometry.

52. This way of finding the hour lines requires two operations for each, viz. one to find the angle DEH at the centre of the auxiliary horizontal dial; and a second to find the angle DCH at the centre of the dial to be constructed. We shall now investigate a formula which gives each angle by a single operation, when two subsidiary quantities common to them all have been found.

For any vertical declining dial let

L = latitude of the place;

D = BCE, the declination of the dial plane reckoned from the east towards the south;

x the variable horary angle described by the sun since noon;

y the corresponding angle DCH at the centre of the dial; and, as before, put E for the angle described at the centre of a horizontal dial for the same latitude in the time x.

From what has been shown in the preceding articles, we have

$$\text{tan. } y = \frac{\text{cot. L sin. E}}{\text{cos. (E—D)}} \quad \text{.....(1.)}$$

$$\text{tan. E} = \text{sin. L tan. } x \quad \text{.....(2.)}$$

In formula (1), instead of cos. (E — D), put its equal cos. E cos. D + sin. E sin. D (ALGEBRA, art. 239), then divide the numerator and denominator by cos. E, and lastly, put tan. E instead of $\frac{\text{sin. E}}{\text{cos. E}}$; the formula will then be transformed to this,

$$\text{tan. } y = \frac{\text{cot. L tan. E}}{\text{cos. D} + \text{sin. D tan. E}}$$

Now put sin. L tan. x instead of tan. E; and again $\frac{\text{sin. } x}{\text{cos. } x}$ instead of tan. x; we then have

$$\text{tan. } y = \frac{\text{cot. L sin. L sin. } x}{\text{cos. } x \text{ cos. D} + \text{sin. L sin. } x \text{ sin. D}} \quad \text{..(3.)}$$

Let P denote a subsidiary angle, such, that

$$\text{tan. P} = \text{sin. L tan. D} = \frac{\text{sin. L sin. D}}{\text{cos. D}};$$

$$\text{then cos. D} = \frac{\text{sin. L sin. D cos. P}}{\text{sin. P}};$$

this value of cos. D being substituted, instead of it, in formula 3, we get

$$\text{tan. } y = \frac{\text{cot. L sin. P}}{\text{sin. D}} \cdot \frac{\text{sin. } x}{\text{cos. } x \text{ cos. P} + \text{sin. } x \text{ sin. P}} \quad (4.)$$

The denominator of this last fraction is manifestly cos. (P—x). Hence we have the following simple formula for computing the angle which the shadow of the axis of any vertical declining dial describes in any time before or after noon.

$$\text{tan. } y = \frac{\text{cot. L sin. P}}{\text{sin. D}} \cdot \frac{\text{sin. } x}{\text{cos. } (x—\text{P})}$$

This formula gives the afternoon hours on a vertical

Dialling. south dial declining towards the west; but we have only to suppose the angles D and x to vary, and attend to the change of sign of sin. x and cos. (x—P), and the formulæ will be adapted to the forenoon hours.

53. If we suppose D, the declination of the plane, to decrease, the dial will approach to a south dial; and since $\frac{\text{tan. P}}{\text{tan. D}} = \frac{\text{sin. L}}{\text{rad.}}$, as D decreases, P will decrease (since L is constant), and they will vanish together, so that ultimately the fraction

$$\frac{\text{sin. P}}{\text{sin. D}} = \frac{\text{tan. P}}{\text{tan D}} \frac{\text{cos. P}}{\text{cos. D}} = \frac{\text{sin. L cos. P}}{\text{cos. D}}$$

becomes simply $\frac{\text{sin. P}}{\text{sin. D}} = \text{sin. L} = \frac{\text{cos. L}}{\text{cot. L}}$, and the preceding formula becomes, when D = 0,

$$\text{tan. } y = \text{cos. L tan. } x,$$

agreeing with the formula for a south dial (art. 39).

54. When the dial declines to the east instead of the west, that the formula may apply, we assume that D is negative; then sin. D and tan. D will be negative (Algebra, art. 225); and since tan. P = sin. L tan. D, we must in the formula make the sign of P negative, and it will in this case be

$$\text{tan. } y = \frac{\text{cot. L sin. P}}{\text{sin. D}} \cdot \frac{\text{sin. } x}{\text{cos. } (x+\text{P})}$$

for the afternoon hours.

55. On the whole, we have this formula for the construction of all south vertical declining dials.

Let L denote the latitude of the dial,
D the declination, which may be west or east,
x the hour angle from noon (15° to an hour),
y the hour line angle from the meridian line on the dial.

Find these two auxiliary quantities, viz. an angle P, and the tangent of an angle Q (of which only the logarithm is required), such, that

$$\text{tan. P} = \frac{\text{sin. L tan. D}}{\text{rad.}};$$

$$\text{tan. Q} = \frac{\text{cot. L sin. P}}{\text{sin. D}}.$$

These quantities, P and tan. P, may be called the *constants* of the dial. Then, the forenoon hours on the west declining dial, and the afternoon hours on the east, will be found from the formula

$$\text{tan. } y = \frac{\text{tan. Q sin. } x}{\text{cos. } (x+\text{P})} \cdot \ldots\ldots\ldots\ldots \alpha \text{ (5.)}$$

and the morning hours on the east declining dial, and afternoon hours on the west, by the formula

$$\text{tan. } y = \frac{\text{tan. Q sin. } x}{\text{cos. } (x-\text{P})} \ldots\ldots\ldots\ldots \beta \text{ (5.)}$$

56. We shall now give examples of the application of the formulæ.

Ex. 1. Let it be required to find the angles which the hour lines make with the meridian line on a vertical south dial that declines 36° westward, the latitude being 54½°.

In this dial, which is represented in Plate CCII. fig. 5, L = 54° 30′; D = 36° west.

Computation of P and tan. Q.

tan. (D = 36°)		9·86126
sin. (L = 54° 30′)		9·91069
tan. (P = 30° 36′)		9·77195
sin. P		9·70675
cot. L		9·85327
sin. D	ar. comp.	0·23078
tan. Q		9·79080

Having determined the constants, the hour line angles may be found as follows: Dialling.

Calculation of hour line angle of XI. A. M.

sin. (x = 15°)	9·41300
tan. Q	9·79080
cos. (x + P = 45° 36′) ar. comp.	0·15511
tan. (y = 12° 52′)	9·35891

Calculation of hour line angle of I. p. m.:—

sin. x	9·41300
tan. Q	9·79080
cos. (x — P = 15° 36′) ar. comp.	0·01630
tan. (y = 9° 26′)	9·22010

The following table exhibits at one view the elements of the dial and the hour line angles for its construction:

Given L = 54° 30′, D = 36 0 west } hence { P = 30° 36′, log. tan. Q = 9·79080

Hours.	x.	x + P.	x — P.	y the hour angle.
IX. a. m.	45°	75° 36′		60° 21′
X.	30	60 36		32 10
XI.	15	45 36		12 52
XII.	0	30 36		0 0
I. p. m.	15		15° 36′	9 26
II.	30		0 36	17 10
III.	45		14 24	24 17
IV.	60		30 24	31 34
V.	75		44 24	39 52
VI.	90		59 24	50 30
VII.	105		74 24	65 44
VIII.	120		89 24	88 52

57. If the hour lines of this dial were traced on a transparent plane and extended, and if the style were produced through the dial, the reverse would show a north dial declining eastward 36°.

Ex. 2. Suppose a vertical south dial decline east 49° in the latitude 51° 30′; to determine the hour line angles. (See fig. 4 of Plate CCII.)

In this case L = 51° 30′; D = 49° east. We now apply formula β of (5). The data of the dial, the constants, and hour line angles, are exhibited in the following table:—

Given L = 51° 30′, D = 49 0 east. } hence { P = 42°, log. tan. Q = 9·84834.

Hours.	x.	x — P.	x + P.	y.
III. a.m.	135°	93°		95° 59′
IV.	120	78		71 12
V.	105	63		56 19
VI.	90	48		46 5
VII.	75	33		39 5
VIII.	60	18		32 42
IX.	45	3		26 32
X.	30	12		19 49
XI.	15	27		11 35
XII.	0	42		0 0
I. p.m.	15		57	18 32
II.	30		72	48 47

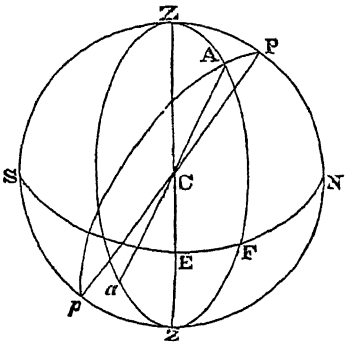
In the calculation for the hour line angle of III. a. m. the cosine of x — P = 93° is negative; this makes the sign of y negative, and therefore y an angle between 90° and 180°.

58. If this dial were traced on a plane, and the hour

Dialling. lines extended and continued through it, and if the style also were produced through the plane, the reverse would be a north vertical dial, declining to the westward 49°.

In general, to make a north declining dial, we have only to make a south declining dial whose declination is the same and lies the same way, and then turn it upside down, and it will be the dial required; but the hours must be numbered the contrary way. Therefore these two examples, duly considered, will serve for examples of all declining dials.

59. It has been already observed (art. 15), that a dial on any plane whatever, given in position at a given place, will be a horizontal dial at some other place, which may be found. This principle gives another method of constructing a declining vertical dial; for if the latitude of that place, and also the difference between its longitude and that of the place where the dial is to show the time, be found, the former will be the angle which the style must make with the plane of the dial; that is, the angle it makes with the substyle; and the latter will give the time the shadow takes to pass between the twelve o'clock line and the substyle, from which the angle they contain may be found. These three elements being known, viz. the latitude and longitude of the place where the dial would be horizontal, and the angle contained by the meridian line and substyle, the construction is reduced to that of a horizontal dial.



60. These elements may be found by spherical trigonometry as follows; let SZN*z* be the meridian, in which Z and *z* are the zenith and nadir, and P, *p* the poles: Let SEN be the horizon, S and N being the south and north points, and E the east; let Z*F*z be a vertical plane or great circle of the sphere on which the dial is to be drawn; let this plane cut the horizon in F, and the plane of the meridian in the straight line Z*z*; and let it be cut perpendicularly in the line A*a* by a circle PA*p* which passes through the poles. Then C*p* or CP will be the axis of the dial, according as it faces the south or the north, C*z* or CZ the twelve o'clock hour line, and C*a* or CA the substyle (art. 48).

In the spherical triangle ZPA, right angled at A, PZ, the complement of the latitude of the place where the dial is to show time is given; so also is the angle PZA, for it is measured by FZ, the arc of the horizon of which the complement is the declination of the dial (art. 47); from these, AP, the measure of the angle contained by PC the axis, and AC the substyle, that is, the latitude of the dial, (art. 48), also AZ, the measure of the angle contained by the substyle AC and the vertical or twelve o'clock hour line, lastly, the angle ZPA, the difference of longitude of the planes ZPC, APC (art. 73), may be all found.

61. By the principles of spherics (see SPHERICAL TRIGONOMETRY),

rad. : sin. PZ = sin. Z sin. AP;
rad. : cos. PZ = tan. Z : cot. P;
rad. : tan. PZ = cos. Z : tan. AZ.

Let L be the latitude of the place where the dial is to serve, Dialling.

D the declination of the dial (art. 47),

l the latitude of the dial, that is, of the place where it would be horizontal (48),

a the longitude of the dial,

b the angle between the substyle and the vertical.

Then from the above proportions there is got

$$\left.\begin{aligned} \sin. l &= \frac{\text{cos. L cos. D}}{\text{rad.}}; && \alpha \\ \cot. a &= \frac{\text{sin. L cot. D}}{\text{rad.}}; && \beta \\ \tan. b &= \frac{\text{cot. L sin. D}}{\text{rad.}}. && \gamma \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots (6.)$$

These formulæ, when L and D are known, give the three elements for the construction of the dial, which is now reduced to that of a horizontal dial. The hour line angles must, however, be so found that one of them shall fall on the vertical or twelve o'clock hour line.

62. Let us again take Ex. 1 of art. 56, and suppose that a vertical south dial, declining 36° to the west, is to be constructed, the latitude being 54° 30′ (fig. 5 of Plate CCII.) In this case L = 54° 30′, D = 36°.

Calculation of *l*,	of *a*,	of *b*.
cos. L 9·76395	sin. L 9·91069	cot. L 9·85327
cos. D 9·90795	cot. D 10·13874	sin. D 9·76922
sin *b* 9·67190	cot. 10·04943	tan. *b* 9·62249
l = 28° 1′	*a* = 41° 45′	*b* = 22° 45′

The construction of our south declining dial for latitude 54° 30′ is now reduced to that of a horizontal dial for latitude 28° 1′; for the sake of brevity, let us call the former place A and the latter B. The earliest hour that can be shown at A, on the dial, is about IX. a. m. that is, 45° of an hour angle from noon. Now when it is 45° from noon at A, because of the difference of longitude, it will be 45° + *a* = 86° 45′ at B; the hour line angle with the meridian corresponding to this will, by the formula for a horizontal dial, be found by this proportion:

As rad.	10·00000
to sin. latitude (28° 1′)	9·67191
so is tan. hour angle from noon (86° 45′)	11·24577
to tan. hour line angle with meridian (83° 6′)	10·91768

Here we have found that at the place B, when it is nine in the morning at A, the hour line will make with the meridian line there an angle of 83° 6′; this is the angle which the hour line of IX. at A will make with the substyle. In the same manner may the angles which the remaining hour lines on the dial make with the substyle be found. The whole are shown in this table.

Hours at A.	Hour Angles at B.	Hour Line Angles with Meridian at B.	Hour Line Angles with Meridian at A.
IX.	86° 45′	83° 6′	60° 21′
X.	71 45	54 56′	32 11
XI.	56 45	35 37	12 52
XII.	41 45	22 45	0 0
I.	26 45	13 19	9 26
II.	11 45	5 35	17 10
	Substyle.		
III.	3 15	1 32	24 17
IV.	18 15	8 49	31 34
V.	33 15	17 7	39 52
VI.	48 15	27 45	50 30
VII.	63 15	42 59	65 44
VIII.	78 15	66 7	88 52

The angles which the hour lines make with the vertical or meridian line at A are found from the like angles at B, by taking the difference between them and the angle $b = 22° 45'$ for all those on one side of the substyle, and the sum of each and that angle when they lie on the other side. The agreement of the results in this table with those in article 56 will appear by inspection.

To trace a Meridian Line on any Plane.

63. In constructing a dial it is always necessary to determine the line in which the plane of the meridian meets the plane of the dial. On an assumed point in the meridian line as a centre describe several concentric circles with any distances in the compasses: at this point fix a wire truly perpendicular to the plane, and of such a length that when the sun shines its shadow shall extend beyond the circles. Watch now the instant when the extremity of the shadow exactly reaches some one of the circles in the forenoon, and mark the point in which it crosses the circle. In the afternoon, mark in like manner the point in which it again crosses the same circle: and any point that is equally distant from the two points so determined will be in a meridian line passing through the centre of the circle, which may now be drawn. By a like attention to the path of the extremity of the shadow when it crosses the other circles, points may be found in a meridian line passing through their common centre; and a mean position of all the meridian lines thus found will be sufficiently accurate for a dial.

The theory of this method is sufficiently obvious. At equal intervals of time each way from noon, the shadow is nearly of the same length, and makes nearly equal angles with the meridian line; the deviation from absolute equality arises chiefly from the continual change in the sun's declination. This, however, is but little in the course of a day near the solstices. Accordingly, greater accuracy will be obtained about midsummer or midwinter than nearer the equinoxes.

64. A good compass will give an approximation to the true position of the meridian; but the variation, which is not the same at all places and at all times, must be known. In 1823 it was about 24° 10′ west at London, and in the same year 27° 48′ west at Edinburgh. If the direction of the meridian be known at one place, the variation may be there determined; and thence the direction of the meridian at another place not very distant may be found.

65. If a good watch be set to true time, or its deviation from it be found, by taking equal altitudes of the sun with a sextant, or by a single altitude, or any other astronomical observation, a dial may thereby be set truly in the meridian.

66. The pole star is distant from the pole about 1° 36′; hence, knowing the latitude, its greater azimuth may be found. At London its greatest deviation from the meridian either way is about 2° 34′ in azimuth. If now two plummets be suspended at some distance from each other, and in such a position that the pole star may appear in the same plane with them, that plane will be nearly in the meridian. If one of the plummets be moveable, and it be shifted, following the change of position in the star, the two extreme positions of the plumb-line will, with the other plummet, determine two vertical planes, which deviate equally from the meridian in opposite directions. If lines were now traced on a horizontal plane in the directions of the vertical planes thus found, these would form with the meridian line sought equal angles on opposite sides of it, and the meridian would be found by bisecting the angle they contain. The pole star comes to the meridian about noon and midnight in the beginning of October. It may then be seen twice in the same night at its greatest distance on opposite sides of the meridian; but one observed maximum distance, and the computed deviation in azimuth, would serve to find the meridian at any time.

The time of the meridian passage of the pole star on any day of the year may be found as taught in works on astronomy. At this time, as shown by a watch, two plumb-lines may be placed in the meridian, or one, and the corner intersection of two walls truly perpendicular instead of another. Great accuracy in the time of the observation is not required, the motion of the star in azimuth being only 7 minutes of a degree in ten minutes of time at London.

67. A meridian line may be traced by observing when two stars which have the same right ascension, or which differ in right ascension by twelve hours, come into the same vertical plane; for then they are both in the meridian.

The pole star and the star ε (the first of the three in the tail) of the great bear have nearly this relative position. On the 1st of January 1834, their mean right ascension, as given in our table of the places of the fixed stars (Astronomy), will be,

	Hours.	Min.	Sec.
ε Ursæ Majoris.....	12	46	41
Polaris.....	1	0	34
	11	46	7

The difference from twelve hours is about forty-six minutes of time. By the revolution of the heavens the star ε comes into the meridian under the pole; but the pole star is not then exactly in the meridian. Afterwards they come into the same vertical, and then the pole star is very near the meridian, and, for finding a meridian line, may be considered as exactly so. The azimuth of the pole star, at the instant when the stars are in the same vertical, may be found by calculation, and the approximate meridian thereby corrected.

There are other pairs of stars which come into the meridian nearly at the same time. The stars β *Draconis* and α *Ophiuchi* are such. The stars δ of the lesser bear, and α of the lyre, are also well adapted to the end in view, in latitudes exceeding the polar distance of the most remote star, which is about $51\frac{1}{2}°$.

68. In whatever way a meridian line has been found on a horizontal plane, two plummets hung over it, or so that their lines may pass through it, will indicate the position of the plane of the meridian in space. The line in which it cuts any other plane, as a vertical wall not far from the meridian line, may be found by placing the eye in the meridional plane, with the plummets between it and the wall, and noting points on the wall which their lines cover from the eye. The ingenious diallist may now, with a little dexterity in practical geometry, fix the style of his dial in the wall or other plane, with its edge in the meridian plane, and making with a vertical line the proper angle, so that it may point to the pole. A perpendicular drawn now from the end of the style on the plane, will give a point in the substyle, which may now be drawn to the centre. Thus two important elements in a dial will be determined.

To find the Declination of a Vertical Plane.

69. Place a board in a position truly horizontal, with a straight side in contact with the plane; trace a meridian line on the board; and the angle made by this line and the line in which the board meets the vertical plane will be the inclination of the plane to the meridian.

To find the Inclination of any Plane to the Horizon.

70. Extend a surface truly level until it meet the plane;

Dialling. the line of their intersection will be horizontal. Draw perpendiculars to this line on the two planes from any point in it, and the angle which these form will be the inclination of the plane to the horizon.

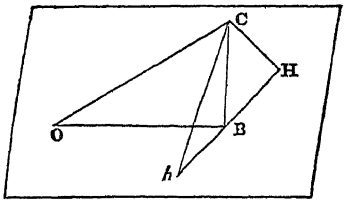
If the plane were made to form one side of a temporary trough into which water was poured, the surface of the water would accurately mark the horizontal line. The inclination of the plane to the surface of the water, which is horizontal, might be found by various expedients too obvious to require being pointed out.

When the position of the meridian and the axis of the dial are truly determined, the finding of the inclination and declination of the plane are problems in practical geometry which may be resolved by the application of levels, or plumb-lines and squares, and those simple principles with which most workmen are familiar.

Inclining Dials.

71. We come now to consider inclining dials, or those which stand oblique to the horizon, either projecting forwards from the perpendicular, or retiring backwards.

From what has been taught, any dial plane being given in position, a meridian line may be traced on it; also, at a point in that line an axis may be fixed pointing to the pole of the world. Suppose now that in the following figure, OB is a meridian line drawn on an inclining dial plane, and OC



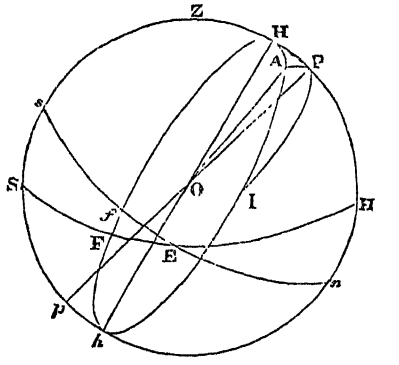
the axis directed to the pole; the angle COB will be the complement of the latitude of that place where the dial, being vertical, would show true time: this, therefore, is known. If, in addition, we knew the declination of the dial, the hour line angles might be found by the formulæ of art. 55. Now it is easy to find the declination, for since the horizon must be perpendicular to the vertical OB, if CB be drawn in the plane of the meridian, and HB*h* in the dial plane, both perpendicular to OB, these lines will be in the plane of the horizon of the place where the dial, being vertical, would show true time; and the angle CBH will be the inclination of the plane of the dial to the meridian, which is the complement of the declination (art. 47). If now we make BH = B*h* of any length, and join CH, C*h*, we have, by trigonometry,

$$\text{cos. CBH} = \frac{(\text{C}h + \text{CH})\,(\text{C}h - \text{CH})}{4\,\text{BH}\cdot\text{BC}}.$$

Hence, by measuring the lines on a scale of equal parts, the inclination may be found.

72. Thus, having the position of the meridian, and the axis, on a dial plane making a given angle with the horizon, we may find the latitude of the place where it would be a vertical declining dial, and also its declination at that place; and with these data the angles which the hour lines make with the meridian may be found by the formulæ for vertical dials, art. 55; or else we may find the latitude and longitude of that place where the dial would be horizontal, and construct it by the rules for a horizontal dial.

73. To begin with the first of these methods, let SZN*h* be the meridian (see fig. in next column), P*p* the axis of the sphere, Z the zenith of a place where the dial is to stand, SEN the horizon, S, E, and N, the south, east, and north points respectively; also let HFI be a circle of the sphere on the plane of which the dial is to be constructed, and let it meet the horizon in F, and the plane of the meridian Dialling. in the line H*h*; the line PO*p* will be the axis of the dial, and HO*h* the meridian line. The arch EF between the east point of the horizon and the plane will be its *declination*, and the spherical angle HFN its *inclination* to the horizon, or the complement of its reclination from the vertical position.



Now, let SE*n* be the horizon of a place having H for its zenith, which of course is the place where the dial would be a vertical dial, and let it cut the dial plane circle in *f*; because the two horizons are perpendicular to the meridian, their intersection will be in the east point in both.

Let L = PN, the given latitude of the place where the dial is to be made;
D = FE, the declination of the dial;
R = complement of angle *f*EF, its reclination;
l = the latitude of the place where the dial would be vertical, which is sought;
d = E*f*, its declination there, also sought:
then *l*—L = N*n*, the measure of the angle FE*f*.

By spherical trigonometry, in the triangle EF*f*, right angled at *f*,

rad. : sin. EF = sin. F : sin. E*f*,
rad. : cos. EF = tan. F : cot. E.

From these proportions we find

$$\left.\begin{aligned}\text{sin. } d &= \frac{\text{cos. R sin. D}}{\text{rad.}}\\ \text{cot. } (l\text{—L}) &= \frac{\text{cot. R cos. D}}{\text{rad.}}\end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots(7.)$$

Hence the angles *d* and *l* are determined; and these being substituted in the formula of art. 55, instead of L and D, it will become a general expression for the angle *y*, which the shadow makes with the meridian line on the reclining dial.

Example.—To find the hour lines on a south dial plane FH*h*, that declines westward 25°, and reclines 15°, in latitude 54° 30′.

Here L = 54° 30′, D = 25°, R = 15°.

To find *d*.		To find *l*.	
rad.	10·00000	rad.	10·00000
cos. R	9·98494	cot. R	10·57195
sin. D	9·62595	cos. D	9·95728
sin. (*d* = 24° 6′)	9·61089	cot.(*l*—L)=16°27′	10·52923

Since *l* — L = 16° 27′, and L = 54° 30′, therefore *l* = 70° 57′. The dial declines to the west; therefore (art. 55),

$$\text{tan. } y = \frac{\text{tan. Q sin. } x}{\text{cos. } (x + \text{P})} \text{ for the forenoon hour lines,}$$

$$\text{tan. } y = \frac{\text{tan. Q sin. } x}{\text{cos. } (x - \text{P})} \text{ for the afternoon.}$$

$$\text{In these tan. P} = \frac{\text{sin. } l \text{ tan. } d}{\text{rad.}},$$

Dialling.

$$\tan. Q = \frac{\cot. l \sin. P}{\sin. d},$$

and hence P = 22° 55′, and log. tan. Q = 9·51759.

The elements of the dial and the results of the calculation are exhibited in this table.

Given $l = 70° 51'$, $d = 24\ 6$ } hence { P = 22° 55′, log. tan. Q = 9·51759.

Hours.	Hour Angle x.	$x + P$.	$x - P$.	Hour Line Angles y.
VIII. a. m.	60°	82° 55′		66° 37′
IX.	45	67 55		31 46
X.	30	52 55		15 16
XI.	15	37 55		6 10
XII. noon.	0	22 55		0 0
I. p. m.	15		7° 55′	4 55
II.	30		7 5	9 25
III.	45		22 5	14 6
IV.	60		37 5	19 40
V.	75		52 5	27 22
VI.	90		67 5	40 13
VII.	105		82 5	66 35

The hour lines are to be drawn on the dial, so as to make with the XII. o'clock hour line the angles in this table. The dial is represented in fig. 7 of Plate CCII.

74. To construct the dial by finding the latitude and longitude of a place where it would be horizontal, we must find the angle which the substyle makes with the meridian, and also the latitude and longitude of the plane.

Resuming the figure of art. 73, let a great circle passing through the pole, and perpendicular to the plane of the dial, meet it in the line OA; this will be the substyle, and AOH the angle which it makes with the meridian or XII. o'clock hour line; AOP the angle which the axis makes with the plane of the dial, and the spherical angle APH its difference of longitude.

In the spherical triangle AHP right-angled at A, AHP = *fhs* is measured by the arc *fs*; but this arc is the complement of the arc *f*E, which we have denoted by *d*, therefore the angle AHP is the complement of *d*. Again, the arc HP is the complement of the arc P*n*, which was expressed by *l*. Now formulæ have been given (in the preceding article) for the computation of *d* and *l*, therefore the angle AHP and the side HP of the spherical triangle may be considered as known. The three remaining parts of the triangle may be found by spherical trigonometry by these proportions,

rad. : cos. H = tan. PH : tan. AH;
rad. : sin. H = sin. PH : sin. AP;
rad. : tan. H = cos. PH : cot. P.

By substituting the symbols *d* and *l* in these proportions, they give

tan. AH (the angle made by the substyle and meridian)..... $= \frac{\text{sin. } d \text{ cot. } l}{\text{rad.}}$;

sin. AP (the angle made by the axis and substyle)..... $= \frac{\text{cos. } d \text{ cos. } l}{\text{rad.}}$;

cot. P (the dif. of long.)..... $= \frac{\text{cot. } d \text{ sin. } l}{\text{rad.}}$.

These formulæ, applied to the example of last article, give

angle made by substyle and meridian = 8° 1′;
angle made by axis and substyle = 17° 20′;
diff. of longitude of dial plane 25° 20′ = 1h. 41⅓m.

The dial may now be constructed as horizontal, and for latitude 17° 20′; and since the meridian line lies to the east of the XII. o'clock line, the hour lines of 2h. 41⅓m., 3h. 41⅓m. &c., reckoned from the substyle of the dial, must be found, and made the hour lines of XI., X., &c. in the forenoon. Also, the hour line of 41⅓m. must be made the hour line of I. The hour line of II. will be on the other side of the substyle, and will correspond to 18⅔m., that of III. to 1h. 18⅔m., and so on. Dialling

Of the Time when the Sun begins or ceases to shine on a Dial on a given Day.

75. The solution of this problem is wanted, that it may be known what hours should be inscribed on a dial. It has various cases; but as all are to be resolved on the same principles, it will be sufficient if we consider one.

Retaining the construction of the fig. of art. 73, let PI be the hour circle passing through the sun when he is in the plane of the dial on a given day. In the spherical triangle HAP, we have found AP, the measure of the angle contained by the axis and substyle; and HPA, the difference of longitude. Again, in the spherical triangle IAP, right-angled at A, besides AP, there is known IP, the sun's distance from the pole on the given day. Hence the angle IPA may be found by this proportion:

tan. PI : tan. PA = rad. : cos. API.

The angle API, expressed in time, is half the period the sun shines on the plane; and the hour angle HPI, in time, is the interval between noon and the sun's leaving the plane.

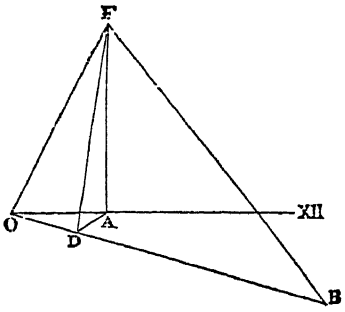
76. Taking the dial constructed in art. 73 as an example, it will be found that when the sun is in the northern tropic, that is, when PI = 66° 30′, the angle IPA = 82° 12′. Now (art. 74), HPA = 25° 20′; therefore, when the sun ceases to shine on the plane, the horary angle IPH from noon is 107° 32′ = 7 hours 10 minutes, the sum of the two arcs; and when he begins to shine on it, the horary angle is 56° 52′ = 3 hours 47 minutes, their difference. Hence it will be needless to trace on the dial any hour line earlier than VIII. in the morning, or later than VIII. in the evening.

Of the Line described by the extremity of a Shadow on a Plane.

77. Sometimes the line which is the boundary of the space passed over by the shadow of the axis of a dial on given days of the year is traced on its plane. The path of the extremity of the shadow when the sun enters the different signs of the ecliptic is an elegant appendage to a dial, and the geometrical problem which determines it is interesting.

78. Setting aside the considerations of the change in the sun's declination, the apparent diurnal path of the sun in the heavens is, in the theory of dialling, considered to be a circle parallel to the equator; therefore any fixed point that projects a shadow throughout a day may be considered as the vertex of a cone, the base of which is the diurnal circle described by the sun on that day, and the space bounded by the shadow will be the same cone continued beyond its vertex. Thus it appears that the shadow of a fixed point in space generates the surface of a cone whose axis passes through the pole of the world; and hence the path of the shadow on any plane will be a *conic section*, because it is the line in which the surface of the cone meets the plane.

Let O be the centre of a horizontal dial, OF the axis, O XII. the meridian line, and OB the shadow of the axis at any time; join FB, draw FA perpendicular to O XII., and AD perpendicular to OB, meeting OB in D; and join FD. Because FA is perpendicular to the plane BO XII. the plane of the triangle FAD is perpendicular to that plane Now, by construction, BD is perpendicular to their common section DA, therefore it is perpendicular to the plane



of the triangle FAD, and consequently FD is perpendicular to OB.

Let a = OF the length of the axis;
r = OB the length of its shadow;
v = the angle BOA contained by the shadow and the meridian;
z = the angle FOB contained by the shadow and the axis;
L = the angle FOA, the latitude;
D = the angle OFB, the sun's polar distance;
in the triangles ODF, ODA, right-angled at D,

OD : OF = cos. FOD : rad.
OA : OD = rad. : cos. AOD,

therefore OA : OF = cos. FOD : cos. AOD;
but in the triangle OAF,

OA : OF = cos. FOA : rad.

therefore cos. FOA : rad. = cos. FOD : cos. AOD.
From the triangle FOB we get this other proportion,

sin. (F + O) or sin. B : sin. F = OF : OB.

The last two proportions in symbols are

cos. L : rad. = cos. v : cos. y,
sin. (D + v) : sin. D = a : r.

By the first proportion, we may determine v from y, the angle the shadow makes with the meridian; and by the second we get r, the length of the shadow. We may also express its length by the hour angle from noon; for if we put x to denote that angle, then (art. 23),

rad. : sin. L = tan. x : tan. y.

From the first and last of these three proportions, it is easy to infer, by spherical trigonometry, that the arcs L and y are the sides of a right-angled spherical triangle, of which v is the hypotenuse, and that x is the angle opposite the side y; hence it follows that

cos. x : tan. L = rad. : tan. v.

To determine the length of the shadow, we have now these formulæ,

$$\tan. v = \frac{\text{rad. tan. L}}{\cos. x}; \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\cos. v = \frac{\cos. \text{L} \cos. y}{\text{rad.}}; \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$r = \frac{a \sin. \text{D}}{\sin. (\text{D} + v)}; \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

By these, and the formulæ

$$\tan. y = \frac{\sin. \text{L} \tan. x}{\text{rad.}},$$

the position of the shadow, and its length, may be found at any time on any given day; the sun's declination being taken from the table which concludes this article.

79. It has been shown (art. 78) generally, that the line described by the shadow is a conic section: the formulæ just found serve to determine its nature in any given case.

By the calculus of sines (Algebra, art. 239), sin. (D + v) = sin. D cos. v + cos. D sin. v; now sin. $v = \sqrt{(1 - \cos.^2 v)}$, therefore, from formulæ (2) and (3), putting rad. = 1, we have

$$r = \frac{a}{\cos. \text{L} \cos. y + \cot. \text{D} \sqrt{1 - \cos.^2 \text{L} \cos.^2 y}}.$$

This is the polar equation of the line which limits the shadow; it may also have this form,

$$a - r \cos. \text{L} \cos. y = \cot. \text{D} \sqrt{r^2 - r^2 \cos.^2 \text{L} \cos.^2 y}.$$

Supposing now t and u to be rectangular co-ordinates, which have their origin at O; we have $t = r \cos. y$, and $r^2 = t^2 + u^2$; therefore, by substitution, and taking the squares of both sides, we find

$$\left.\begin{array}{l}(\cot.^2 \text{D} \sin.^2 \text{L} - \cos.^2 \text{L})\, t^2 + 2 a t \cos. \text{L} \\ + u^2 \cot.^2 \text{D} - a^2\end{array}\right\} = 0,$$

an expression which by the calculus of sines may be transformed to

$$\left.\begin{array}{l}t^2 \sin. (\text{D} + \text{L}) \sin. (\text{D} - \text{L}) - 2 a t \cos. \text{L} \sin.^2 \text{D} \\ - u^2 \cos.^2 \text{D} + a^2 \sin.^2 \text{D}\end{array}\right\} = 0.$$

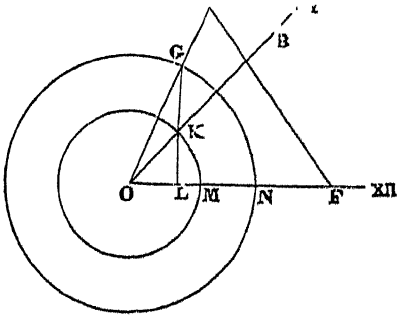
This is the equation of the line described by the shadow referred to axes perpendicular to each other; it contains the first and second powers of the co-ordinates and constants, therefore the line is, in general, a conic section.

80. If L = D, then sin. (L − D) = 0. In this case the term which contains t^2 vanishes, and the remaining terms indicate that the curve is a parabola.

If L is greater than D, so that the sine of D − L is negative, the equation belongs to an ellipse; but if L be less than D, the equation belongs to a hyperbola. In each case the meridian line is the transverse axis of the curve.

The path of the shadow is an ellipse at any place within the polar circle on the days when the sun does not set; it is a parabola at that place on the day that the sun just touches the horizon at midnight; it is a straight line at all places of the earth on the equinoctial days; and in every other case it is a hyperbola.

81. The points in which the curve crosses its axis may be found from its polar equation by making $u = 0$, and $u = 180°$. If r' and r'' denote the distances from the centre, when $u = 0$, then $r' = \frac{a \sin. \text{D}}{\sin. (\text{D} + \text{L})}$; $r'' = \frac{a \sin. \text{D}}{\sin. (\text{D} - \text{L})}$. The first of these is the length of the shadow at noon. The vertices of the curve lie on the same side of the centre of the dial when it is a hyperbola, but on opposite sides when it is an ellipse. The other elements of the curve may be found in the same way, and the curve may be described as a conic section. In practice it will however be sufficient to find the points in which the curve crosses the hour lines of the dial, and then trace the curve through them by hand. The intersection of the curve and any hour line may be found by this construction.



Let O be the centre of the dial, and O XII. the meridian line. Take any two lines, OM, ON, in the proportion of the cosine of the latitude to radius; and about O as a centre, with these distances, describe circles. Take OF in the meridian line equal to the axis of the dial, and make the angle OFH equal to the sun's distance from the

Dialling. pole. Let K be the intersection of any hour line and the lesser circle. Draw KL perpendicular to the meridian, meeting the greater circle in G. Draw OG, meeting FH in H. In the hour line OY, take OB equal to OH, and B is the point in which the hour line meets the path of the shadow.

For, by trigonometry,

OG : OK = sin. OKL : sin. OGL = cos. KOL : cos. GOL;

that is, because KOL = YOL = y,

rad. : cos. L = cos. y : cos. HOL.

Hence the angle HOL = v (formula 2 of art. 78); now HFO = D, and OF = a, and sin. H : sin. F = OF : OH,

that is, sin. (D + v) : sin. D = a : OH;

therefore OH = OB is the length of the shadow (formula 3).

Whatever has been shown regarding the shadow of a horizontal dial, will apply to any dial whatever, if L be put for the latitude of the place where the dial would be horizontal, and the substyle be taken for the meridian line.

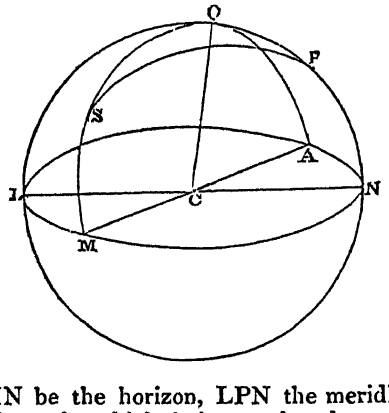
Dials with variable Centres.

82. Dials of this kind are not common; yet they are deserving of attention, because of the elegance of their geometrical theory. Their construction depends on this principle.

It is possible to determine a system of hour points on a plane, such, that if a style be placed in the plane of the meridian at certain points, to be found, corresponding to the days of the year, and making with the horizon any given angle, its shadow shall pass through the hour points at the times they indicate, and in this way show the time of the day.

83. To establish the truth of this proposition, the following problem is to be resolved.

Having given the sun's declination, the time from noon, and the latitude of a place; to find the angle which the shadow of a style in the plane of the meridian, and inclined at a given angle, makes with the meridian line on a horizontal plane.



Let LMN be the horizon, LPN the meridian, P the pole, CQ the style, which, being produced, meets the celestial meridian in Q. Let S be the sun in the hour circle PS, and MSQA a great circle passing through S and Q, and cutting the horizon in the line MCA.

Put L = PN, the given latitude;

E = QN, the given elevation of the style;

D = PS, the sun's distance from the pole;

x = QPS, the hour angle;

z = the angle LQM;

y = angle ACN, or arc LM, which is to be found.

In the spherical triangle PSQ, by spherics,

cot. PS. sin. PQ = cot. Q sin. P + cos. PQ cos. P;

and in the spherical triangle QLM, right-angled at L,

cot. LQM = cot. LM sin. QL.

Now, in the first of these formulæ,

PS = 90° — D, PQ = E — L, Q = 180° — z, P = x; Dialling.

and in the second,

LQM = z, LM = y, sin. QL = sin. QN = sin. E;

therefore, by substituting the symbols in the formulæ, we have

tan. D sin. (E—L) = — cot. z sin. x + cos. (E—L) cos. x; (1.)

cot. z = cot. y sin. E.....(2.)

Let the value of cot. z be substituted instead of it in the first equation, then, deducing from the result the value of cot. y, we find

$$\cot. y = \frac{\cos. (E - L) \cos. x - \sin. (E - L) \tan. D}{\sin. E \sin. x}.$$

This formula gives the value of y, the angle made by the shadow and the meridian of the dial, which was required.

84. Fig. 13 of Plate CCII. represents a dial with a moveable centre, O XII. being the meridian line, and the hour points as shown in the figure. Let C be the variable centre, which is the position of the bottom of the style on any given day, A any one of the hour points, and AC the position of the shadow at that hour on the given day; then, x denoting the hour angle from noon, and y the hour line angle AC XII., the preceding formula gives the value of y. Draw AB perpendicular to the meridian, put OB = t, AB = u, t and u being the co-ordinates of an hour point; and put r for OC, the variable distance of the bottom of the style from the fixed point C in the plane of the dial; then Bc = $t - r$. And because cot. C = $\frac{Bc}{BA}$, that is,

$$\cot. y = \frac{t - r}{u},$$

therefore

$$\frac{t - r}{u} = \frac{\cos. (E - L) \cos. x - \sin. (E - L) \tan. O}{\sin. E \sin. x}.$$

and hence, deducing the value of r,

$$r = \begin{cases} \dfrac{t \sin. E \sin. x - u \cos. (E - L) \cos. x}{\sin. E \sin. x} \\ + \dfrac{u \sin. (E - L) \tan. D}{\sin. E \sin. x}. \end{cases}$$

By the nature of the dial, the position of the style must depend entirely on the sun's declination, and be altogether independent of the hour of the day. These conditions will be satisfied if we make

$$t \sin. E \sin. x - u \cos. (E - L) \cos. x = 0;$$

$$\frac{u \sin. (E - L)}{\sin. E \sin. x} = a, \text{ a constant quantity;}$$

for by this assumption t and u are independent of D, the sun's declination; and $r = a$ tan. D independent of x. By resolving the equations, we obtain

$$t = a \cot. (E - L) \cos. x.....(1.)$$

$$u = a \frac{\sin. E}{\sin. (E - L)} \sin. x.....(2.)$$

$$r = a \tan. D.....(3.)$$

These equations express the nature of every dial of this kind.

85. To construct the dial, we must assume a line of any convenient length, as a scale on which the co-ordinates of the hour points may be measured. The values of t and u are now to be computed by making $x = 15°$ for the hours of XI. and I.; again, $x = 30°$ for the hours of X. and II., and so on. A graduated scale must be formed along the meridian line, proceeding both ways from O, that point being the position of the style at the equinoxes; and since it appears from the figure in art. 83, that for any given hour angle x, the angle y at the variable centre c ought to increase as the sun approaches the north pole, the scale of declination for the north side of the equator

Dialling. the cylinder about on the table till the shadow falls on it parallel to those upright lines which divide the signs, that is, till the shadow be parallel to the (supposed) axis of the cylinder; and then the point or lowest shadow will fall upon the time of the day among the curve hour lines, and will show the sun's altitude at that time, among the cross parallels of his altitude which go round the cylinder; at the same time it will indicate the sign of the ecliptic in which the sun is.

The dial may also, when used, be suspended by the ring F in its top. Dials of this kind, of rather rude construction, are sometimes used by the rural population in France.

92. The construction of this dial requires that the sun's altitude be found for any given hour of the day, knowing the latitude of the place and the sun's declination.

Let D be the sun's declination,
L the latitude,
x the hour angle at the pole,
z the sun's altitude.

Then $90° - D$, $90° - L$, $90° - z$, are the three sides of a spherical triangle, and x is the angle opposite to the last of these sides, hence, by spherics,

$\sin. z = \sin. L \sin. D + \cos. L \cos. D \cos. x$.....(1.)

This is equivalent to

$\sin. z = \sin. L \sin. D (1 + \cot. L \cos. D \cos. x)$.....(2.)

From this formula, by giving different values to x, the hour from noon, there will be found corresponding values of z, the sun's altitude.

Ex. To find the sun's altitude at ten in the forenoon or two in the afternoon on the 21st of May at London, in latitude 51° 31′, the sun then nearly entering the sign *gemini*. In this case, from the table at the end, $D = 20°$, 8′, we have also $L = 51° 31'$, and $x = 2^h = 30°$.

cot. L	9·90035	sin. L	9·89364
cot. D	10·43580	sin. D	9·53682
cos. x	9·93753	2·878	0·45909
1·878	0·27368	sin. z	9·88955

$2·878 = 1 + \cot. L \cot. D \cos. x \quad z = 50° 51'$.

The formula supposes that the latitude and declination are of the same name, that is, both north or both south. When one is north and the other south, then the first term will be negative, and we have for this case

$\sin. z = \sin. L \sin. D (\cot. L \cos. D. \cos. x - 1)$....(3); and when the hour angle exceeds 90°, it must be remembered that cos. x is a negative quantity, so that the expression in which it occurs is subtractive.

Ring Dial.

93. This kind of dial is shown in figure 7. It is formed of a brass ring or rim, usually about two inches in diameter, and one third of an inch in breadth. In a point of this rim there is a hole, through which the sun's light passes, and forms a lucid speck on the opposite concave surface, on which the hours of the day are marked.

These divisions are made by describing a circle to represent the ring, and drawing a horizontal chord EF; with this as a radius describe a quadrant FD, and divide it into degrees, and through those which mark the sun's altitude at every hour of the day, at the time of either equinox, draw lines from E to the opposite side of the circle, and there put the corresponding figures. Thus for a place whose latitude is 51° 32′, the XII. o'clock line will pass through 38° 38′ the colatitude, and the XI. and I. line through 36° 56′, the X. and II. through 32° 36′, the IX. and III. through 26° 5′, the VIII. and IV. through 18° 8′, and the VII. and V. through 9° 17′. The dial, thus constructed, would only show time at the equinox; but to make it perform the whole year, the hole is made moveable, and the signs of the ecliptic or the days of the month are marked on the convex surface of the ring by taking ET and Et, on each side of E, equal to twice the sun's declination when he enters any particular sign, as Taurus and Pisces, and there marking the character of the sign or corresponding month, and so for all the others; and by these the dial is rectified for the time of the year. From the figure it appears that E XII. δ is equal to FE XII. or the altitude of the sun in the equinox; but T XII. E is equal to the sun's declination in Taurus, because it is an angle at the circumference standing on an arc which is double the declination; therefore T XII. δ is equal to the meridian altitude when the sun enters Taurus, and a ray passing through the hole at T will mark the XII. o'clock hour of that day. But this dial will not show the other hours exactly, because T III. d exceeds E III. d, the equinoctial hour, by the angle of declination, and the same holds of the rest. To remedy this defect, the concave surface of the ring has sometimes been made broader, and seven circles described upon it, the middle one to represent the equinoctial, and the extremes the tropics; and on these circles the hours have been marked as shown in a table of altitudes.

To use the dial, set the moveable hole to the day of the month, or the degree of the sun's place in the ecliptic; then, suspending it by the ring, turn it towards the sun till his rays point out the hour among the divisions in the inside.

Universal or Astronomical Ring Dial.

94. This is represented in figure 6 of Plate CCI. It serves to show the time of the day in any part of the earth, whereas the former is only adapted to a particular latitude. It consists of two rings or flat circles from two to six inches in diameter. The outer ring A represents the meridian of any place. Two of its opposite quadrants are divided into 90°, serving, the one for north and the other for south latitude. The inner ring represents the equator, and turns within the outer on two pivots at the extremities of a diameter, where the hour XII. is marked. A thin reglet or bridge goes across the circles, and in its middle there is an opening, along which there slides a cursor C, having a small hole in it for the sun to shine through. The middle of this bridge represents the axis of the celestial sphere, and its extremities the poles; on one side of it the signs of the zodiac are drawn, and on the other the days of the month. A piece, to which a ring H is fixed, slides along the meridian; and the dial when used is suspended by the ring.

In this dial, the divisions laid down on the axis on either side of the centre are the tangents of the angles of the sun's declination, to a radius equal to that of the brass circle, which represents the equator. These may be laid down from a scale of equal parts, of which 1000 answer to the length of the semiaxes from the centre to the equinoctial ring; and then the extreme divisions on the axis will be at the distance of 434 of these equal parts (the tangent of 23° 29′) from the division at the centre.

To use this dial, place the line marked on the sliding piece (opposite to the supporting ring) over the degree of the latitude of the place, and put the line which crosses the hole of the cursor to the degree of the sign or to the day of the month. Turn the inner ring on its pivots, and put it at right angles to the outer; and suspend the instrument by the ring H, so that the middle of the bridge (which is the axis of the dial) may be parallel to the axis of the world; then turn its flat side towards the sun, so that his rays passing through the little hole in the cursor may fall exactly on a line drawn round the middle of the concave surface of the inner ring; and in this posi-

tion the bright spot shows the hour of the day on that surface.

The hour of XII. is not shown by this dial, because the outer circle, being then in the plane of the meridian, hinders the sun's rays from falling on the inner. Nor will it serve to show the hour on the equinoctial days, because his rays then pass parallel to the plane of the dial.

Universal Dial on a Cross.

95. This dial, represented by figure 1 of Plate CCI. is moveable on a joint C for elevating it to any latitude on the quadrant CO 90, as it stands on the horizontal board A. The arms of the cross stand perpendicularly to the middle part, and the top of it from *a* to *n* is of equal length with either of the arms *mk*, *nt*.

Having set the board A level, and the line *ut* (on the middle of a side of the cross) to the latitude of the place on the quadrant, and the point N on the compass north by the needle, allowing for the variation; the plane of the cross will then be parallel to the plane of the equator, and the dial rectified so as to show time.

The morning hours from III. till VI. will be shown by the upper edge *kl* of the arm *io* casting a shadow on a face of the arm *cm*; from VI. to IX. the lower edge *i* of the arm *io* will cast a shadow on the hours of the side *oq*; from IX. to XII. noon, the edge *ab* of the upper part *an* will cast a shadow on the arm *nf*; from XII. to III. in the afternoon, the edge *cd* of the top part will cast a shadow on the hours of the arm *klm*; and from III to VI. the edge *gh* will cast a shadow on the hours on the part *pu*; and from VI. to IX. the shadow of the edge *ef* will show the time on the top part *an*.

The breadth of each part *ab*, *ef*, &c. must be so great as never to let the shadow fall entirely without the part or arm on which the hours are marked, when the sun is at his greatest declination from the equator. To determine the breadth of the sides of the arms which contain the hours, make an angle ABC (fig. 2) of $23\frac{1}{2}°$, the sun's greatest declination; and in Bc take B*d*, equal to the intended length of each arm, from the side of the long middle part, which is also the length of the top part above the arms, and draw the perpendicular *def*.[1] Then, as the edges of the shadow from each arm will be parallel to BA when the sun's declination is $23\frac{1}{2}°$, it is plain that if the length of the shadow be B*d*, the least breadth it can have to keep the edge Be of the shadow B*egd* from going off the side of the arm before it comes to its end, must be *de* or B*d'*; but in order to keep the shadow within the quarter divisions of the hours when it comes near the end of the arm, the breadth thereof should be still greater, so as to be almost doubled, on account of the distance between the tips of the arms.

To place the hours right on the arms, lay down the shape and size of the cross *abcd* on paper (fig. 3), and on *a* as a centre, with *ae* as a radius, describe the quadrantal arc *ef*. Divide this arc into six equal parts, and through the divisions draw lines *ag*, *ah*, &c. continuing three of them to the arm *ae*, which are all that fall on it, and they will meet the arms in the points through which the hour lines are to be drawn right across it.

Divide each arm in the same manner, and set the hours to their proper places, as shown in the figure; each of the hour spaces should be divided into four equal parts for the half hours and quarters in the quadrant *ef*; and straight lines should be drawn through the division marks of the quadrant to the arms of the cross, in order to determine the places where the subdivisions of the hours must be marked.

An universal Dial, showing the Hours by a Globe, and by several Gnomons.

96. The dial is represented in fig. 9. Plate CCI. It may be made of a thick square piece of wood or hollow metal. The sides are cut into semicircular hollows, on which the hours are placed, the style of each coming out from its bottom as far as the ends of the hollow projects. The corners are cut into angles, in the insides of which the hours are also marked; and the edge at the end of each side of the angle serves as a style for casting a shadow on the hours marked on the opposite side. In the middle of the uppermost plane there is an equinoctial dial, in the centre of which an upright wire is fixed for casting a shadow on the hours of that dial, and supporting a small terrestrial globe on its top. The whole dial stands on a pillar rising out of a circular base, in which there is a compass and magnetic needle for placing the meridian style towards the south. The pillar has a joint with a graduated quadrant on it (supposed to be hid from sight under the dial in its representation) for setting the dial to the latitude of any given place. The equator of the globe is divided into twenty-four equal parts, and the hours are laid down on it: the time of the day may be shown by these hours when the sun shines on the globe.

To construct the dial: On a square piece of wood or metal of proper thickness draw the lines *ac*, *bd* (fig. 8) at a distance equal to the intended thickness of the style *abcd*; and in the same manner trace out the form of the three other styles *efgh*, *iklm*, *nopq*, all directed towards the centre of the square. On *a* and *b* as centres, with such a radius as will leave sufficient strength of stuff, when the distance KI is equal to A*a*, describe the quadrantal arcs A*c*, B*d*. In like manner, with the same radius describe arcs in all the quadrantal openings, leaving room, however, for the equinoctial dial in the middle. Divide each quadrant into six equal parts for as many hours, as in the figure, and subdivide these for half hours and quarters, numbering the whole eight quadrants as in the figure. To lay down the hours in the angular spaces in the corners: On K and I as centres, with a radius equal to KI, which is equal to A*a*, describe the arcs K*t*, I*t*, meeting in *t*. Divide each arc into four equal parts, and from the centres through the points of division draw the right lines I 3, I 4, I 5, I 6, I 7, and K2, K1, K12, K11; and they will meet the sides of the angle where the hours should be marked. These hour spaces should also be subdivided into quarters. Do the like for the other three angles, determining in this way the hours shown as in the figure, in which it will be observed that the dotted lines which are parallel are all directed to the same hour of the day. The angular and quadrantal spaces should now be cut out, quite through the solid material of which the dial is formed, and the gnomons inserted in their proper position, observing that these should be as broad as the dial is thick, and this breadth and thickness such as to keep the shadows of the gnomons from ever falling quite out of the hollows, even when the sun's declination is greatest. Lastly, construct the equinoctial dial in the middle, agreeably to its theory in art. 19, and the dial will be finished.

To rectify and use the dial: Place it with its base level, and the gnomons of the quadrants directed to the cardinal points by means of the compass; then bend the pillar in the joint, till the axis be inclined to the horizon at an

[1] Place dashes (omitted in the engraving) over the letters *d* and *e* in the perpendicular to Bc, thus making them *d'*, *e'*; and in fig. 3 observe that the letter *a* ought to be over the figure 3 on the adjoining line. Also in fig. 1 write *b* on the top opposite to *c*.

Dialling. angle equal to the latitude of the place. The plane of the equinoctial dial will then be parallel to the equator, the axis of the globe directed to the pole of the heavens; and when the sun shines on the dial, the hours will be indicated by all the parallel edges which cast a shadow, as well as by the axis of the globe and the globe itself, which will show to what places of the earth the sun is rising, setting, and in the meridian.

Universal Mechanical Dial, Plate CCII. Fig 11.

96. This is an equinoctial dial, which may be applied to the construction of a dial on any kind of plane, by a process requiring no calculation. Suppose, for example, the plane ABCD is horizontal, and that GEF is the meridian line, assumed if the plane be moveable, or found if it be fixed. Place the equinoctial dial H with its axis GI directed to the pole, or, in the present case, so as to make with the meridian line an angle equal to the latitude of the place, with the twelve o'clock hour line over the meridian line. If now EF, the lower edge of the upright triangular support KEF, lie along the meridian, and the edge EK make with EF an angle equal to the latitude, the dial H will be in its proper position when its axis GI is parallel to EK. Supposing now the whole apparatus to be in a dark place, let a lighted candle be carried round GI, the axis of the equinoctial dial, and let the position of the shadow on the horizontal plane be noted when it falls on the successive hours of the equinoctial dial, then lines from G through these positions will be the hour lines on the horizontal dial. In this way a dial may be described on any plane whatever.

Dials on three different Planes, Plate CCII. Fig. 12.

97. This combination of dials shows the hour at the same time on the equinoctial dial IK, the horizontal dial ABC, and the vertical south dial; the same axis or gnomon FHG serving all the three. The figure sufficiently explains its construction and application. The method of tracing the hour lines proposed in the preceding article may be applied to produce the horizontal and south dials from the equinoctial dial.

Babylonian, Italian, and Jewish Hours.

The dials which have been described in this article are all intended to show astronomical or apparent time, of which the hours are equal, if we set aside the equation of time. Such are the hours by which we reckon time; but besides these, there are *Babylonian*, *Italian*, and *Jewish* hours.

The Babylonian hours are reckoned from sun rising to sun rising, and are twenty-four equal hours, nearly of the same length as the common hours, only they are differently numbered.

The Italian hours begin at sunset, and are numbered to twenty-four at sunset next day. They also are equal, and nearly the same as the common hours.

The Jewish hours, otherwise called the *old unequal planetary* hours, are reckoned from sunrise; and the day, from sunrise to sunset, is divided into twelve equal parts or hours. The hours of one day, however, will not be equal to those of another, at least in our climate, because of the inequality of the length of the days. Dialling.

The older writers on dialling teach how to construct dials which shall show time according to all these ways of dividing the day. They are, however, mere matters of curiosity, and therefore we think it sufficient, in this work, to have thus briefly noticed them. They are fully explained by Emerson in his *Dialling*; see also Ferguson's *Lectures*.

Table of the Sun's Longitude and Declination, and the Equation of Time, for every day in the year.

The construction of some of the dials which have been described requires that the sun's place in the ecliptic, that is, his longitude reckoned from the beginning of the sign Aries, and his declination for the different days of the year, should be known. And in order to convert apparent time into true time, that is, the time shown by the sun into the time shown by a good clock or watch going uniformly, the equation of time is wanted for every day of the year. None of these, however, can be exactly the same on the same day of every year at any given place. Thus, at Greenwich, for four succeeding years beginning with 1820, they were at noon on the first of March as follows:

Years.	Sun's Longitude.				Declination.			Equation of Time.	
	S.	°	′	″	°	′	″	M.	S.
1820	11	10	52	39	7	29	44	12	36·2
1821	11	10	38	10	7	35	13	12	39·1
1822	11	10	23	38	7	40	43	12	41·7
1823	11	10	8	49	7	46	18	12	43·4
1824	11	10	54	55	7	28	50	12	36·1

There are various reasons why the above three elements are not the same on the same day of every year: the principal one is, because the sun requires nearly six hours more than 365 days to complete a revolution in the ecliptic; and this annual deficiency being compensated by the intercalary day in every fourth year, after this interval the elements return nearly, but not exactly, to the same value on the same day of the year. Our table corresponds to 1830, the second after leap year. This will be sufficiently accurate for the construction of dials, and finding true time by them for a considerable number of years to come.

The columns of the table containing the sun's longitude and declination require no explanation. The numbers in that for the equation of time have the signs of addition (+) and of subtraction (—) annexed to them. Thus the sign + joined to $3^m.\ 50^s.$, the equation for the first of January, is understood to belong to all the days from the beginning of the year to the 15th of April inclusive, and to indicate that the equation is to be added to the time shown by the dial to get true time, or that shown by the clock. Again, the sign — belongs to all days from 16th April to 15th June inclusive, and shows that the equation must be subtracted from the time shown by the dial, and so on throughout the year.[1] (H. M—E.)

[1] See also the article DIPLEIDOSCOPE.

TABLE showing the Sun's Longitude and Declination, and the Equation of Time, for every day of the second year after leap year.

JANUARY.				MARCH.				MAY.			
Days.	Sun's Longitude.	Sun's Declination.	Equation of Time.	Days.	Sun's Longitude.	Sun's Declination.	Equation of Time.	Days.	Sun's Longitude	Sun's Declination.	Equation of time.
	S. ° ′	° ′	M. S.		S. ° ′	° ′	M. S.		S. ° ′	° ′	M. S.
1	9 10 39	23 2 S.	3 50+	1	11 10 27	7 39 S.	12 42+	1	1 10 34	15 0 N.	3 1—
2	9 11 40	22 57	4 19	2	11 11 28	7 16	12 30	2	1 11 32	15 18	3 8
3	9 12 42	22 51	4 47	3	11 12 28	6 53	12 17	3	1 12 31	15 36	3 15
4	9 13 43	22 45	5 14	4	11 13 28	6 30	12 4	4	1 13 29	15 54	3 22
5	9 14 44	22 39	5 41	5	11 14 28	6 7	11 50	5	1 14 27	16 11	3 28
6	9 15 45	22 32	6 8	6	11 15 28	5 44	11 36	6	1 15 25	16 28	3 33
7	9 16 46	22 24	6 34	7	11 16 28	5 21	11 22	7	1 16 23	16 45	3 38
8	9 17 47	22 17	7 0	8	11 17 27	4 58	11 7	8	1 17 21	17 1	3 43
9	9 18 49	22 8	7 25	9	11 18 27	4 34	10 51	9	1 18 18	17 18	3 46
10	9 19 50	22 0	7 49	10	11 19 27	4 11	10 36	10	1 19 16	17 34	3 49
11	9 20 51	21 50	8 13	11	11 20 27	3 47	10 20	11	1 20 14	17 49	3 52
12	9 21 52	21 41	8 37	12	11 21 27	3 24	10 4	12	1 21 12	18 4	3 54
13	9 22 53	21 31	8 59	13	11 22 27	3 0	9 47	13	1 22 10	18 20	3 55
14	9 23 54	21 21	9 22	14	11 23 26	2 36	9 30	14	1 23 8	18 34	3 56
15	9 24 55	21 10	9 43	15	11 24 26	2 13	9 13	15	1 24 6	18 49	3 56
16	9 25 56	20 59	10 4	16	11 25 26	1 49	8 56	16	1 25 3	19 3	3 56
17	9 26 58	20 47	10 24	17	11 26 25	1 25	8 38	17	1 26 1	19 17	3 55
18	9 27 59	20 35	10 44	18	11 27 25	1 2	8 20	18	1 26 59	19 30	3 53
19	9 29 0	20 23	11 3	19	11 28 24	0 38	8 3	19	1 27 57	19 43	3 51
20	9 0 1	20 10	11 21	20	11 29 24	0 14	7 45	20	1 28 54	19 56	3 48
21	10 1 2	20 57	11 38	21	0 0 23	0 9	7 26	21	1 29 52	20 8	3 45
22	10 2 3	19 48	11 55	22	0 1 23	0 33 N.	7 8	22	2 0 50	20 20	3 41
23	10 3 4	19 29	12 11	23	0 2 22	0 57	6 50	23	2 1 47	20 32	3 37
24	10 4 5	19 15	12 26	24	0 3 22	1 20	6 32	24	2 2 45	20 44	3 32
25	10 5 6	19 0	12 40	25	0 4 21	1 44	6 13	25	2 3 43	20 55	3 27
26	10 6 7	18 46	12 53	26	0 5 21	2 7	5 55	26	2 4 40	21 5	3 21
27	10 7 8	18 30	13 6	27	0 6 20	2 31	5 36	27	2 5 38	21 16	3 14
28	10 8 9	18 15	13 18	28	0 7 19	2 54	5 18	28	2 6 35	21 26	3 8
29	10 9 10	17 59	13 29	29	0 8 18	3 18	4 59	29	2 7 33	21 35	3 0
30	10 10 11	17 42	13 39	30	0 9 18	3 41	4 41	30	2 8 30	21 44	2 53
31	10 11 12	17 26	13 48	31	0 10 17	4 4	4 22	31	2 9 28	21 53	2 45
FEBRUARY.				APRIL.				JUNE.			
1	10 12 13	17 9 S.	13 57+	1	0 11 16	4 28 N.	4 4+	1	2 10 25	22 2 N.	2 36—
2	10 13 13	16 52	14 4	2	0 12 15	4 51	3 46	2	2 11 23	22 10	2 27
3	10 14 14	16 34	14 11	3	0 13 14	5 14	3 28	3	2 12 20	22 17	2 18
4	10 15 15	16 17	14 17	4	0 14 13	5 37	3 10	4	2 13 17	22 25	2 8
5	10 16 16	15 58	14 22	5	0 15 12	5 59	2 52	5	2 14 15	22 32	1 58
6	10 17 17	15 40	14 26	6	0 16 11	6 22	2 34	6	2 15 12	22 38	1 48
7	10 18 17	15 22	14 29	7	0 17 10	6 45	2 16	7	2 16 10	22 44	1 37
8	10 19 18	15 3	14 32	8	0 18 9	7 7	1 59	8	2 17 7	22 50	1 26
9	10 20 19	14 44	14 34	9	0 19 7	7 30	1 42	9	2 18 4	22 55	1 15
10	10 21 19	14 24	14 35	10	0 20 6	7 52	1 25	10	2 19 2	23 0	1 4
11	10 22 20	14 5	14 35	11	0 21 5	8 14	1 9	11	2 19 59	23 5	0 52
12	10 23 21	13 45	14 35	12	0 22 4	8 36	0 52	12	2 20 56	23 9	0 40
13	10 24 21	13 25	14 33	13	0 23 2	8 58	0 36	13	2 21 53	23 13	0 28
14	10 25 22	13 5	14 31	14	0 24 1	9 20	0 21	14	2 22 51	23 16	0 15
15	10 26 22	12 44	14 29	15	0 25 0	9 41	0 5	15	2 23 48	23 19	0 3
16	10 27 23	12 23	14 25	16	0 25 58	10 2	0 9—	16	2 24 45	23 21	0 10+
17	10 28 23	12 3	14 21	17	0 26 57	10 24	0 24	17	2 25 43	23 23	0 23
18	10 29 24	11 42	14 16	18	0 27 56	10 45	0 38	18	2 26 40	23 25	0 36
19	11 0 24	11 20	14 11	19	0 28 54	11 6	0 52	19	2 27 37	23 26	0 49
20	11 1 25	10 59	14 5	20	0 29 53	11 26	1 5	20	2 28 34	23 27	1 2
21	11 2 25	10 37	13 58	21	1 0 51	11 47	1 18	21	2 29 32	23 27	1 15
22	11 3 26	10 16	13 51	22	1 1 50	12 7	1 30	22	3 0 29	23 27	1 28
23	11 4 26	9 54	13 43	23	1 2 48	12 27	1 42	23	3 1 26	23 27	1 41
24	11 5 26	9 32	13 34	24	1 3 46	12 47	1 54	24	3 2 24	23 26	1 54
25	11 6 27	9 9	13 25	25	1 4 45	13 7	2 5	25	3 3 21	23 25	2 7
26	11 7 27	8 47	13 15	26	1 5 43	13 26	2 15	26	3 4 18	23 23	2 20
27	11 8 27	8 24	13 4	27	1 6 41	13 46	2 25	27	3 5 15	23 21	2 33
28	11 9 27	8 2	12 53	28	1 7 40	14 5	2 35	28	3 6 12	23 19	2 45
				29	1 8 38	14 23	2 44	29	3 7 10	23 16	2 57
				30	1 9 36	14 42	2 53	30	3 8 7	23 13	3 9

Table of the Sun's Longitude and Declination, &c. continued.

JULY.				SEPTEMBER.				NOVEMBER.			
Days.	Sun's Longitude.	Sun's Declination.	Equation of Time.	Days	Sun's Longitude.	Sun's Declination.	Equation of Time.	Days	Sun's Longitude.	Sun's Declination.	Equation of Time.
	S. ° ′	° ′	M. S.		S. ° ′	° ′	M. S.		S. ° ′	° ′	M. S.
1	3 9 4	23 9 N.	3 21+	1	5 8 30	8 24 N	0 3—	1	7 8 34	14 22 S.	16 15—
2	3 10 1	23 5	3 32	2	5 9 28	8 2	0 22	2	7 9 34	14 41	16 16
3	3 10 58	23 0	3 44	3	5 10 26	7 40	0 41	3	7 10 35	15 0	16 17
4	3 11 56	22 55	3 55	4	5 11 24	7 18	1 1	4	7 11 35	15 19	16 16
5	3 12 53	22 50	4 5	5	5 12 22	6 56	1 20	5	7 12 35	15 38	16 15
6	3 13 50	22 44	4 15	6	5 13 20	6 33	1 40	6	7 13 35	15 56	16 13
7	3 14 47	22 38	4 25	7	5 14 19	6 11	2 0	7	7 14 35	16 14	16 10
8	3 15 44	22 32	4 35	8	5 15 17	5 48	2 20	8	7 15 36	16 31	16 6
9	3 16 41	22 25	4 44	9	5 16 15	5 26	2 41	9	7 16 36	16 49	16 1
10	3 17 39	22 18	4 53	10	5 17 14	5 3	3 1	10	7 17 36	17 6	15 56
11	3 18 36	22 10	5 1	11	5 18 12	4 40	3 22	11	7 18 37	17 23	15 49
12	3 19 33	22 2	5 9	12	5 19 10	4 17	3 43	12	7 19 37	17 39	15 42
13	3 20 30	21 54	5 17	13	5 20 9	3 54	4 4	13	7 20 38	17 55	15 34
14	3 21 28	21 45	5 24	14	5 21 7	3 31	4 24	14	7 21 38	18 11	15 25
15	3 22 25	21 36	5 31	15	5 22 6	3 8	4 45	15	7 22 39	18 27	15 15
16	3 23 22	21 26	5 37	16	5 23 5	2 45	5 6	16	7 23 39	18 42	15 4
17	3 24 19	21 16	5 43	17	5 24 3	2 22	5 27	17	7 24 40	18 57	14 53
18	3 25 17	21 6	5 48	18	5 25 2	1 59	5 48	18	7 25 41	19 12	14 40
19	3 26 14	20 55	5 53	19	5 26 0	1 35	6 9	19	7 26 41	19 26	14 27
20	3 27 11	20 44	5 57	20	5 26 59	1 12	6 30	20	7 27 42	19 40	14 13
21	3 28 9	20 33	6 0	21	5 27 58	0 49	6 51	21	7 28 43	19 53	13 58
22	3 29 6	20 21	6 3	22	5 28 57	0 25	7 12	22	7 29 43	20 6	13 42
23	4 0 3	20 9	6 6	23	5 29 55	0 2	7 33	23	8 0 44	20 19	13 26
24	4 1 1	19 57	6 8	24	6 0 54	0 22 S.	7 54	24	8 1 45	20 32	13 9
25	4 1 58	19 44	6 9	25	6 1 53	0 45	8 14	25	8 2 45	20 44	12 51
26	4 2 55	19 31	6 10	26	6 2 52	1 8	8 34	26	8 3 46	20 55	12 32
27	4 3 53	19 18	6 10	27	6 3 51	1 32	8 55	27	8 4 47	21 7	12 13
28	4 4 50	19 4	6 9	28	6 4 50	1 55	9 15	28	8 5 48	21 17	11 53
29	4 5 47	18 50	6 8	29	6 5 49	2 19	9 35	29	8 6 49	21 28	11 32
30	4 6 45	18 36	6 6	30	6 6 48	2 42	9 54	30	8 7 49	21 38	11 11
31	4 7 42	18 22	6 4								

AUGUST.				OCTOBER.				DECEMBER.			
1	4 8 40	18 7 N.	6 1+	1	6 7 47	3 5 S.	10 14—	1	8 8 50	21 48 S.	10 49—
2	4 9 37	17 51	5 57	2	6 8 46	3 29	10 33	2	8 9 51	21 57	10 26
3	4 10 34	17 36	5 53	3	6 9 45	3 52	10 51	3	8 10 52	22 6	10 3
4	4 11 32	17 20	5 48	4	6 10 44	4 15	11 10	4	8 11 53	22 14	9 39
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6	4 13 27	16 48	5 36	6	6 12 42	5 1	11 46	6	8 13 55	22 29	8 49
7	4 14 24	16 31	5 30	7	6 13 42	5 24	12 3	7	8 14 56	22 36	8 23
8	4 15 22	16 15	5 23	8	6 14 41	5 47	12 20	8	8 15 57	22 43	7 57
9	4 16 19	15 57	5 15	9	6 15 40	6 10	12 36	9	8 16 58	22 49	7 30
10	4 17 17	15 40	5 6	10	6 16 40	6 33	12 52	10	8 17 59	22 55	7 3
11	4 18 15	15 22	4 58	11	6 17 39	6 56	13 8	11	8 19 0	23 0	6 36
12	4 19 12	15 5	4 48	12	6 18 39	7 19	13 23	12	8 20 1	23 5	6 8
13	4 20 10	14 46	4 38	13	6 19 38	7 41	13 37	13	8 21 2	23 9	5 39
14	4 21 8	14 28	4 28	14	6 20 38	8 4	13 51	14	8 22 3	23 13	5 10
15	4 22 5	14 10	4 17	15	6 21 37	8 26	14 4	15	8 23 4	23 17	4 41
16	4 23 3	13 51	4 5	16	6 22 37	8 48	14 17	16	8 24 5	23 20	4 12
17	4 24 1	13 32	3 53	17	6 23 36	9 10	14 29	17	8 25 7	23 22	3 43
18	4 24 58	13 12	3 40	18	6 24 36	9 32	14 41	18	8 26 8	23 24	3 13
19	4 25 56	12 53	3 27	19	6 25 36	9 54	14 52	19	8 27 9	23 26	2 43
20	4 26 54	12 33	3 14	20	6 26 35	10 16	15 3	20	8 28 10	23 27	2 13
21	4 27 52	12 13	3 0	21	6 27 35	10 37	15 12	21	8 29 11	23 27	1 43
22	4 28 50	11 53	2 45	22	6 28 35	10 59	15 22	22	9 0 12	23 28	1 13
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24	5 0 46	11 13	2 15	24	7 0 35	11 41	15 38	24	9 2 15	23 26	0 13
25	5 1 43	10 52	1 59	25	7 1 34	12 2	15 45	25	9 3 16	23 25	0 17+
26	5 2 41	10 31	1 43	26	7 2 34	12 23	15 52	26	9 4 17	23 23	0 47
27	5 3 39	10 11	1 26	27	7 3 34	12 43	15 57	27	9 5 18	23 21	1 16
28	5 4 37	9 49	1 9	28	7 4 34	13 3	16 2	28	9 6 19	23 18	1 46
29	5 5 35	9 28	0 51	29	7 5 34	13 23	16 7	29	9 7 20	23 15	2 15
30	5 6 33	9 7	0 33	30	7 6 34	13 43	16 10	30	9 8 22	23 12	2 44
31	5 7 31	8 45	0 15	31	7 7 34	14 3	16 13	31	9 9 23	23 8	3 13

Dialogism || Dialogue.

DIALOGISM, in *Rhetoric*, a mode of writing which consists in the narration of a dialogue, or in which the conversation of two or more persons is given in the reported form. It is also applied, less strictly, to a soliloquy, or that kind of conversation which a person holds with himself, when reduced into the narrative form.

DIALOGUE, a conversation between two or more persons; either written or oral.

This mode of writing was introduced at a very early period, there being several instances of it in the Mosaic history. The dialogue was the form most generally adopted by the Greek philosophers as the most convenient and agreeable method of conveying instruction. And indeed it seems to be attended with considerable advantages, if judiciously managed; for in this way things may be canvassed more minutely, and many lesser matters, which serve to clear up a subject, may be introduced with better grace, by means of questions and answers, objections and replies, than can be conveniently done in a continued discourse. It possesses also this further advantage, that the author is at liberty to choose his speakers; and therefore, as Cicero has observed, when we imagine that we have persons of an established reputation for wisdom and knowledge talking together, this circumstance necessarily adds a weight and authority to the discourse, and more closely engages the attention. The subject-matter of dialogue is very extensive; for whatever is a proper subject of discourse, public or private, serious or jocose—whatever is fit for wise and ingenious men to talk upon, either for improvement or diversion—is suitable for a dialogue.

The principal things necessary to be observed in this species of composition may be well illustrated from Cicero's excellent dialogues concerning an orator. A dialogue then consists of two parts; an *introduction*, and *the body of the discourse*.

The *introduction* acquaints us with the place, time, persons, and occasion of the conversation. Thus Cicero places the scene of his dialogues at the country seat of Crassus; a very proper retreat, both for such a debate and the parties engaged in it. And as they were persons of the first rank employed in the greatest affairs of the state, and as the discourse occupied them for two days, he represents it to have happened at the time of a festival, when no business was done at Rome, and an opportunity was thus afforded them of being absent. The two principal disputants are Crassus and Antony, the greatest orators of that age, and therefore the most proper persons to dispute respecting the qualifications essential for their art. Some good writers have run into the impropriety of feigning dialogues between persons who were not contemporaries. Plato adopted this method, in which he has been followed by Macrobius. Others, again, who wished to bring persons to discourse together who lived in different ages, without such inconsistency, have written dialogues of the dead. Lucian has made himself most remarkable in this way. As to the number of persons in a dialogue, they may be more or fewer. Some of Cicero's dialogues have but two, others three or more, and those concerning an orator seven. But it is convenient in some respects that they should all be persons of different characters and abilities; a circumstance which contributes both to the variety and beauty of the discourse, like the different attitudes of figures in a picture. Thus, in Cicero's dialogues last mentioned, Crassus excelled in art, Antony principally by the force of his genius, Catullus by the purity of his style, Scevolo by his skill in the law, Cæsar by wit and humour; and Sulpitius and Cotta, though young men, were both excellent orators, yet they differed in their manner. But there should be always one principal person, having the main part of the conversation; like the hero in an epic poem or a tragedy, who excels the rest in action, or the principal figure in a picture, which is always made the most conspicuous. In Plato's dialogues this is Socrates; and in those of Cicero, above mentioned, the principal person is Crassus. Dialogue.

It is usual likewise, in the introduction, to acquaint us with the occasion of the discourse. Indeed this is not always mentioned; as in Cicero's dialogue concerning the parts of oratory, where the son begins immediately with desiring his father to instruct him in the art. But it is generally taken notice of, and most commonly represented as accidental. Thus Cicero, in his dialogues concerning an orator, makes Crassus occasionally fall upon the subject of oratory, in order to divert the company from the melancholy thoughts of what they had been discoursing of before, with relation to the public disorders, and the dangers which threatened their common country. But prolixity in the introduction is especially to be avoided. Addison condemns this fault in some authors who employ dialogue. "For though," as he says, "some of the finest treatises of the most polite Latin and Greek writers are in dialogue, as many very valuable pieces of French, Italian, and English appear in the same dress; yet in some of them there is so much time taken up in ceremony, that, before they enter on their subject, the dialogue is half over."

Regarding the *body* of the discourse, some things relating to the persons, and others to the subject, may be here remarked.

With reference to the *persons*, the principal thing to be attended to is to keep up throughout a justness and consistency of character. This distinction ought to be so perfectly observed, that even from the very words it may be always known who is the speaker. Herein consists one great difficulty in the composition of a dialogue, especially when the characters are numerous. The principal speaker should appear to be a person of superior sense and wisdom, and best acquainted with the subject. No question ought to be asked him, nor objection started, but what he should fairly answer; and all that is said by the rest should principally tend to promote his discourse, and carry it through in the most agreeable manner. When the argument is attended with difficulties, one other person or more, of equal reputation, or nearly so, but of different sentiments, should be introduced to oppose him, and maintain the contrary side of the question. This affords an opportunity for a thorough examination of the point on both sides, and for answering all objections. But if the combatants are not pretty equally matched, and masters of the subject, they will treat it but superficially. Through the whole debate, however, there ought not to be the least wrangling or obstinacy; nothing, indeed, but the appearance of good humour and good breeding, together with a readiness to submit to conviction and the force of truth, according as the evidence shall appear to be on one side or the other. In Cicero, these two characters are Crassus and Antony; and from them Addison seems to have taken his Philander and Cynthio in his *Dialogues upon the Usefulness of Ancient Medals*, which are formed pretty much upon Cicero's plan. When younger persons are introduced, or such as are not equally acquainted with the subject, they should rather be inquisitive than disputative; and the questions they ask should be neither too long nor too frequent, in order that they may not too much interrupt the debate. Sulpitius and Cotta sustain this character in Cicero, and Eugenius in Addison. It is very convenient, however, that there should be one person of a witty and jocose humour, to enliven the discourse and render it the more entertaining, especially when the dialogue is drawn out to any considerable length. Cæsar performs this part in Cicero; and in Addison, Cynthio, a person of a similar turn, opposes Philander in a humorous way. Addison's subject admitted of this; but the seriousness and gravity of Cicero's argument required a different speaker for the jocose part. Many persons ought not to speak immediately after

Dialogue.

one another; though Scaliger and others think a fourth person may sometimes be permitted to speak in the same scene without confusion. However, if this is not commonly allowed upon the stage, where the actors are present, and may be distinguished by their voice and habit; much less should it be so in a dialogue, where we have only their names to distinguish them.

With regard to the *subject*, all the arguments should appear probable at least, and nothing should be advanced which may seem weak or trivial. There ought also to be an union in dialogue, in order that the discourse may not ramble, but keep up to the main design. Short and pleasant digressions are sometimes allowable, for the ease and entertainment of the reader; but every thing should be so managed that he may still be able to carry on the thread of the discourse in his mind, and keep the main argument in view, till the whole be finished. The writers of dialogue have not confined their discourses to any certain space of time, but either concluded them with the day, or broken off when their speakers have been tired, and resumed them again the next day. Thus Cicero allows two days for his three dialogues concerning an orator; but Addison extends his to three days, allowing a day for each. But the same method has not always been observed in composing dialogues: for sometimes the writer, by way of narrative, relates a discourse which passed between other persons. Such are the dialogues of Cicero and Addison last mentioned, and many others both of the ancients and moderns. But at other times the speakers are introduced in person as talking to each other. This, as Cicero observes, prevents the frequent repetition of those words, "he said," and "he replied;" and by placing the hearer, as it were, in the conversation, gives him a more lively representation of the discourse. In this manner, therefore, Cicero wrote his *Dialogue of Old Age*, in which Cato, who was then advanced in years, recounts the satisfaction of life which may be enjoyed in old age; and, in fact, he tells his friend Atticus he was himself so affected with that discourse, that when he reviewed it, he sometimes fancied they were not his own words, but Cato's. There are some other dialogues of Cicero written in the same way; and both Plato and Lucian generally chose this method.

Dialysis ‖ Diameter.

DIALYSIS, in *Grammar*, a mark or character consisting of two points placed over one of two vowels, to *dissolve* a diphthong, that is, to show that the two vowels are to be separated in the pronunciation of the word; as *aër*, *mosaic*.

DIAMASTIGOSIS, in *Grecian Antiquity*, a solemnity performed at Sparta at the festival of Diana Orthia. It is said to have had its origin in the following circumstance:—Two Spartans had discovered under a tree the wooden statue of that goddess which had been brought by Orestes from Tauris, and immediately lost their reason. To propitiate the angry goddess, the inhabitants of the Spartan suburbs immediately offered sacrifices at her altar. During the ceremony, however, a quarrel arose, in the course of which some persons were killed. It was necessary to atone for this pollution without delay: and human victims chosen by lot were annually sacrificed, until Lycurgus introduced the less inhuman rite of the diamastigosis, which consisted in scourging a certain number of young men with stripes until the blood flowed down their bodies upon the altar. Besides merely preventing a waste of valuable life, Lycurgus designed by the introduction of the diamastigosis to inure the Spartan youth to bodily pains and hardships of the severest kind; and many legends are to be found in the ancient classics of young men who bore these tortures with such unflinching firmness, that though they sometimes proved fatal, the sufferers exhibited no signs of pain even in the agonies of death. Death thus manfully encountered, was considered among the Spartans as no less honourable than death on the field of battle.

DIAMETER, in *Geometry*, a right line passing through the centre of a circle, or other curvilinear figure, terminated at each side by the circumference, and dividing the figure into two equal parts.

END OF VOLUME SEVENTH.

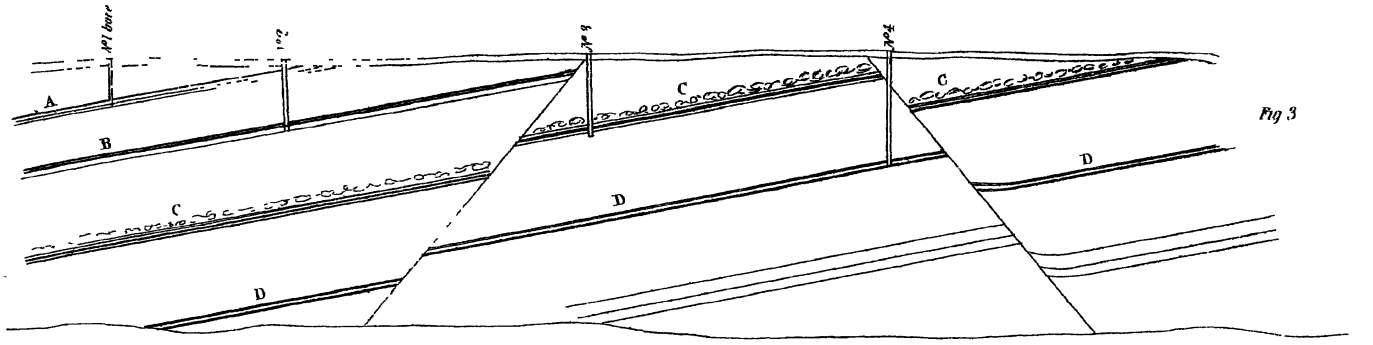


Fig 3

Section on the line of dip and rise, shewing the general effect of the overlying strata upon the buildings
Scale 6 feet to an inch

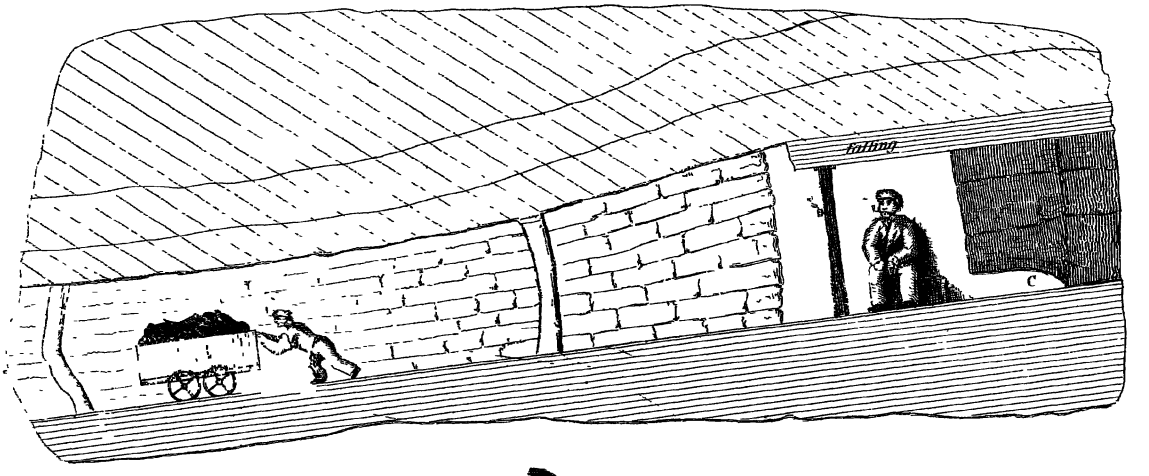


Fig 2

LONGWALL METHOD OF WORKING COAL

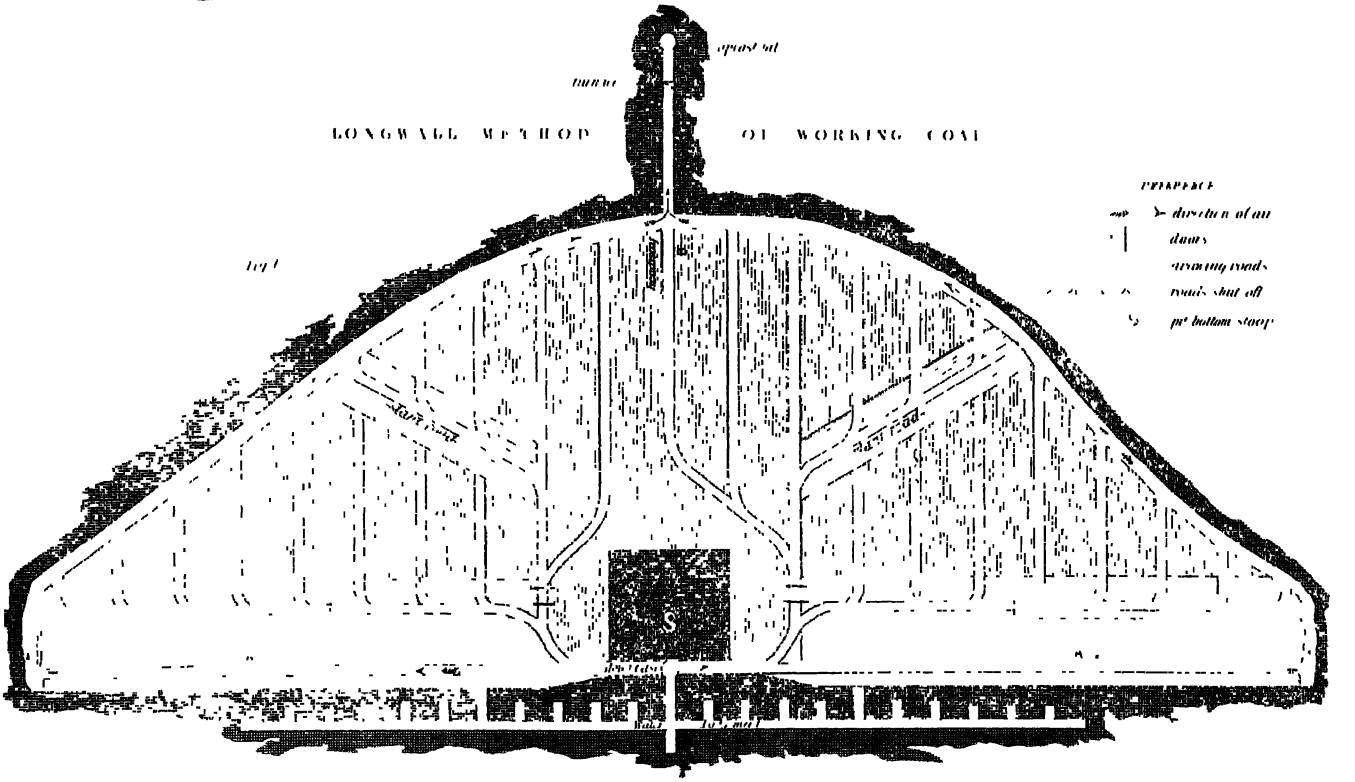
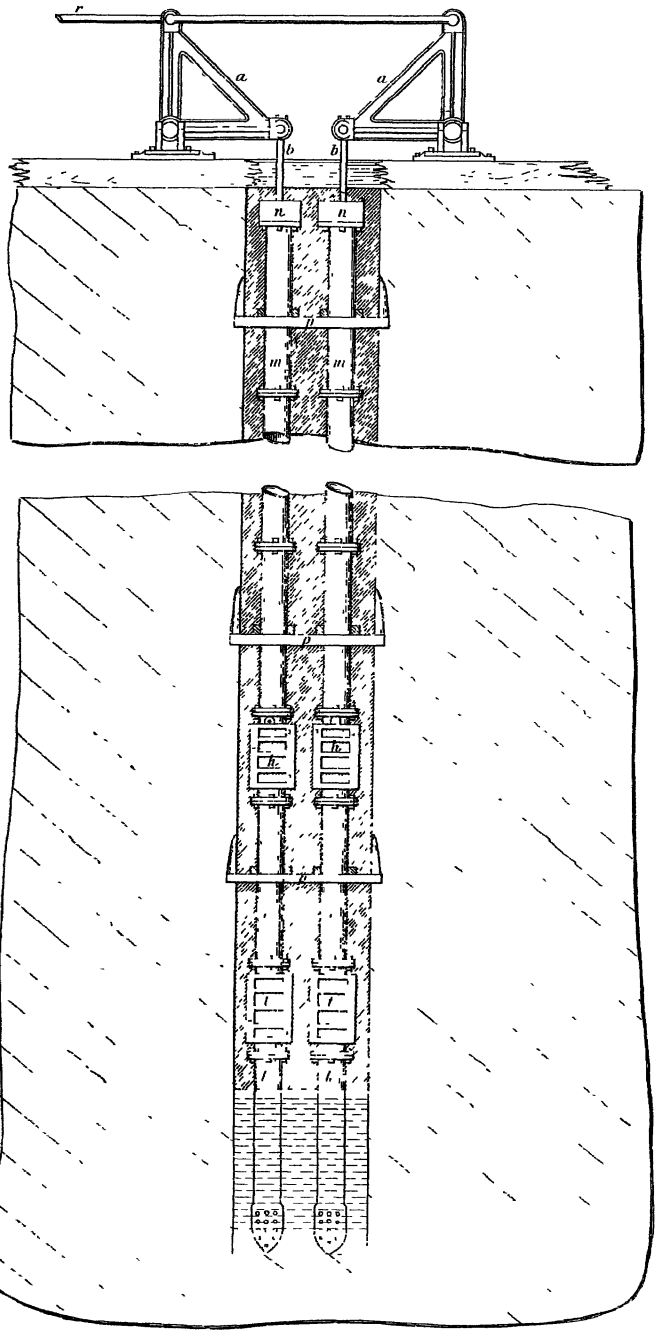


Fig 1

Scale 60 yards to an inch

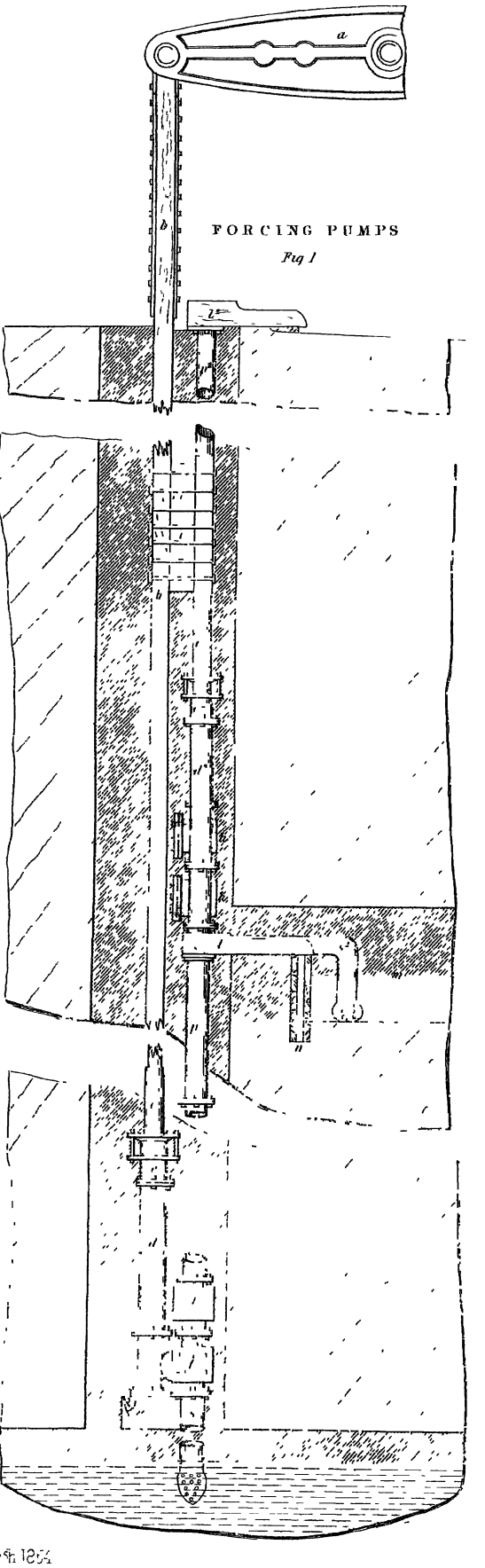
LIFTING PUMPS

Fig 2



FORCING PUMPS

Fig 1



Published by A & C Black, February 8th 1854

Fig 2.

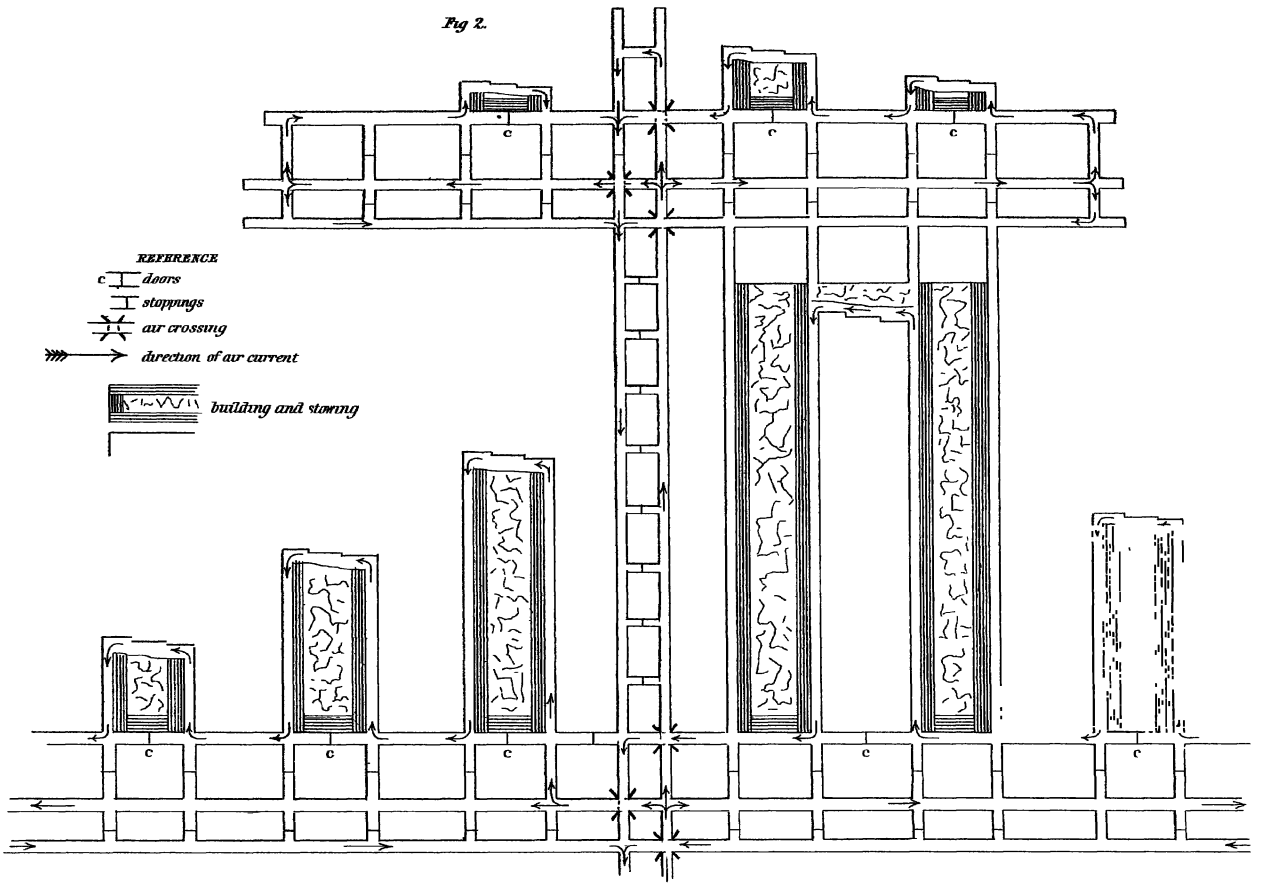
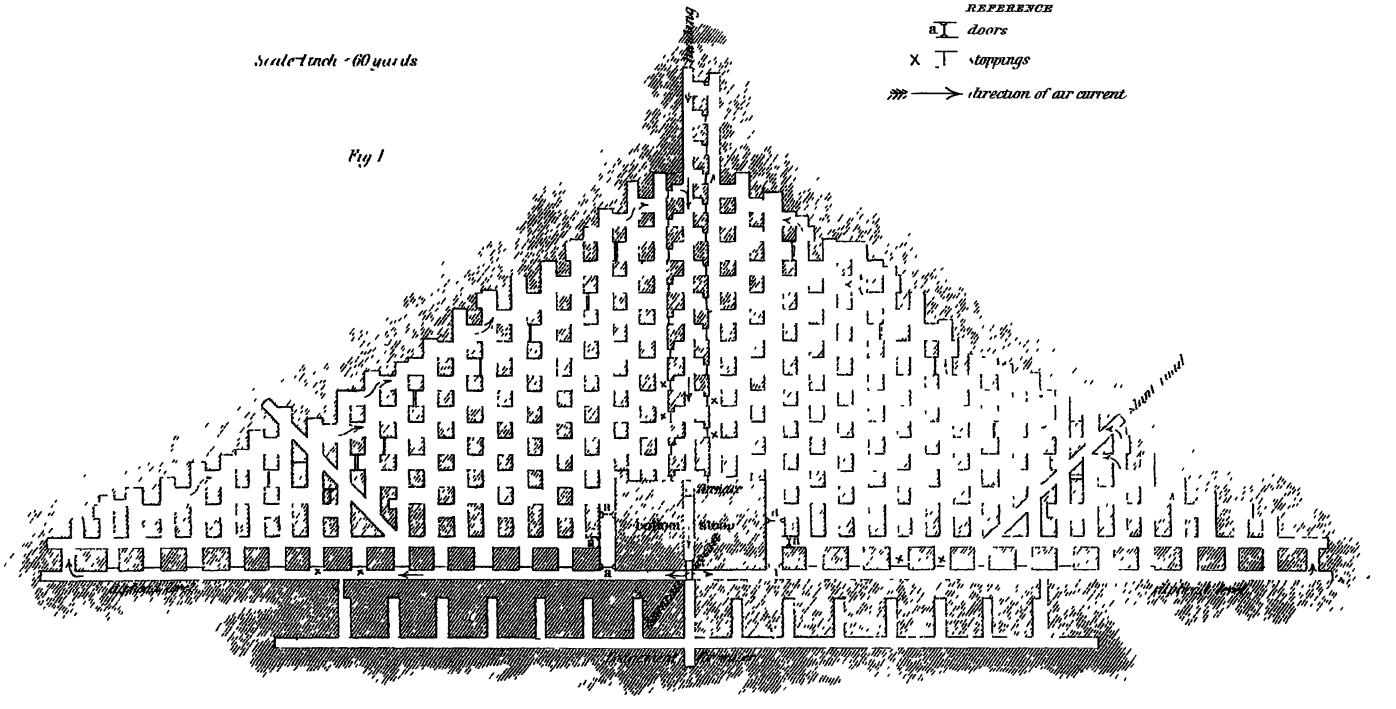


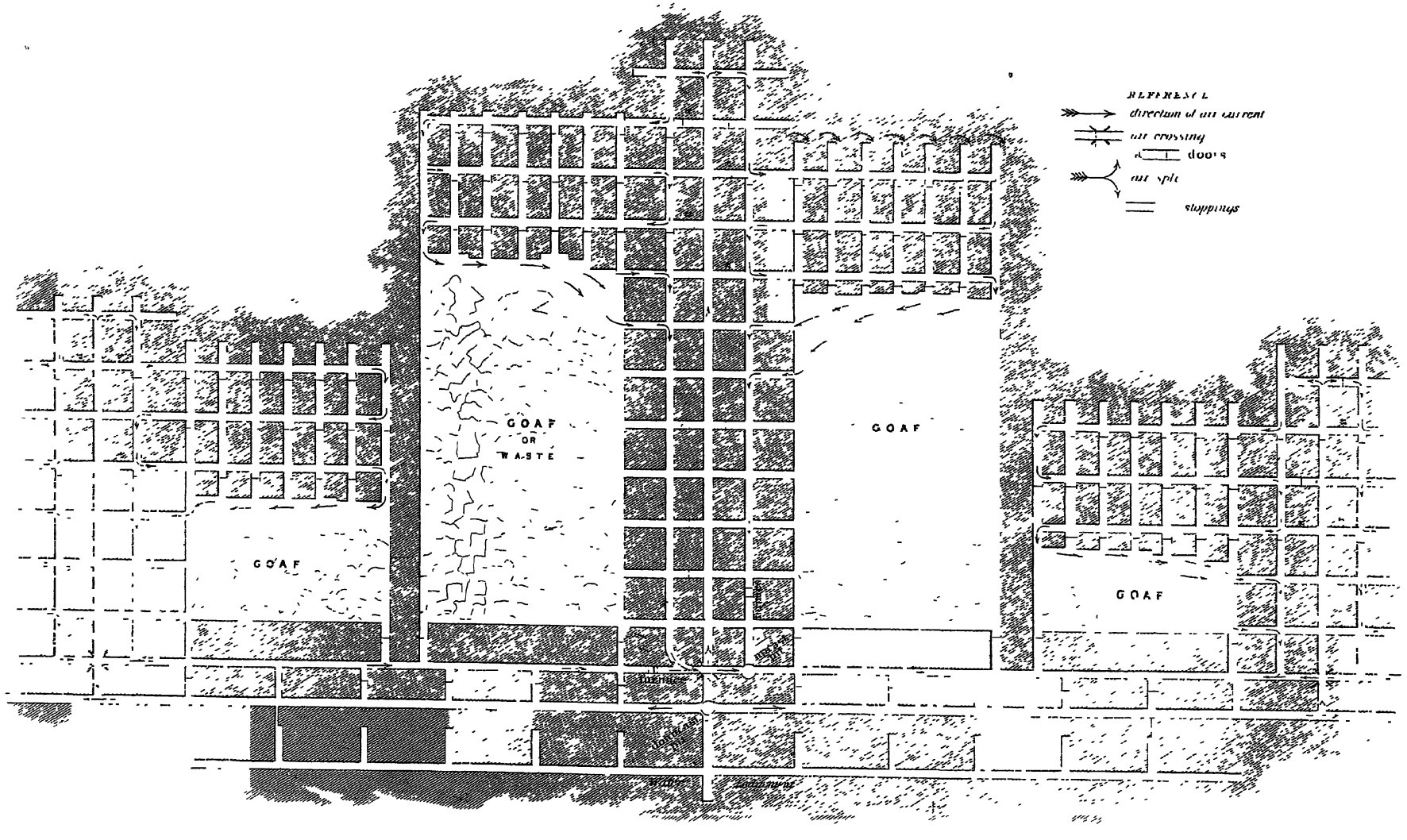
Fig 1



Published by A&C Black, Edinburgh, 1854

BORD AND PILLAR WORKING

Shewing the method of working whole coal and pillars at the same time



Published by A & C Black Edinburgh 1854

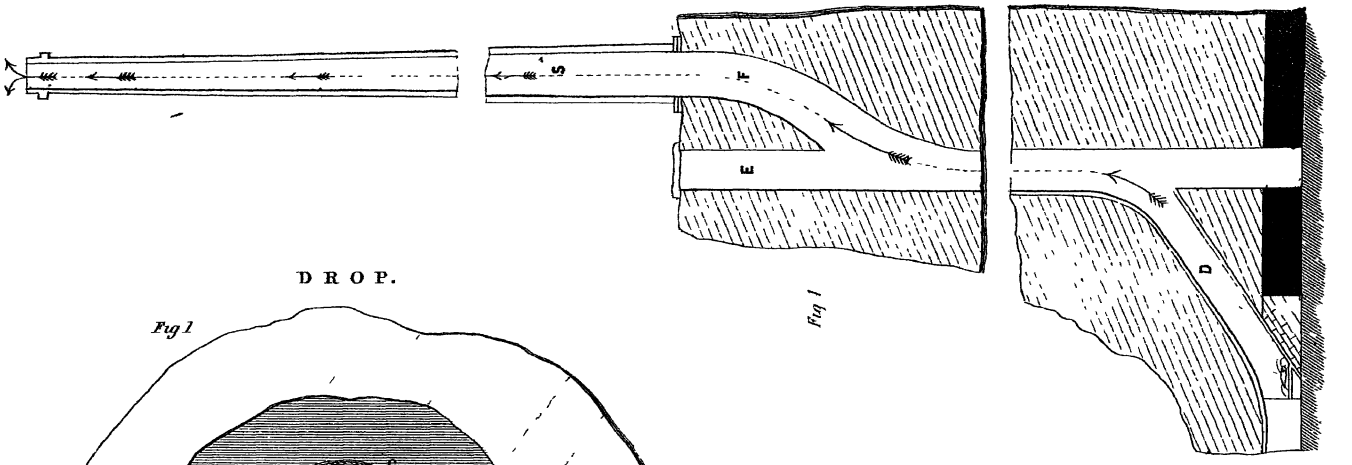
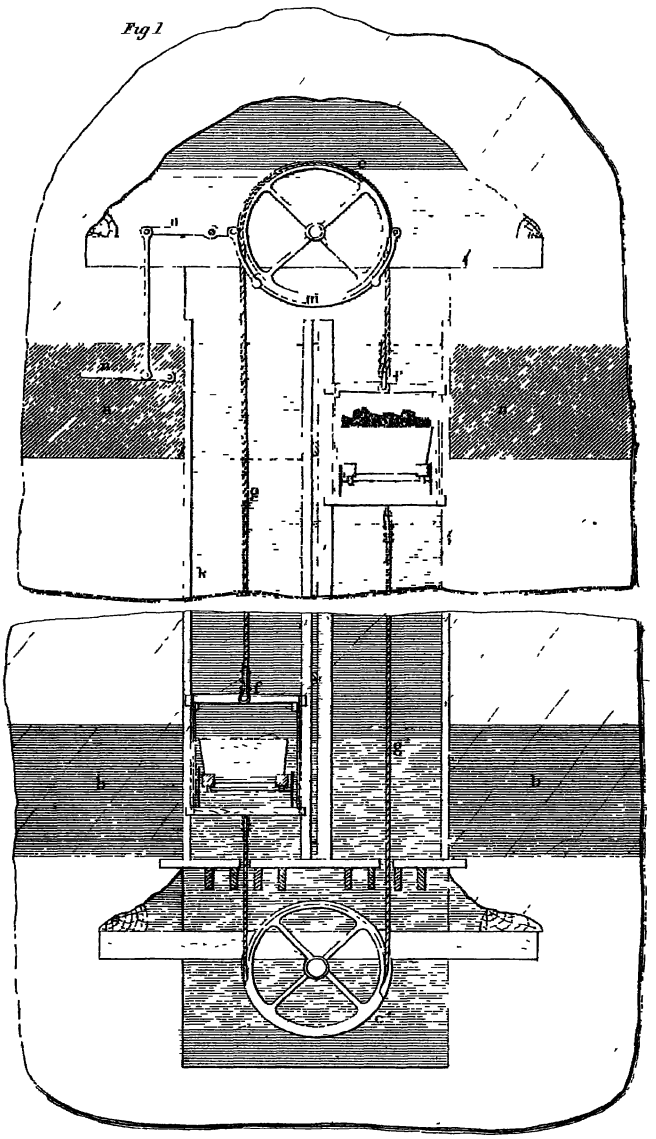


Fig 1

DROP.

Fig 1



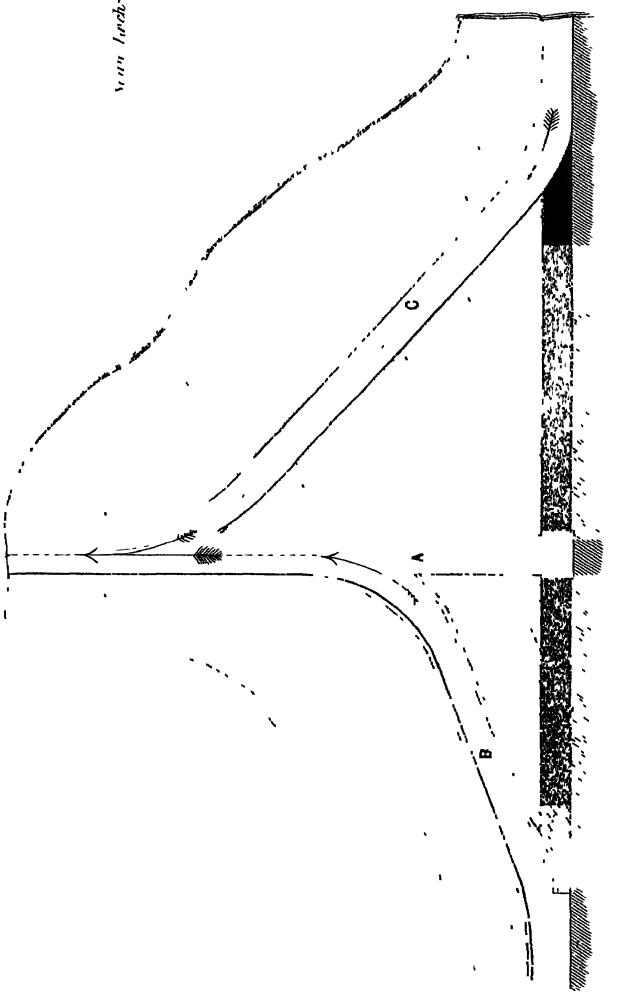


Fig 2

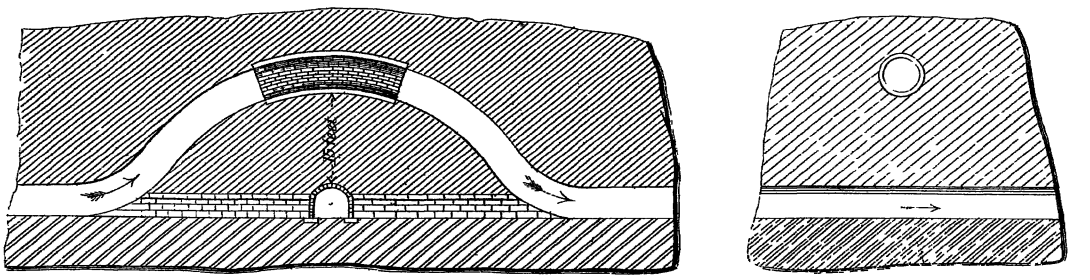
Ground plan

Scale 1 inch = 6 feet

Published by W. & C. Tait, Edinburgh, 1835.

AIR CROSSING,
ON AN ENLARGED SCALE

Fig 2

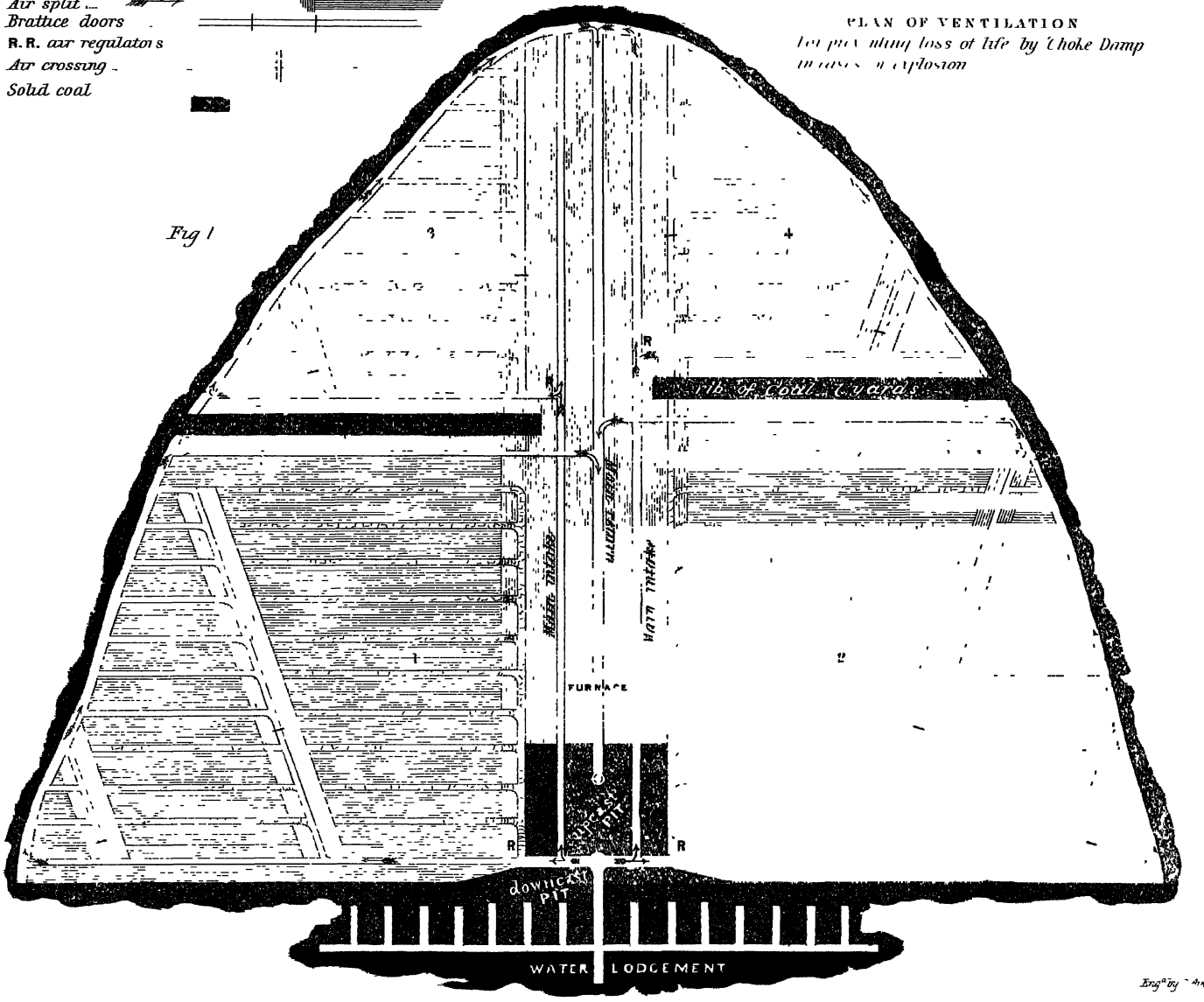


REFERENCE

Drawing Roads
Roads cut off
Building & Stowing
Air split
Brattice doors
R.R. air regulators
Air crossing
Solid coal

PLAN OF VENTILATION
for preventing loss of life by Choke Damp
in case of an explosion

Fig 1



Engd by [illegible]

Scale 60 yards to an inch

Published by A & C Black, Edinburgh, 1854

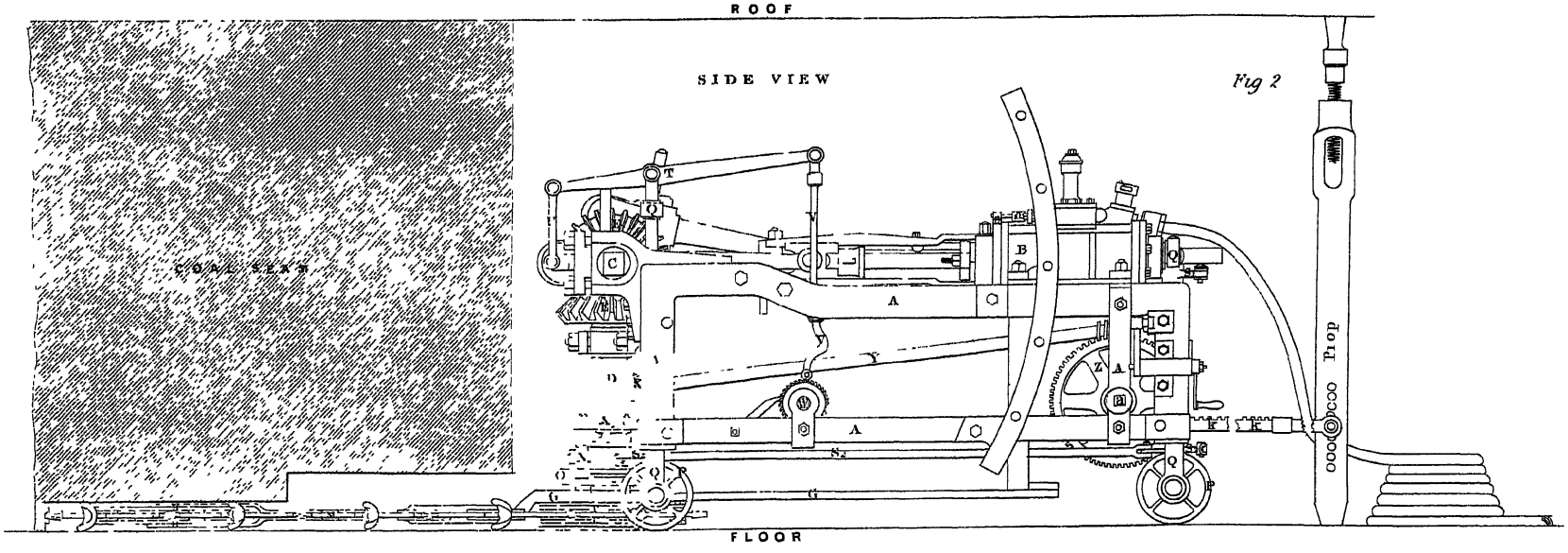


Fig 3

END VIEW

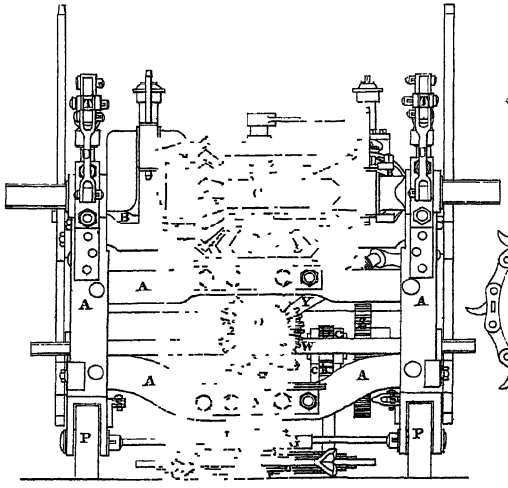


Fig 4

Fig 5

Fig 6

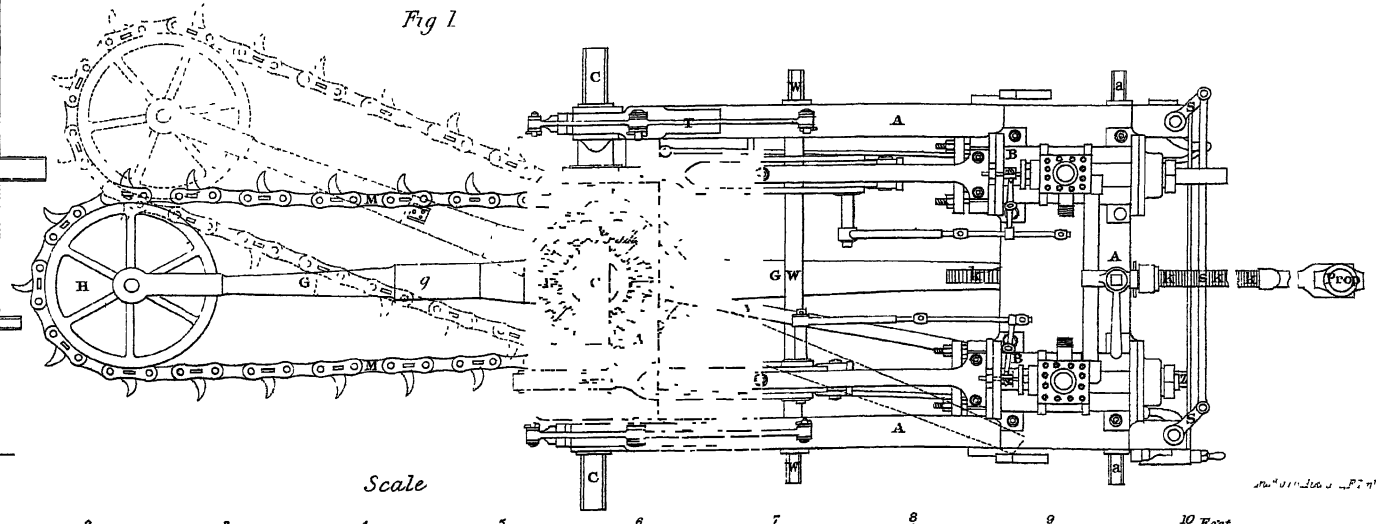


Fig 7

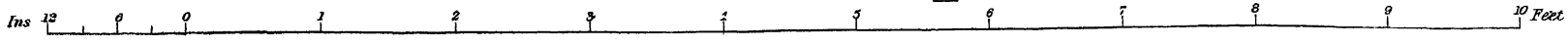


PLAN

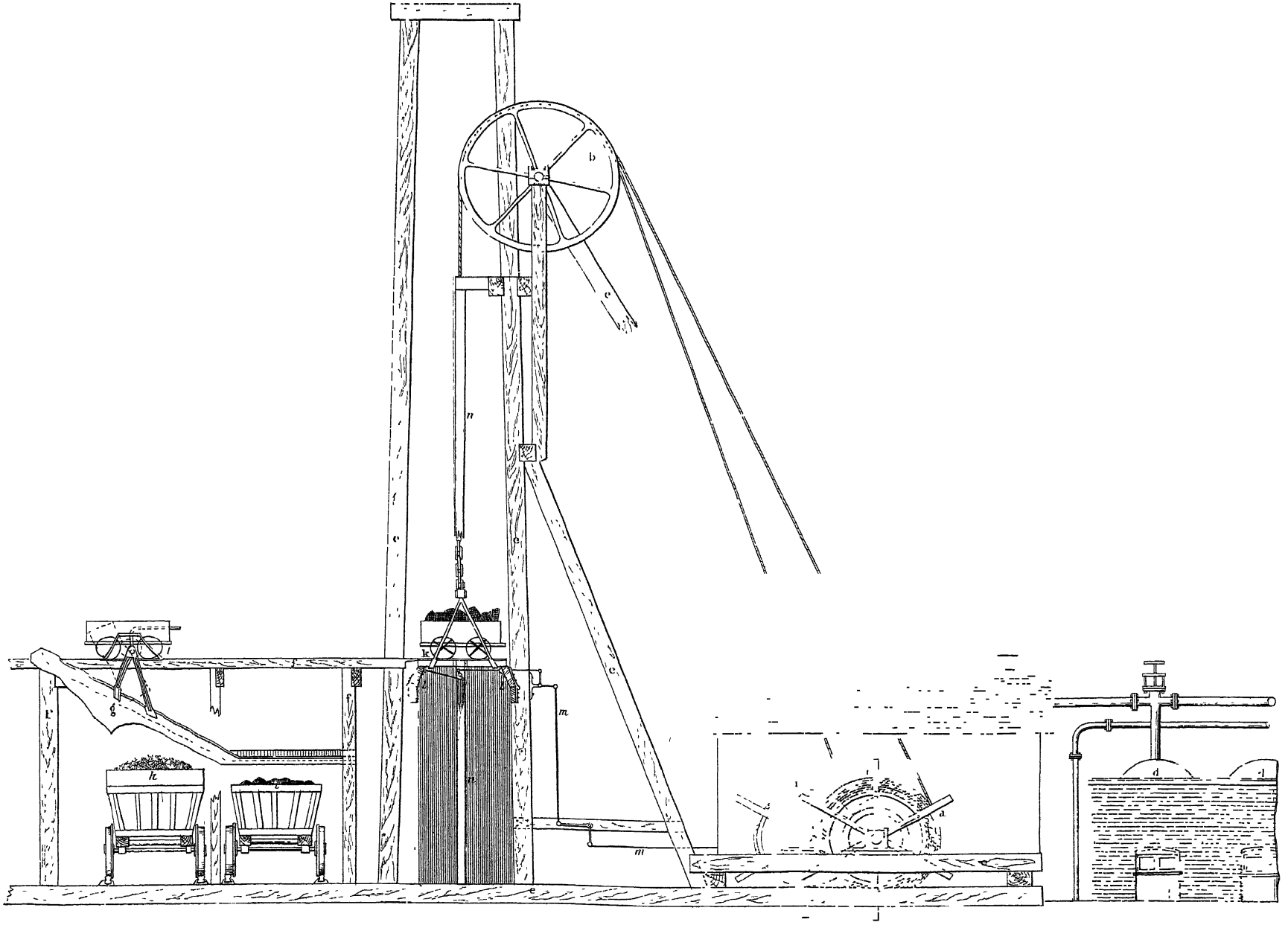
Fig 1



Scale

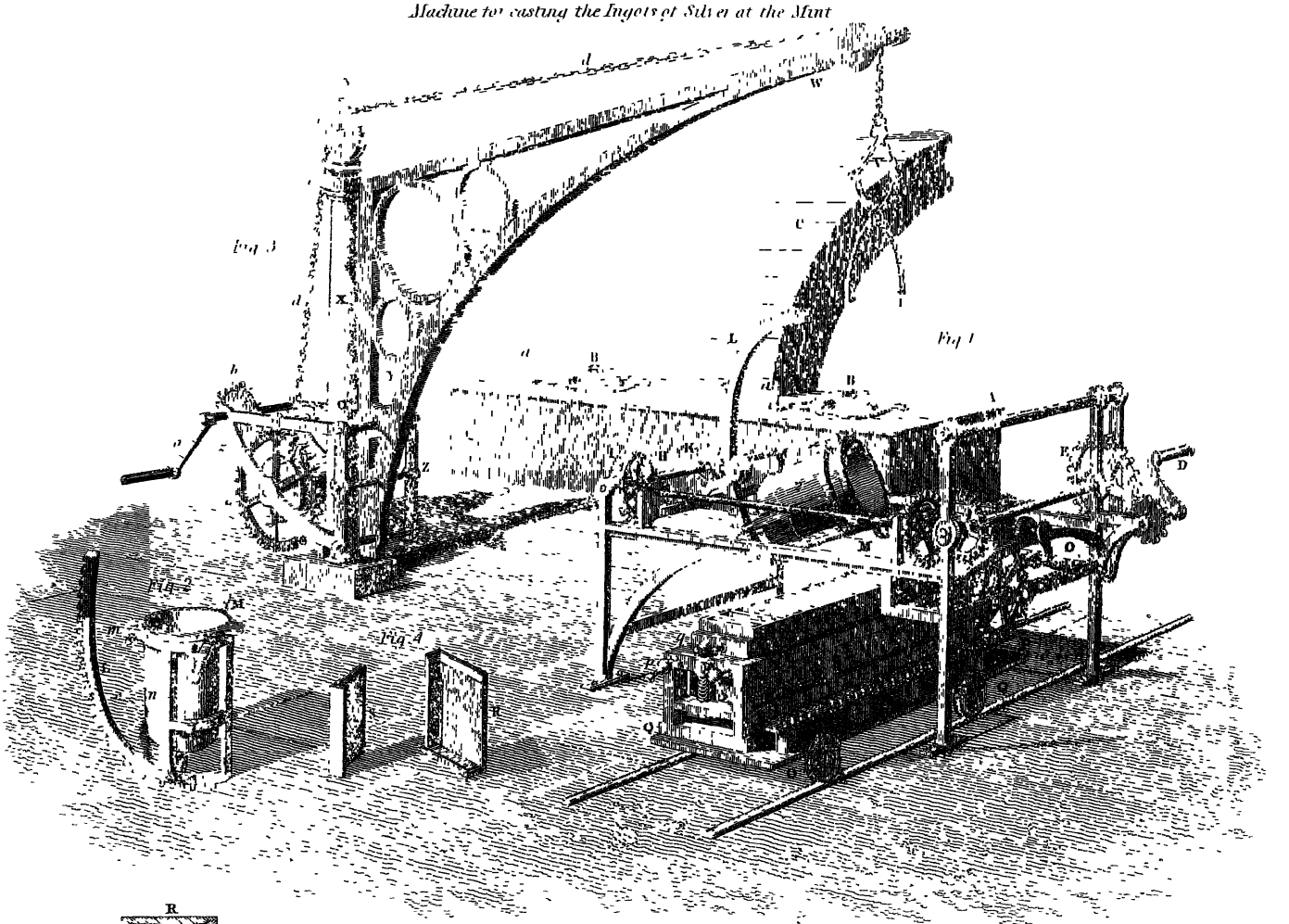


Published by A. & C. Black, Edinburgh, 1854



Published by A & C Black, Edinburgh 1851

Machine for casting the Ingots of Silver at the Mint



Laminating Rollers.

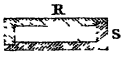


Fig 5

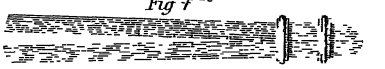


Fig 7

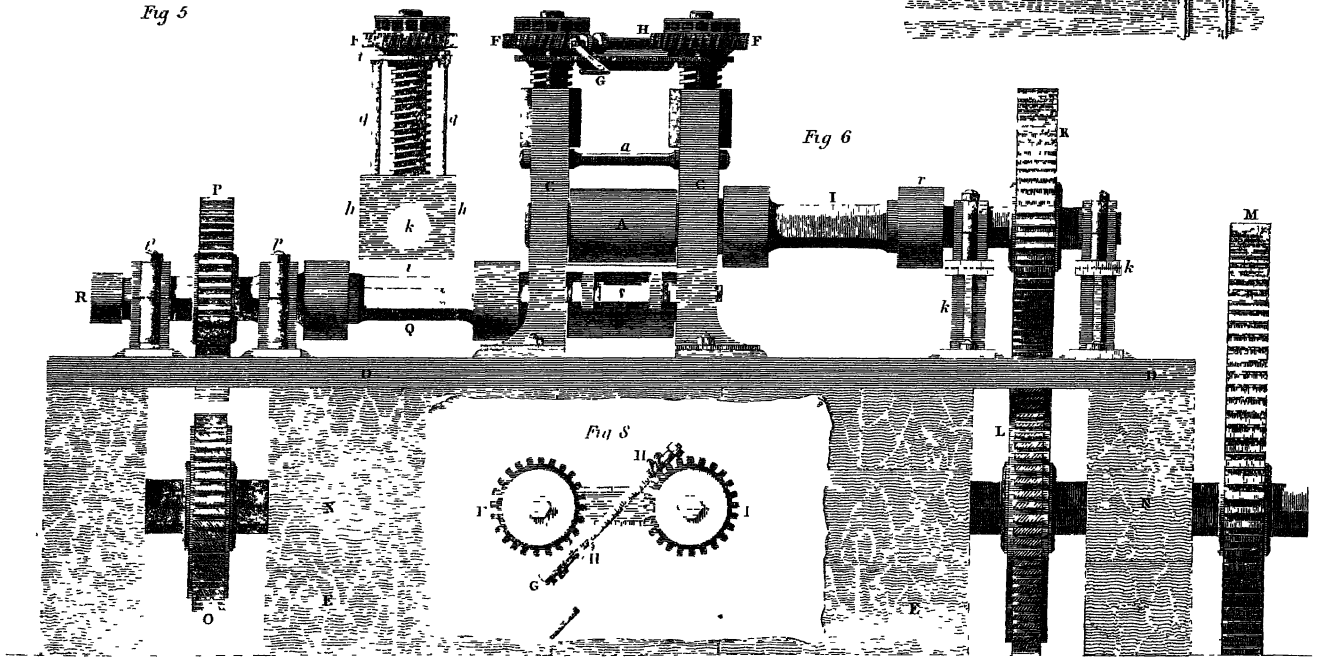


Fig 6

Fig 8

Published by A & C Black, Edinburgh

Engd by G. Aikman Edr.

Machines used in the Mint

Fig 4



Fig 1



Fig 2

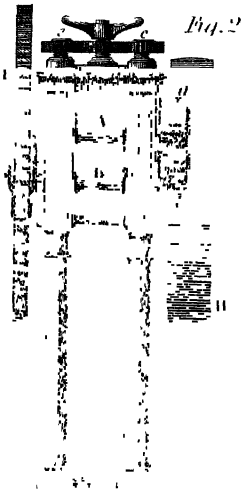
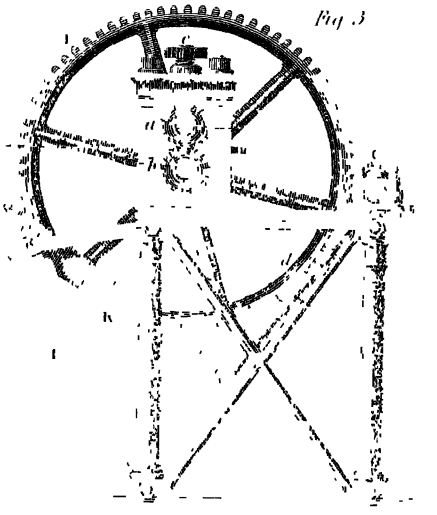


Fig 3



Sir John Barton's Machine for reducing Plates of Metal to an equal thickness

Fig 6

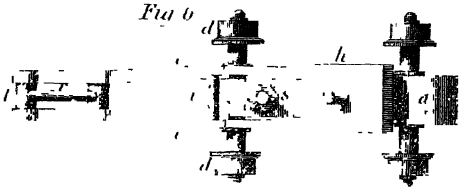


Fig 7

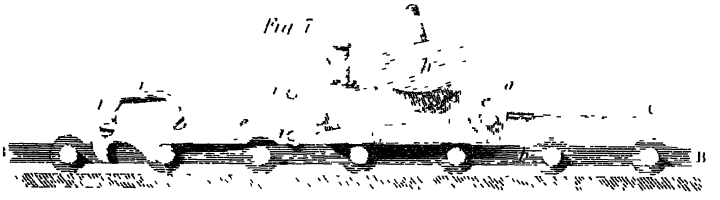
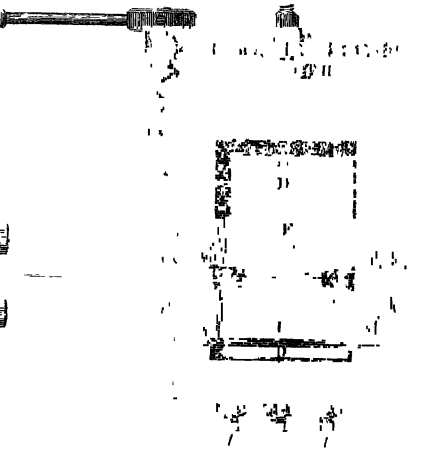


Fig 8

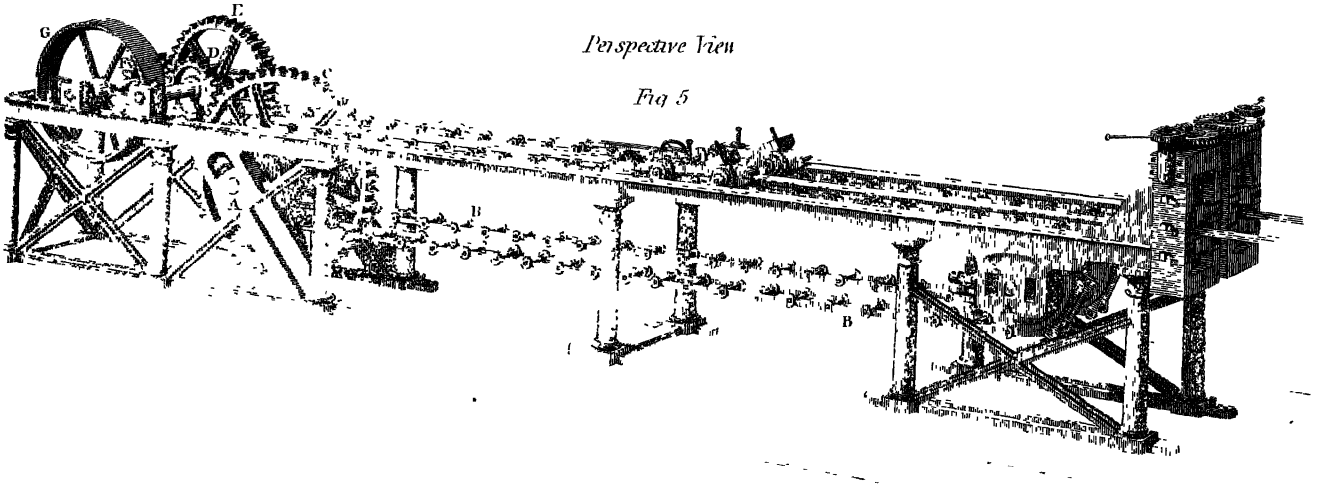


Fig 9



Perspective View

Fig 5



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COINAGE.

MACHINES used in the MINT

Fig 1

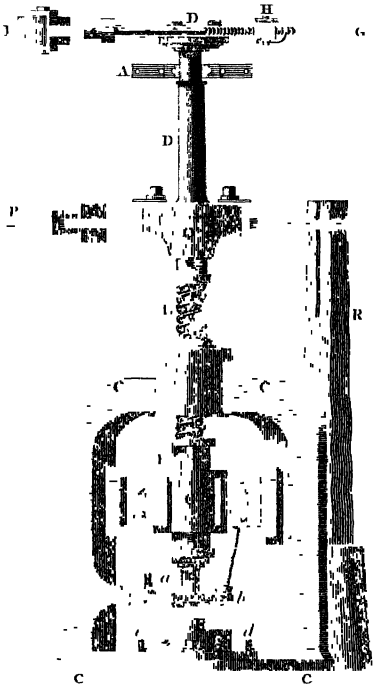
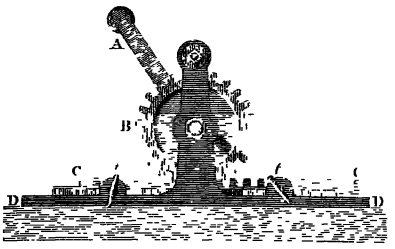


Fig 5



Milling

Fig 6

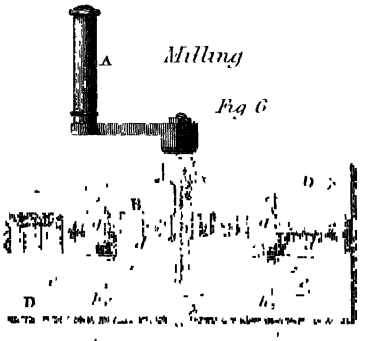


Fig 2

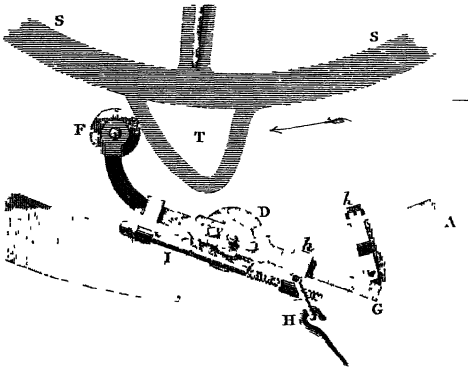


Fig 3

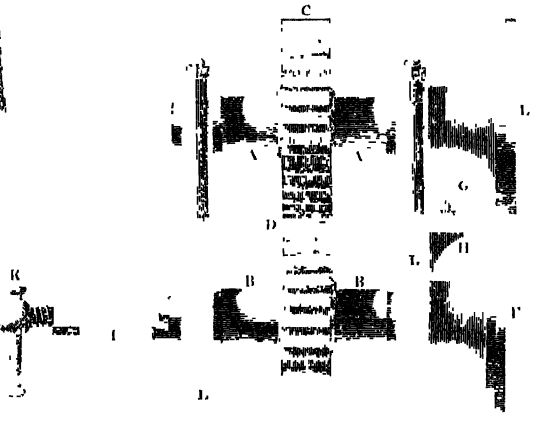


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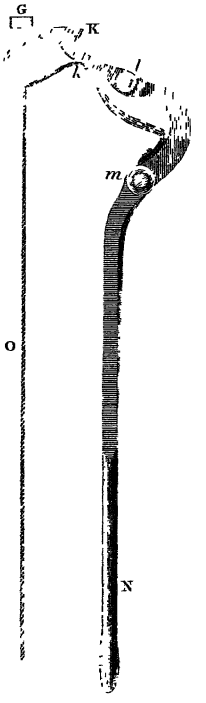


Fig 7

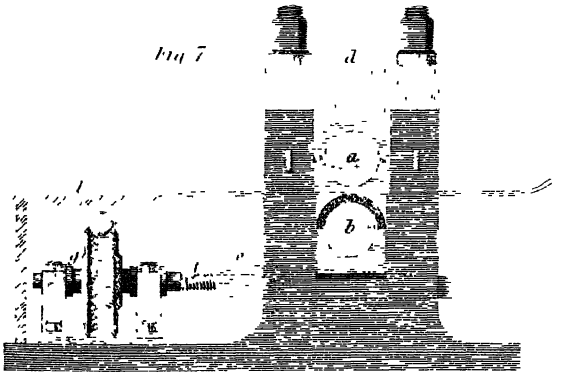
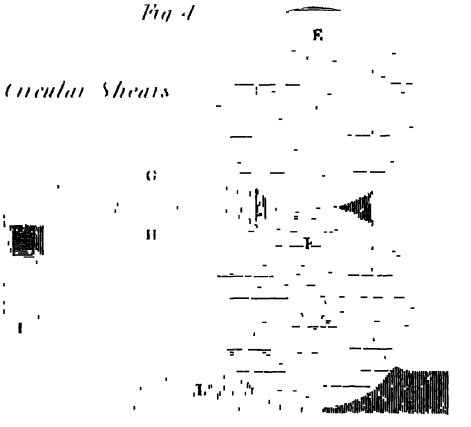


Fig 4

Circular Shears



ELEVATION of COINING PRESS used in the ROYAL MINT

Fig 1

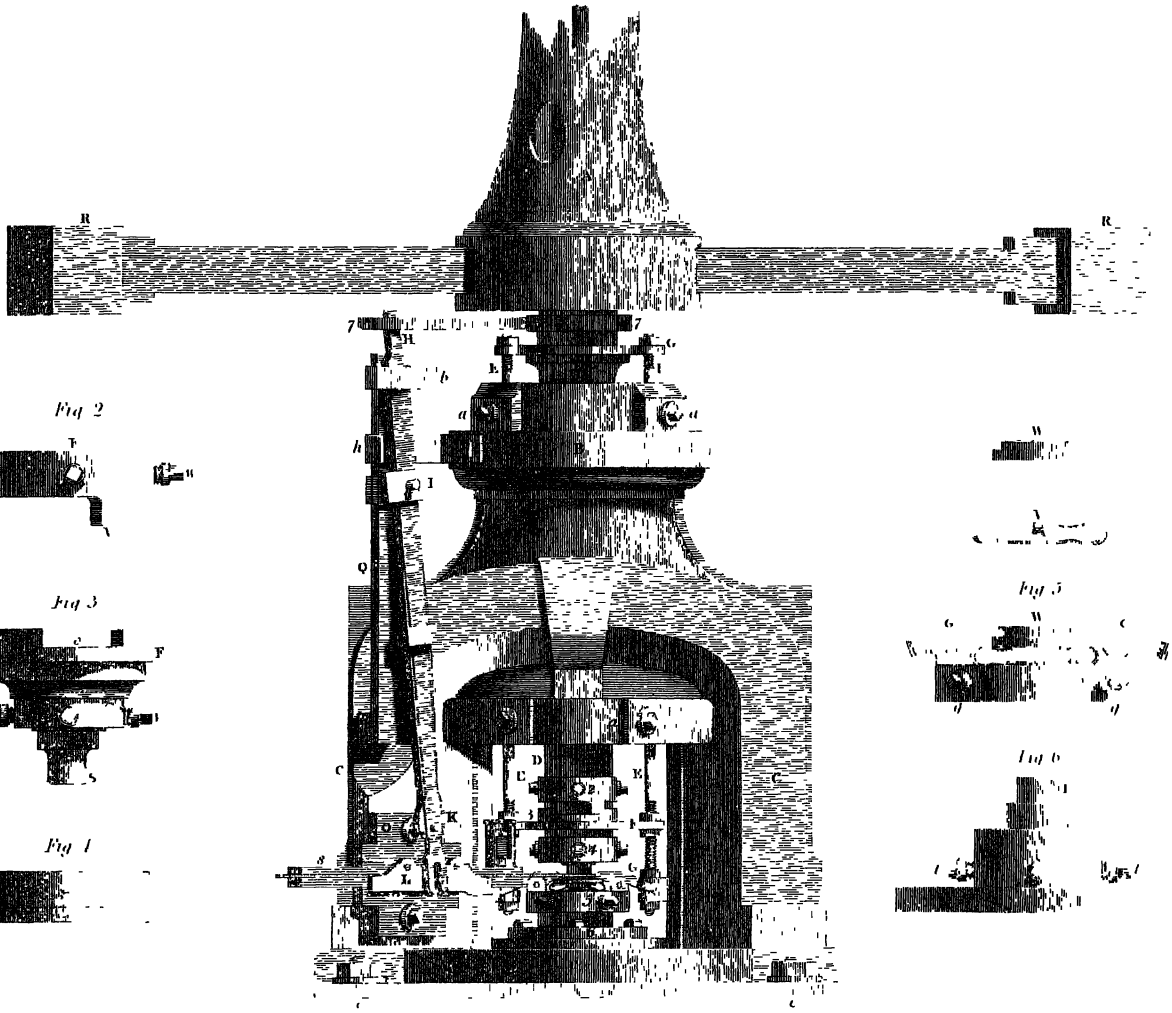


Fig 2



Fig 3

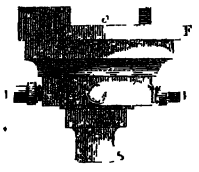


Fig 4

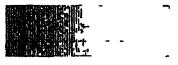


Fig 5

Fig 6

Fig 12

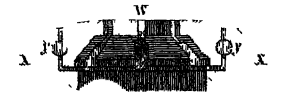


Fig 8



Fig 7



Fig 9

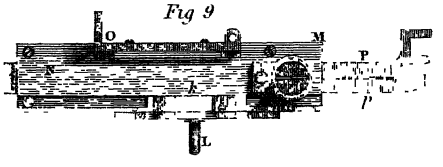


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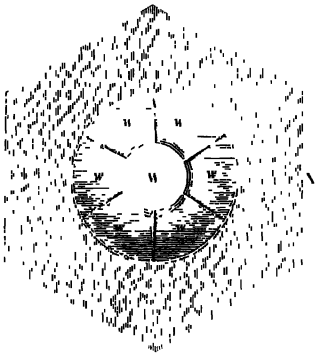


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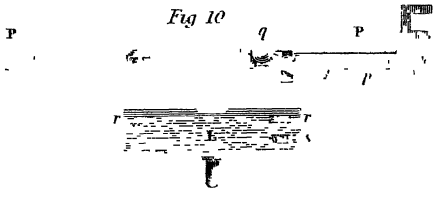
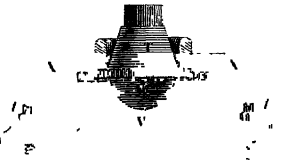
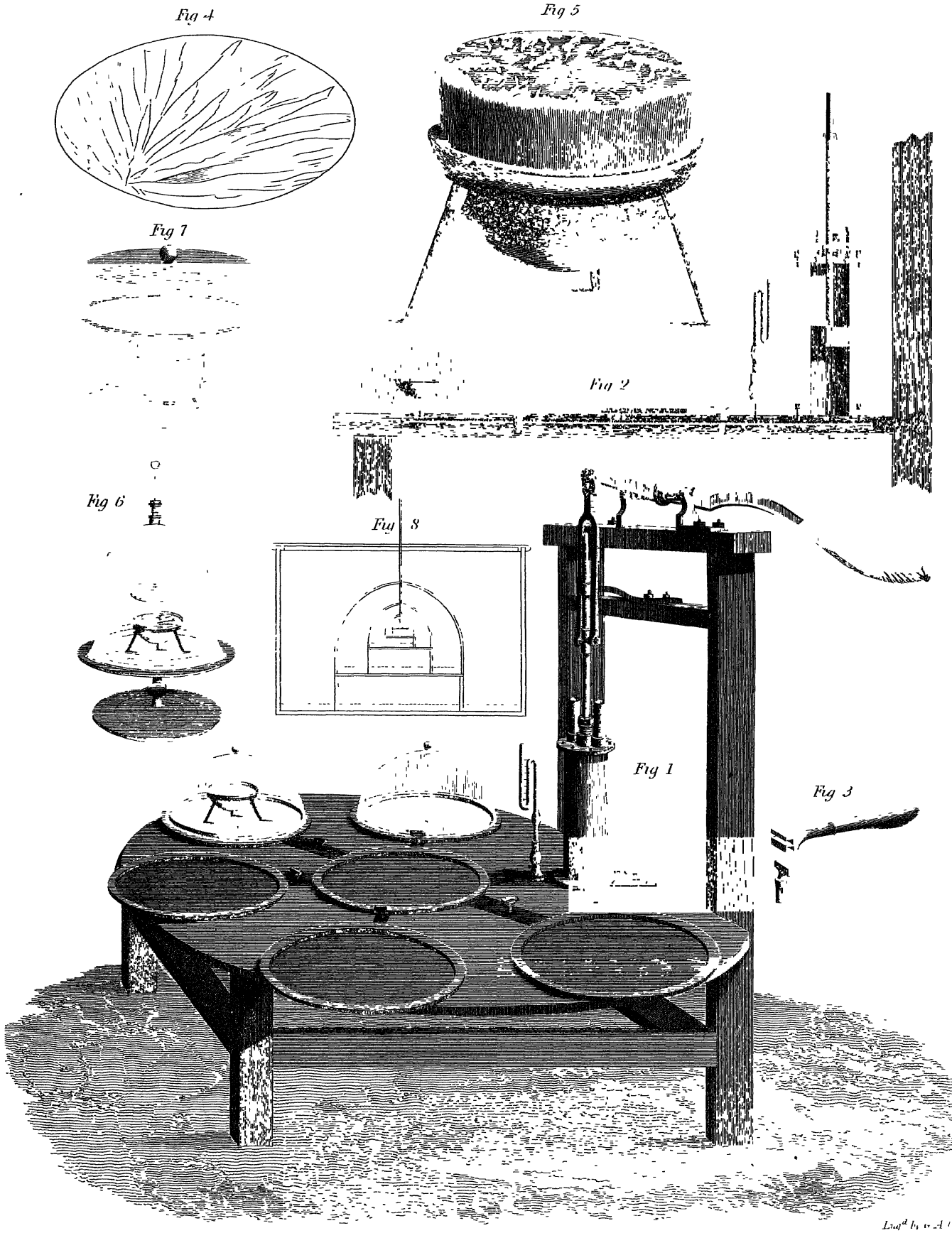


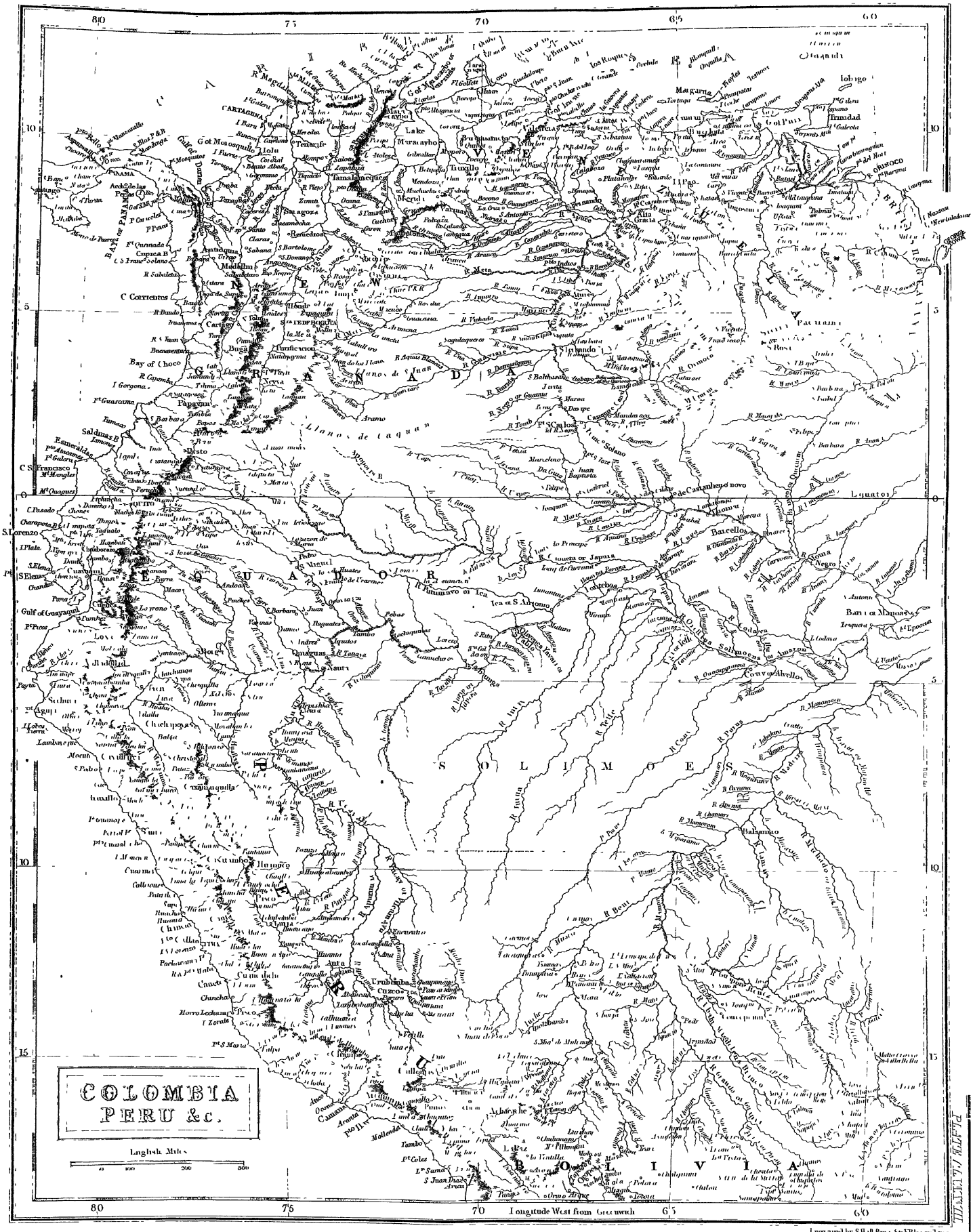
Fig 11



PROFESSOR LESLIE'S APPARATUS FOR COOLING AND FREEZING



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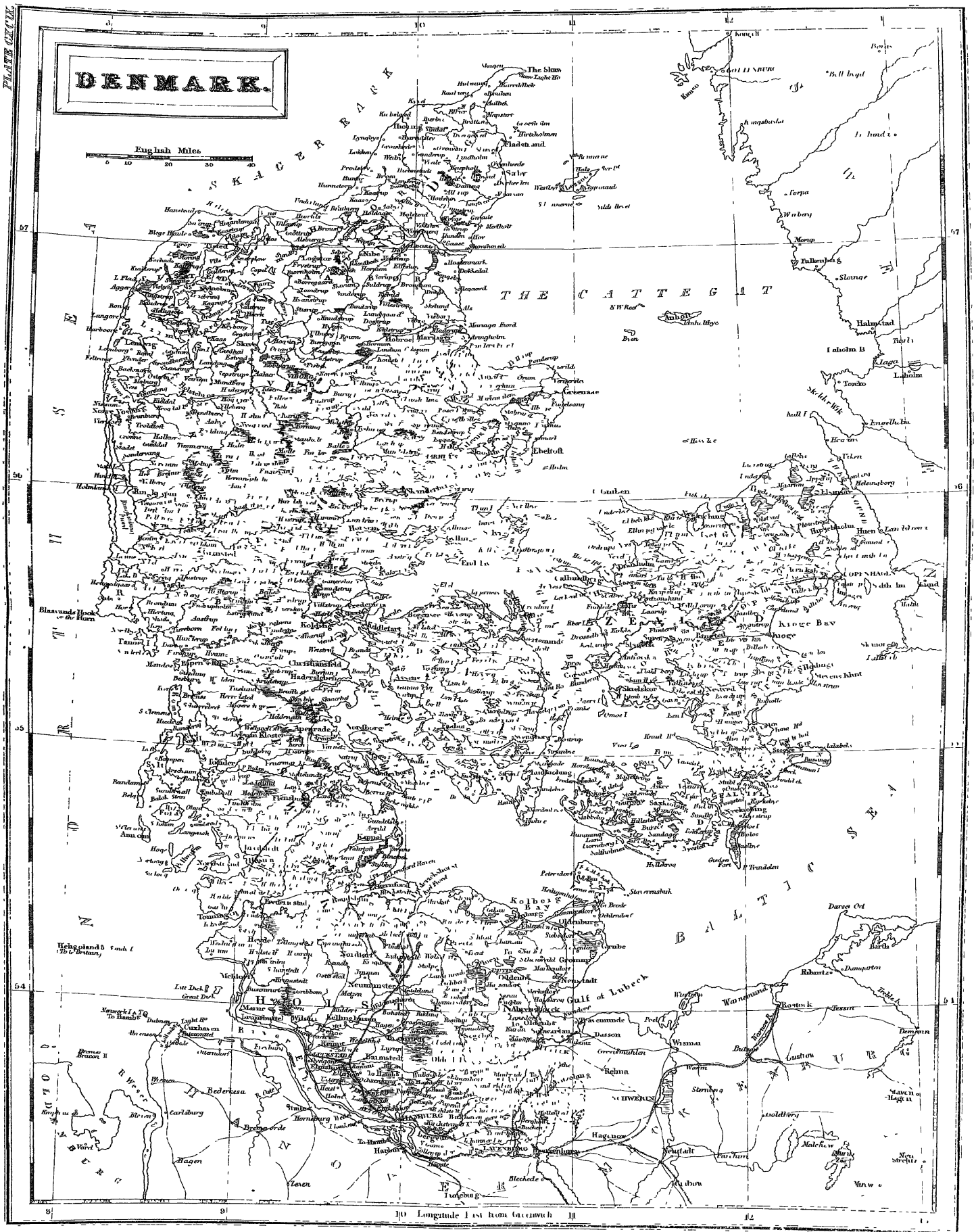
Edinburgh. Published by A & C Black

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PLATE LXXVIII

PLATE CXLI.

DENMARK.



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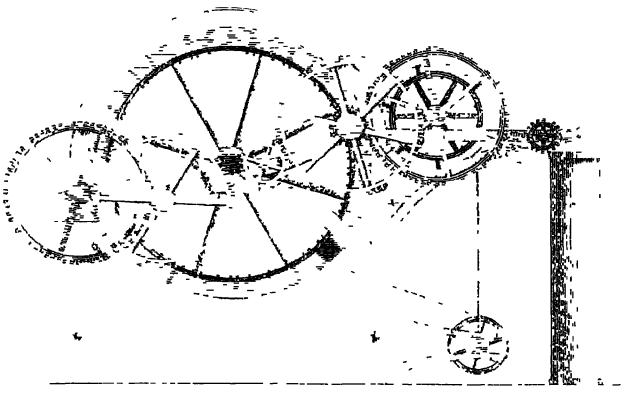
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COTTON MANUFACTURE.

PLATE CXC.

CARDING

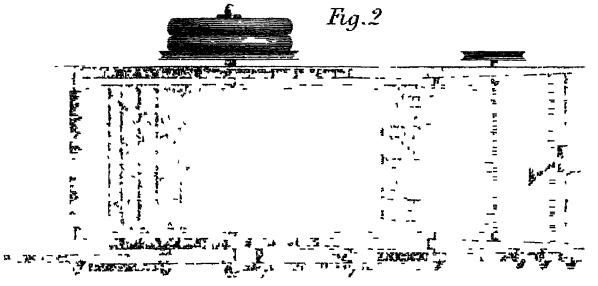
Side Elevation of Cards
Fig 1



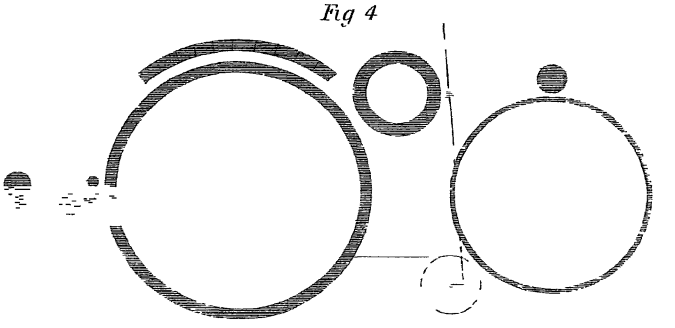
Front Elevation of Cards
Fig 3



Plan of Cards.
Fig.2



Vertical Section of Cards
Fig 4



DRAWING AND ROVING

Fig.5
End Elevation of Drawing frame

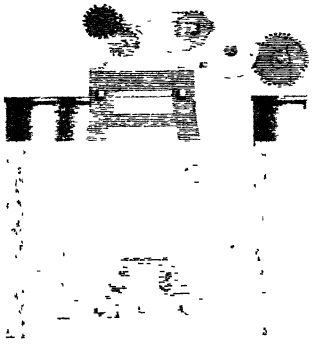


Fig 7
End Elevation of Roving frame

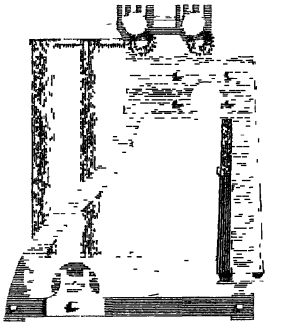


Fig 9
Front Elevation of Roving or Can frame



Plan of Drawing frame

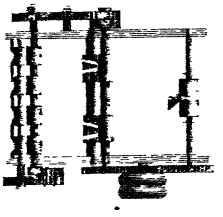


Fig 6

Plan of Roving frame



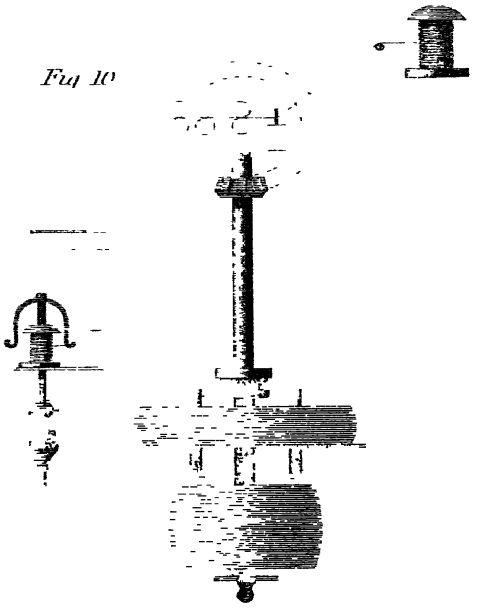
Fig 8

Engd by G Aitman Edin

TWIST SPINNING

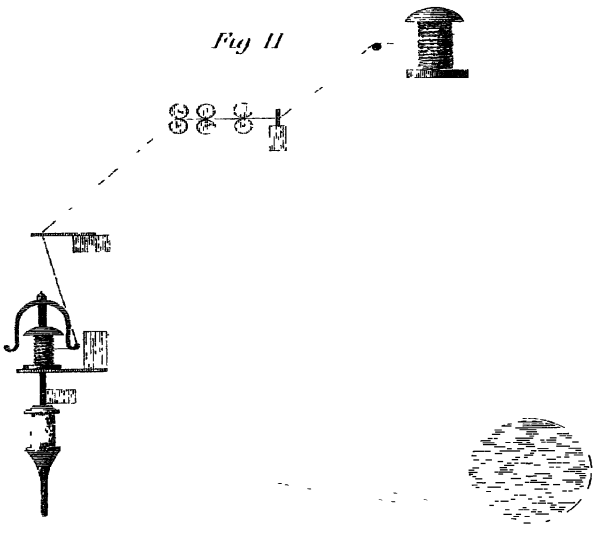
Sir R Arkwright's Spinning Frame

Fig 10



The Throstle

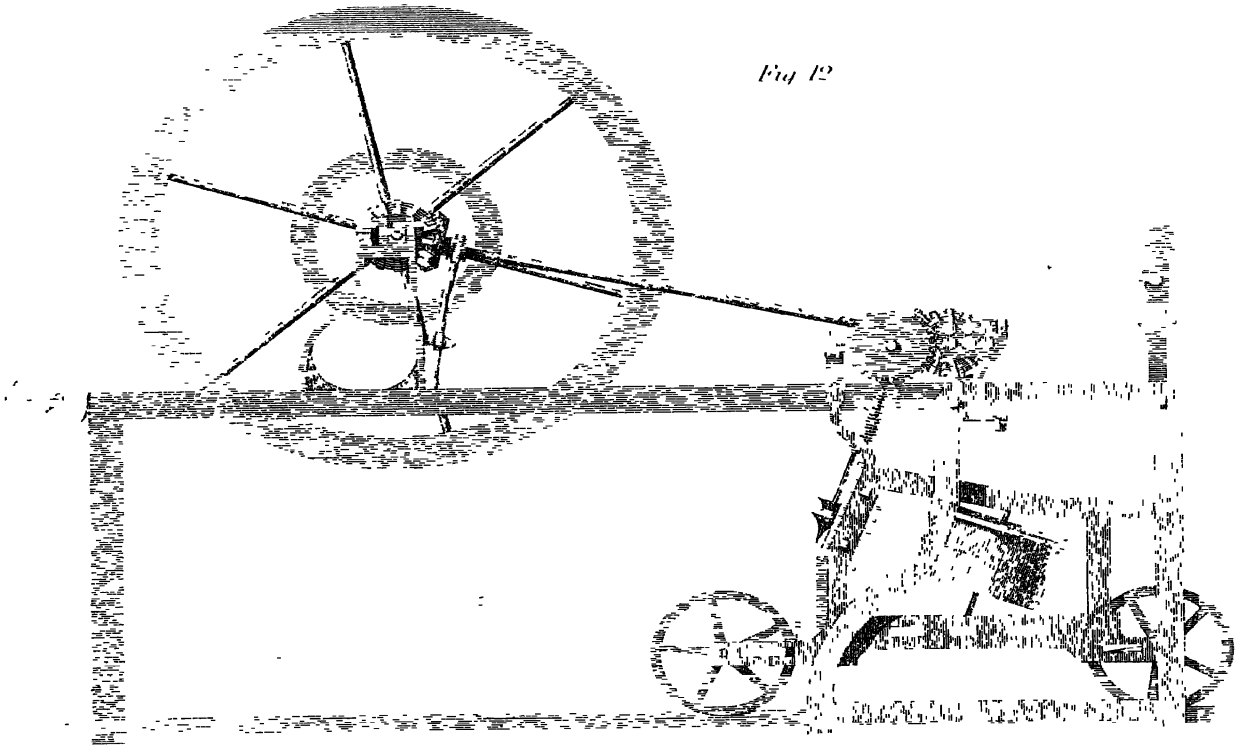
Fig 11



MULE SPINNING

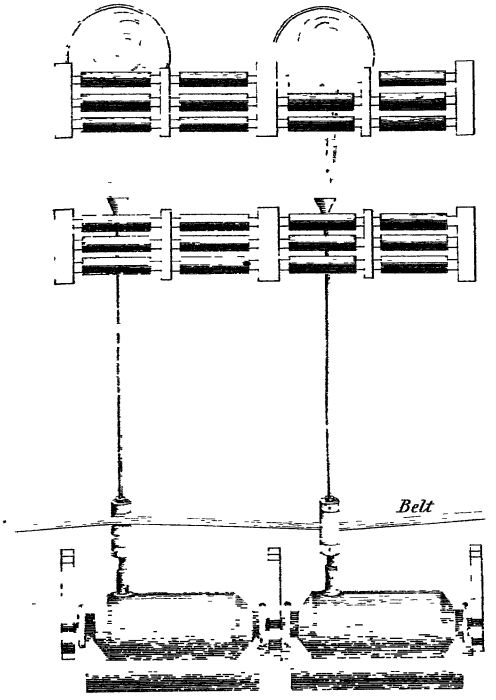
The Mule Jenny

Fig 12



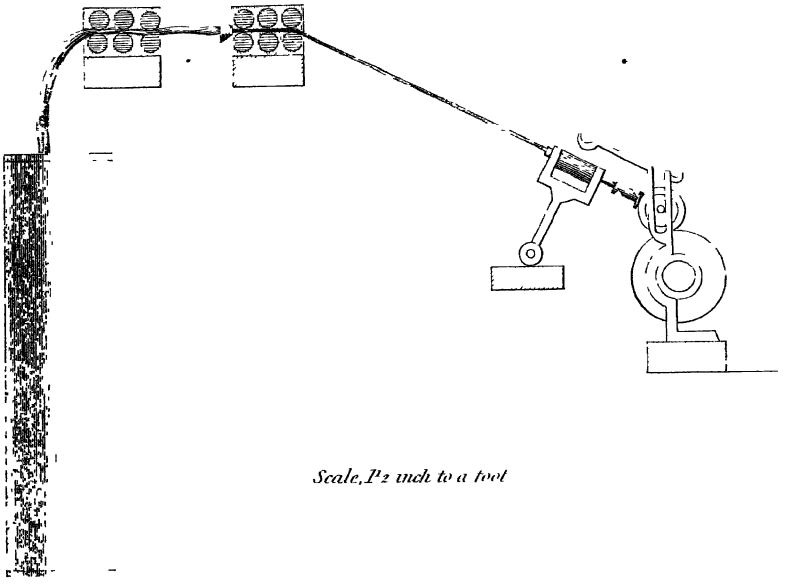
Published by A. Black Edinburgh

Fig 3



Plan and Section of Tube Frame

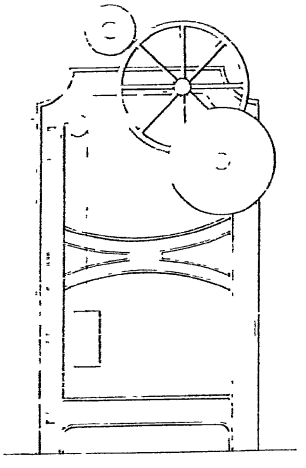
Fig 1



Scale, P2 inch to a foot

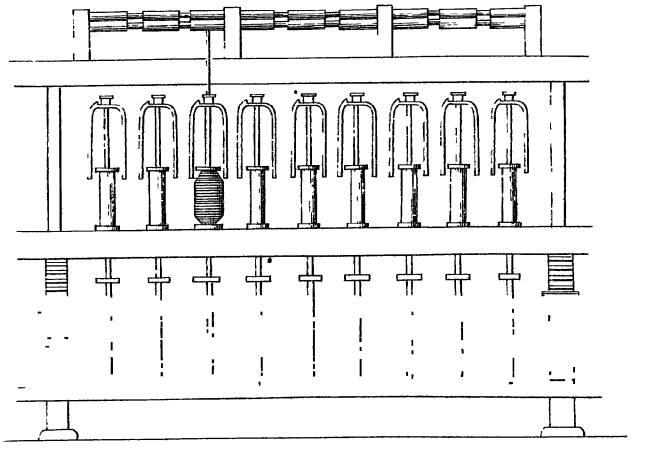
End and Front View of Fly Frame

Fig 1.



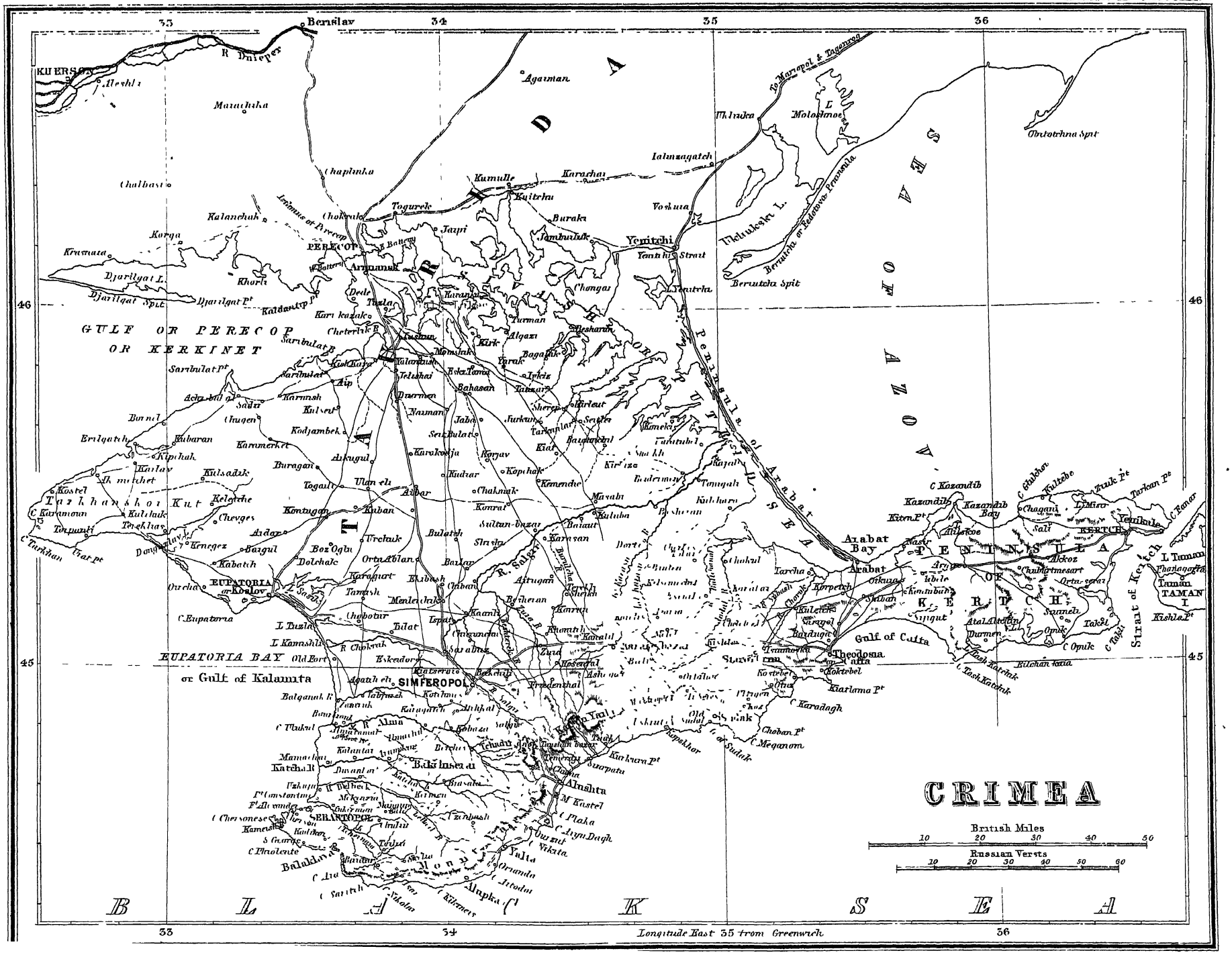
Scale, 3/8 inch to a foot

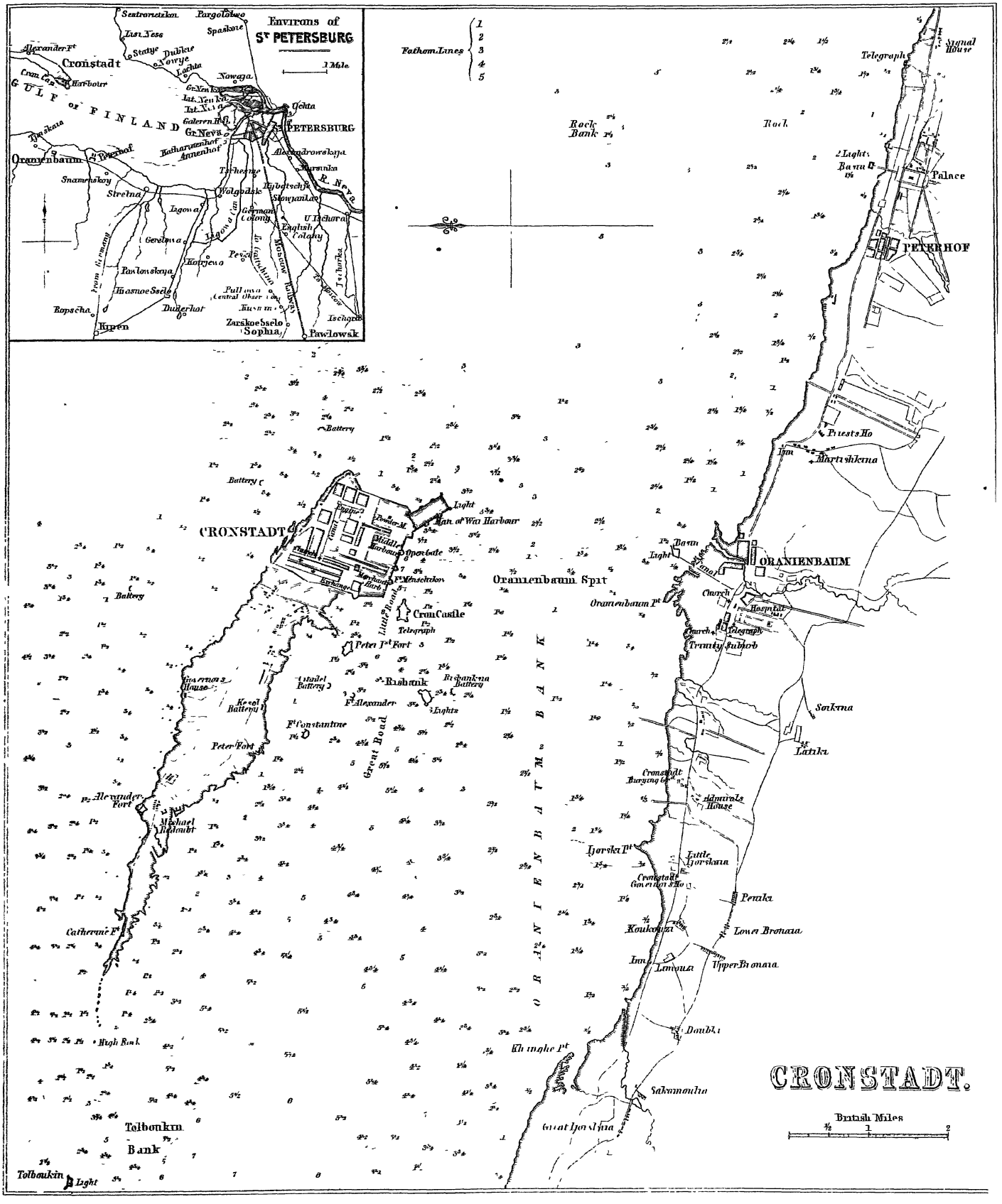
Fig 2



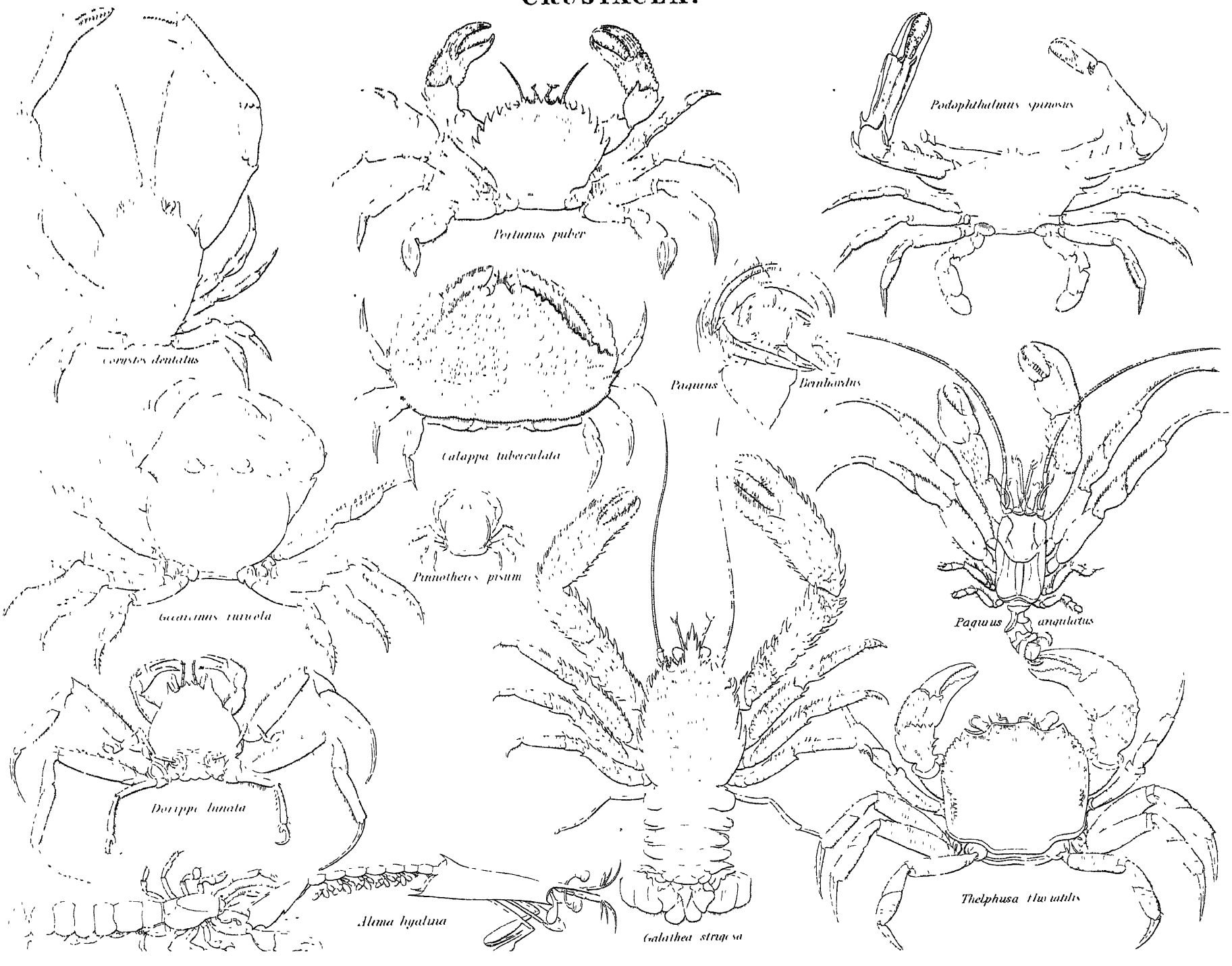
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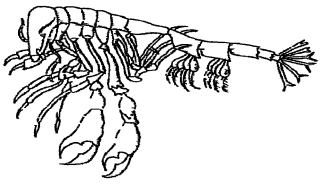
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CRIMEA
British Miles
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Russian Versts
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Berislav
R. Dnieper
KUERSOW
Mariupika
Agaiman
Chaplinka
Chalbast
Kamulle
Karachai
Kuitchu
Togurek
Jaipi
Buraka
Yenitchi
Yenitchi Strait
Voskuta
Ialanzagatch
Molotchnoe L.
Ohtatchna Spit
Berdutcha Spit
Kalanchak
Korga
Krasnaia
PEREKOP
Armansk
Djarilgat L.
Djarilgat Spit
Djarilgat Pt.
Khorla
Kaldan I.
Kara kadake
Cheterlik R.
GULF OR PERECOP OR KERKINET
Saribulat R.
Saribulat Pt.
Aip
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Kulsert
Kodjambek
Karamerket
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Kulsadak
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Dolchake
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Orta Ablan
Karagart
EUPATORIA or Koslov
C. Eupatoria
L. Tuzla
L. Kamashli
EUPATORIA BAY or Gulf of Kalamita
Old Fort
Eskedere
SIMFEROPOL
Agatch el.
Balganak R.
Kotchan
Karagoltch
Bakchisarai
Katchalt
Duvanlar
Bulganak R.
Alma
Kabaza
Kalantar
Mamachai
Tchuku
Tchorgun
Baidar
Ai Petri
Alushta
M. Kastel
C. Aia
C. Sarytch
Aitodor
Alupka
Baidar R.
Belbek R.
Kamara
Mekenzia
Inkerman
Sebastopol
Balaklava
C. Chersonese
C. Fiolente
Yalta
Oreanda
Dulbar
Kutchuk Uzenbash
Bolshoi Uzenbash
Kuban
Ulanchi
Kudrar
Chakmak
Kamrat
Sultan-bazar
Bulatch
Urchak
Strelka
Karasan
Baklar
Akmetchet
Akmetchet R.
Chubotur
Tilat
Ekibash
Chaban
Akrugan
Tarakli
Sheikh
Kamra
Kaanli
Kamishli
Kamishli R.
Kamishli Pt.
Kamishli Bay
Kamishli Spit
Kamishli Isthmus
Kamishli Lake
Kamishli Peninsula
Kamishli Point
Kamishli Strait
Kamishli Channel
Kamishli Harbour
Kamishli Anchorage
Kamishli Roads
Kamishli Light
Kamishli Lighthouse
Kamishli Buoy
Kamishli Beacon
Kamishli Tower
Kamishli Fort
Kamishli Castle
Kamishli Church
Kamishli Mosque
Kamishli Synagogue
Kamishli Cemetery
Kamishli Ruins
Kamishli Antiquities
Kamishli Museum
Kamishli Library
Kamishli Hospital
Kamishli Asylum
Kamishli Prison
Kamishli Barracks
Kamishli Arsenal
Kamishli Dockyard
Kamishli Shipyard
Kamishli Quay
Kamishli Wharf
Kamishli Pier
Kamishli Jetty
Kamishli Mole
Kamishli Breakwater
Kamishli Lighthouse
Kamishli Beacon
Kamishli Buoy

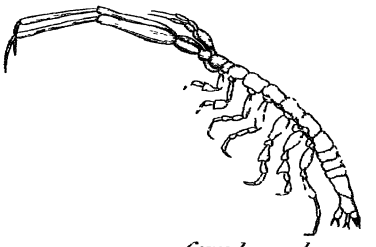


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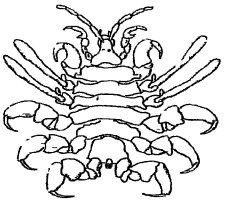

Corystes dentatus
Portunus puber
Podophthalmus spinosus
Calappa tuberculata
Paguus
Bernhardus
Pinnotheres pisum
Gecarcinus ruricola
Paguus anguliatus
Dorippe lanata
Thelphusa fluviatilis
Alima hyalina
Galathea strigosa



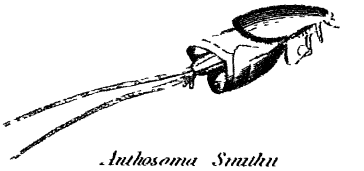
Phronima sedentaria



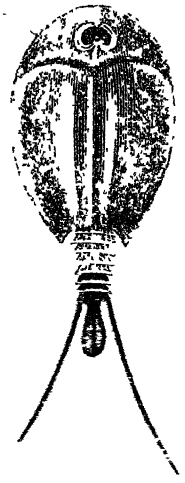
Corophium longicorne



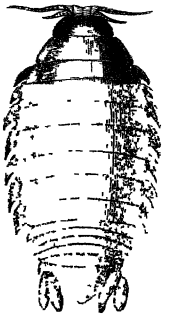
Cyamus ceti



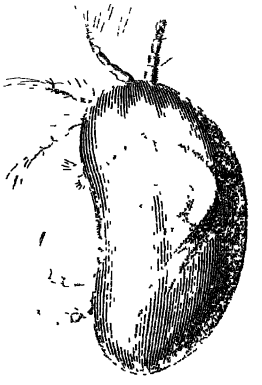
Anthosoma Smithii



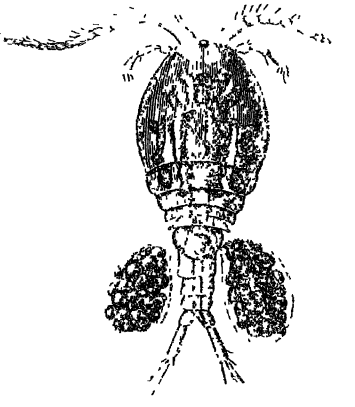
Lepidum prolongata



Æga marginata



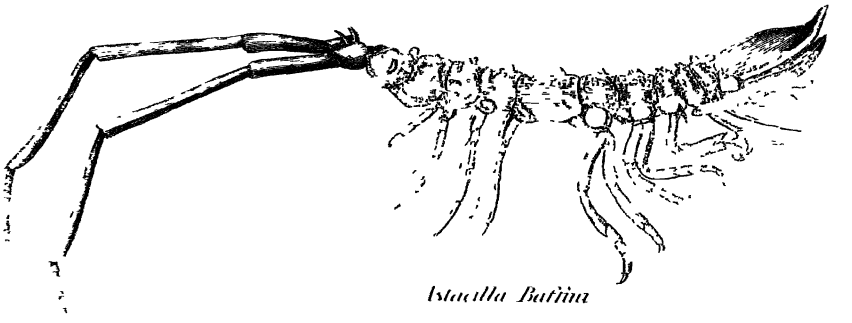
Cypris ornata



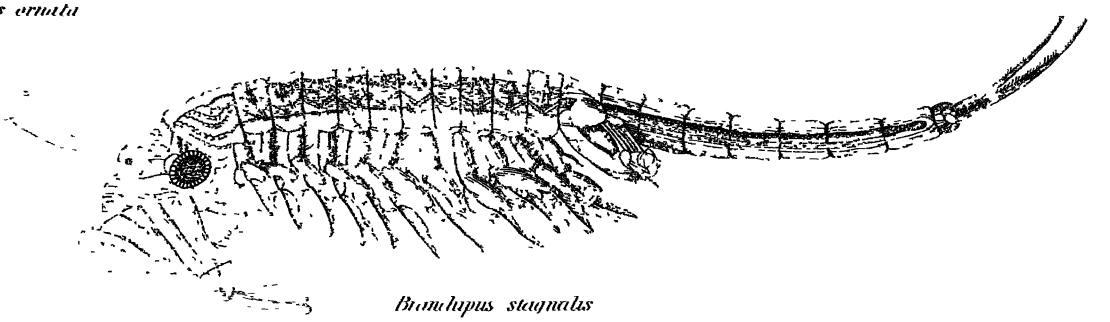
Cyclops quadricornis



Cypris ornata



Istacilla Latitia



Branchipus stagnalis

Published by A. & C. Black, Edinburgh

CRYSTALLIZATION.

Fig 1

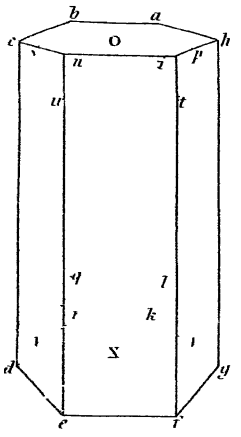


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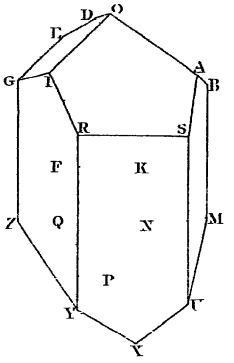


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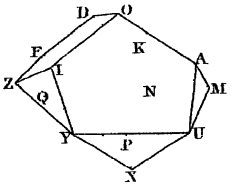


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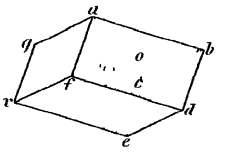


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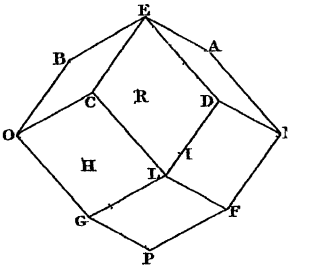


Fig 11



Fig 10

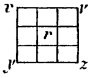


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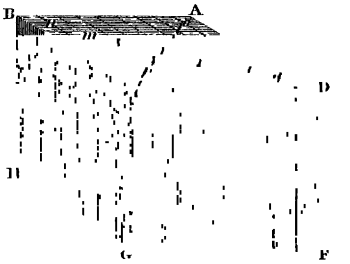


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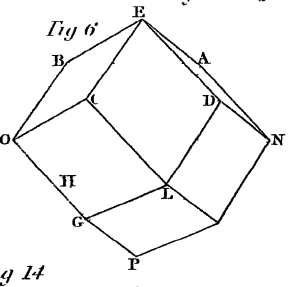


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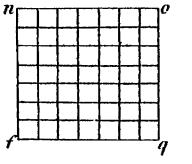


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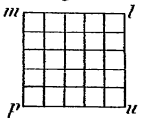


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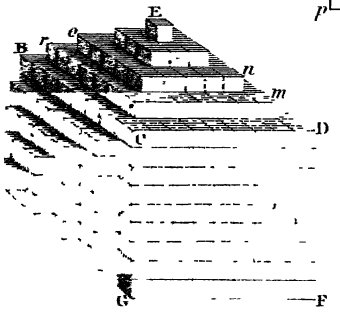


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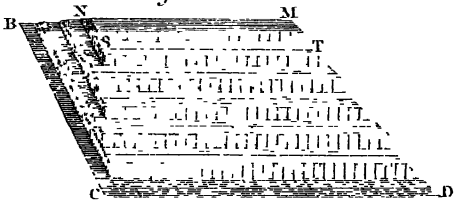


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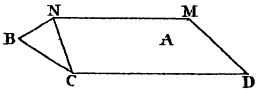


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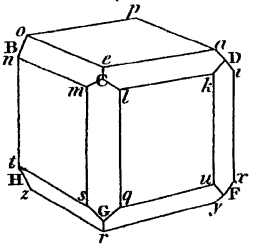


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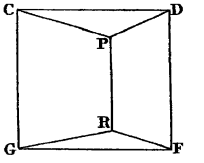


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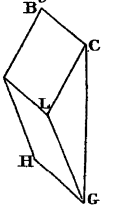


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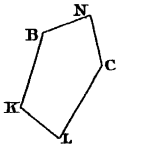


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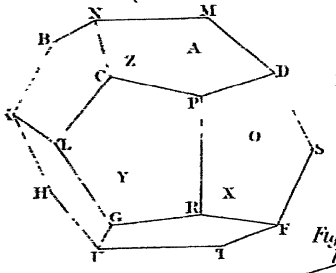


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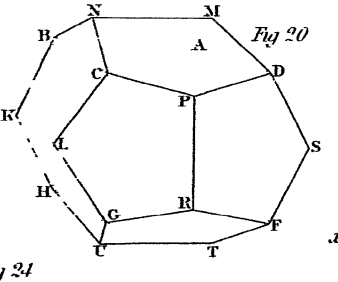


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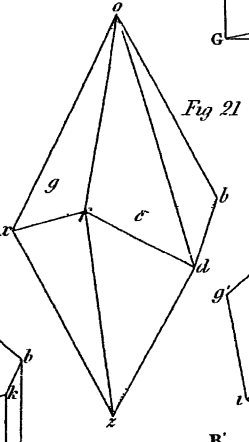


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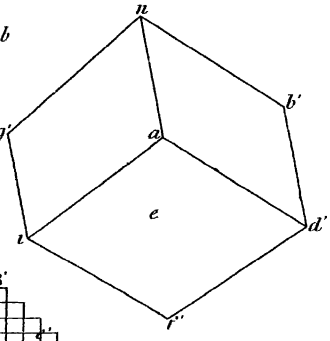


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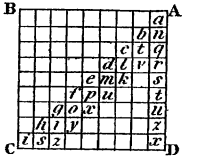


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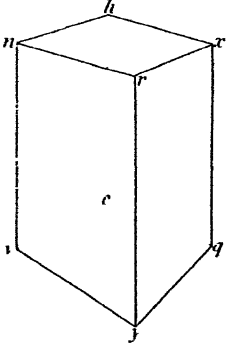


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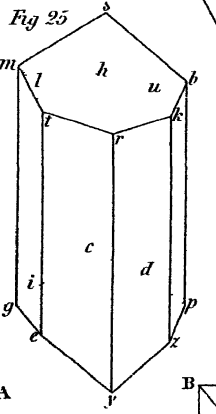


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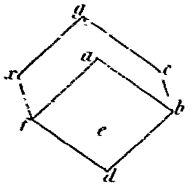


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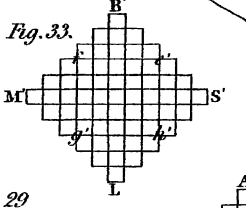


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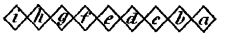


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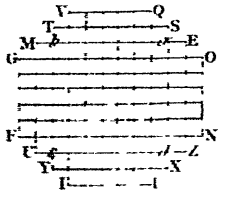


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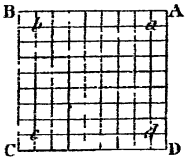


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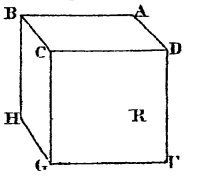


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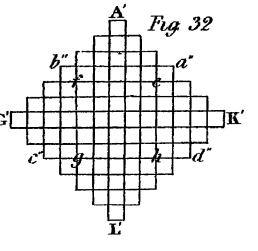
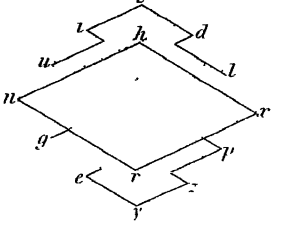
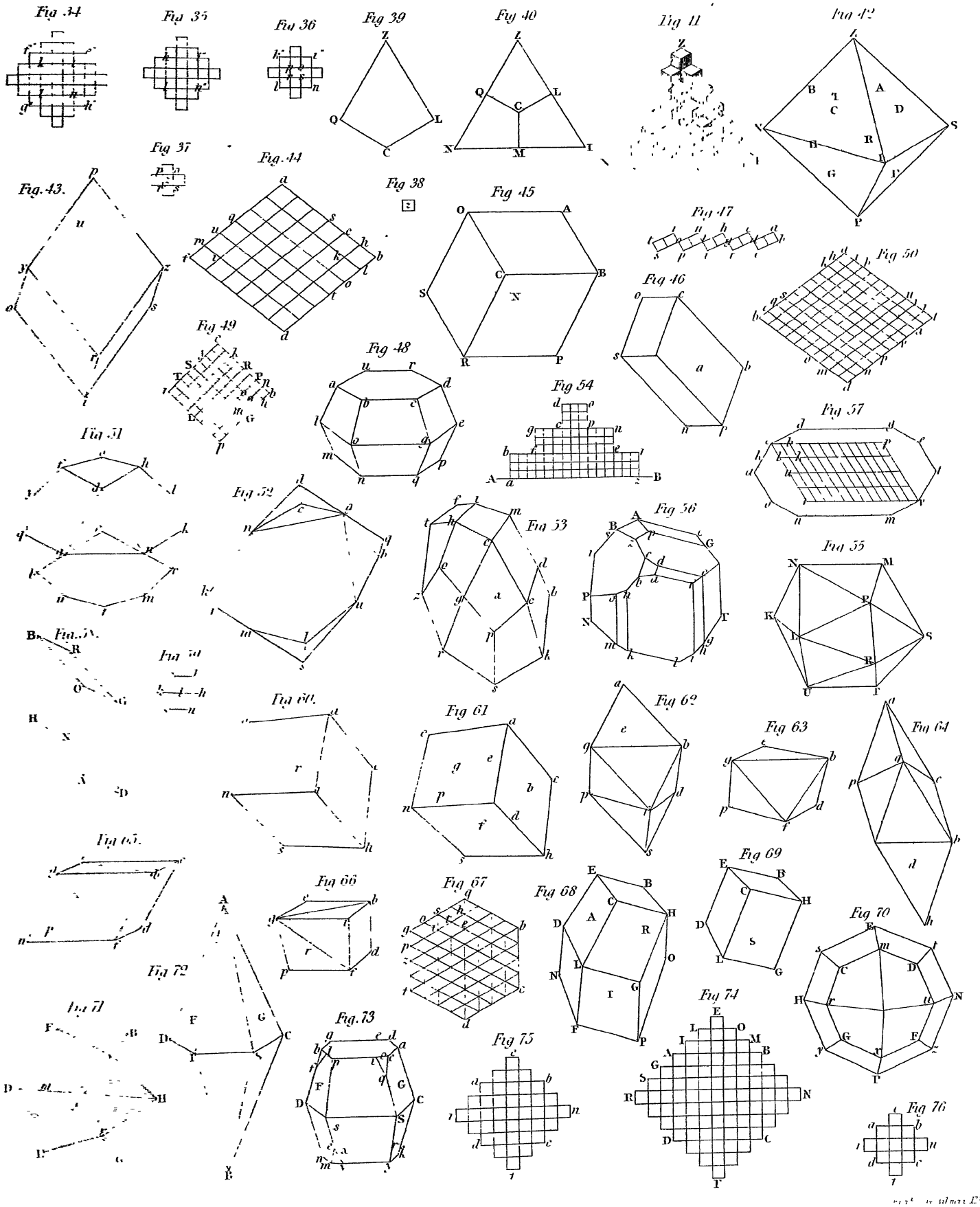


Fig 26



CRYSTALLIZATION.



DIALLING.

Fig 1

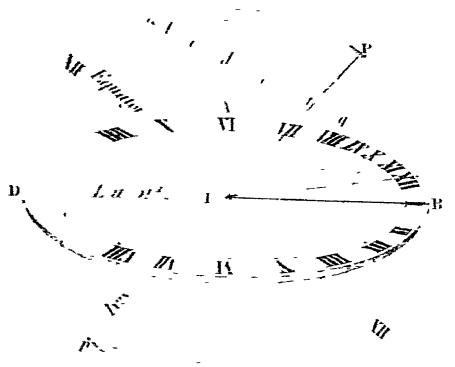


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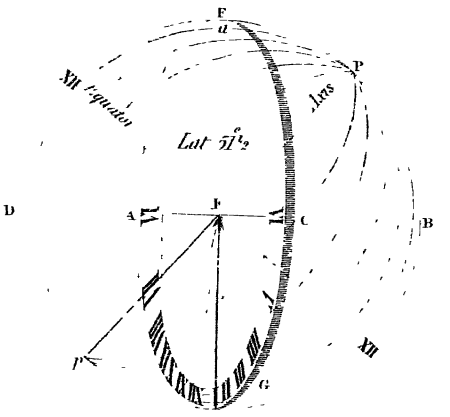


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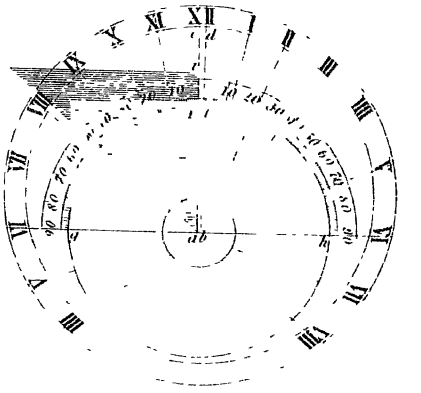


Fig 4



Fig 7

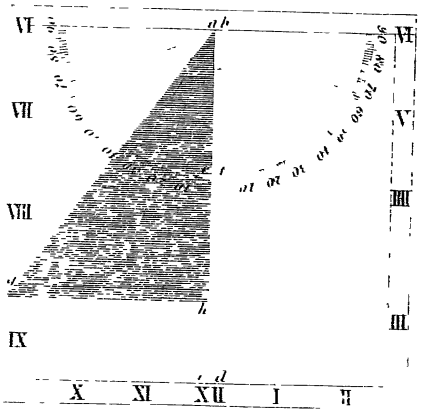


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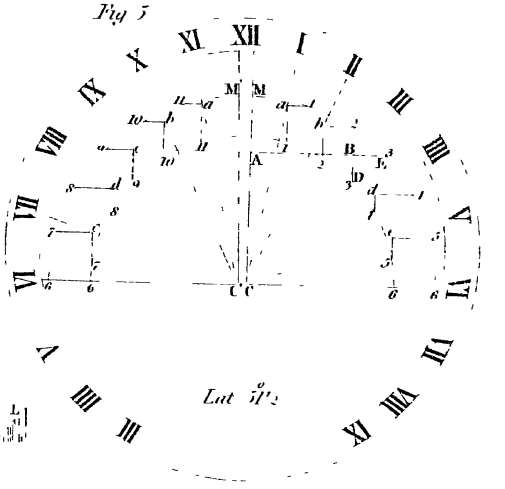


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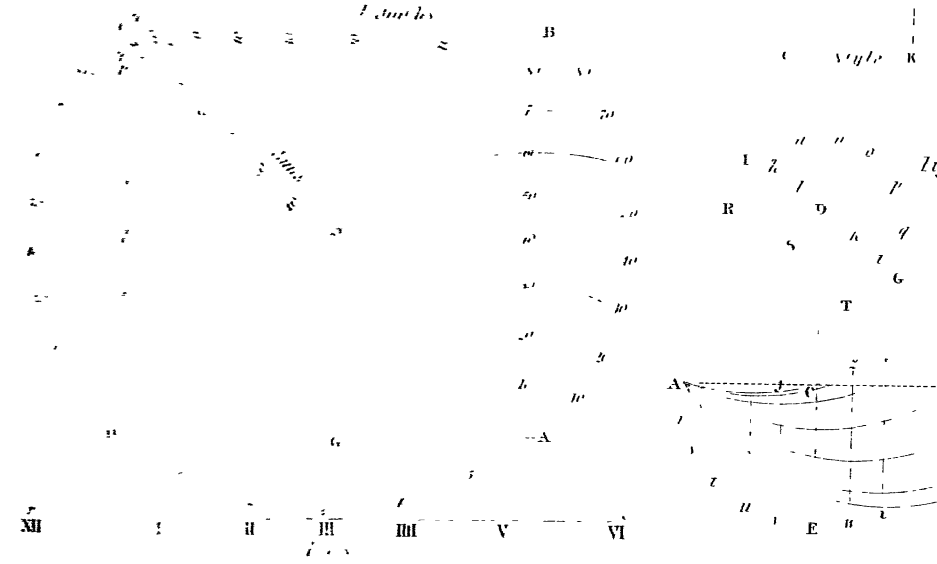


Fig 10

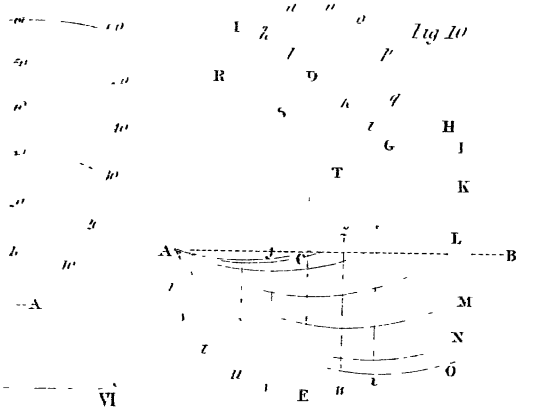


Fig 11

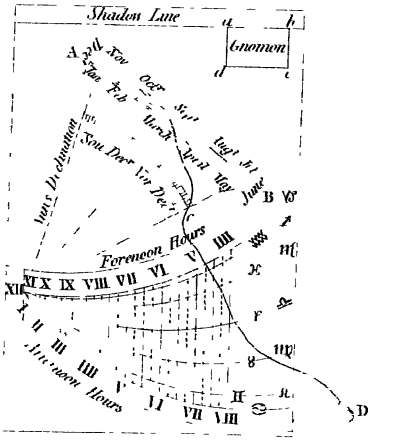


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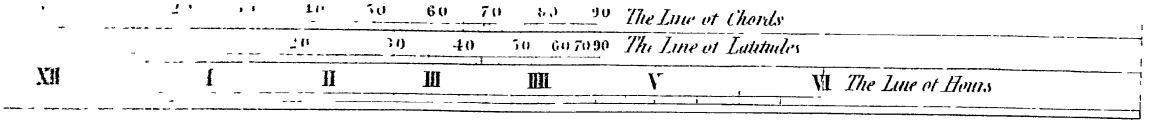


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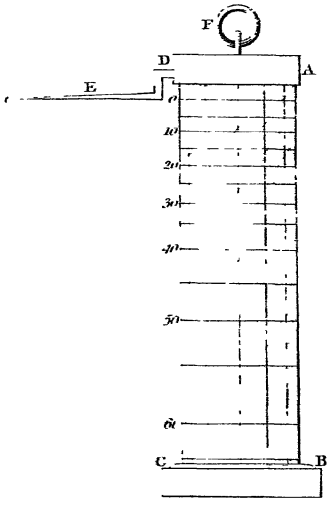


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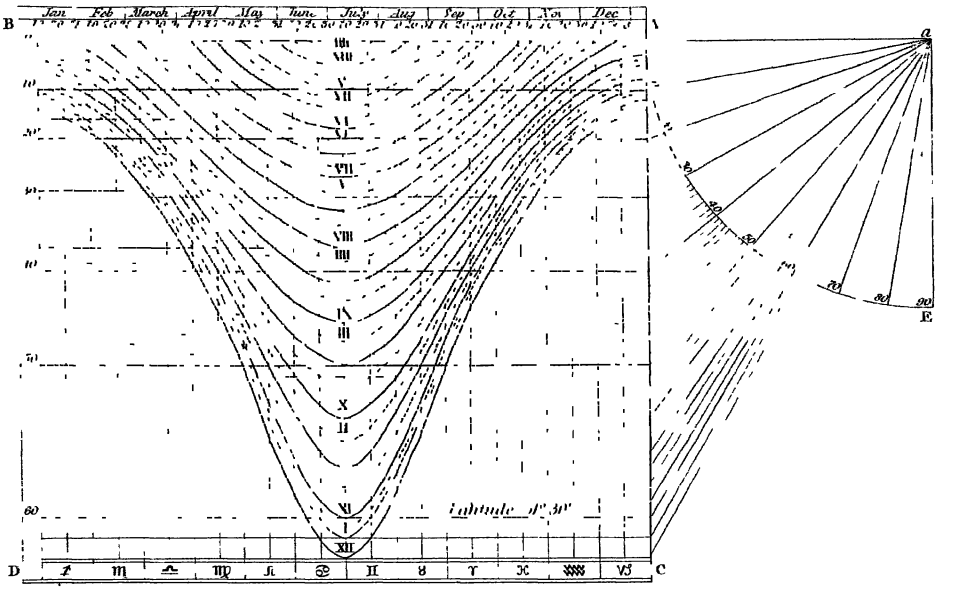


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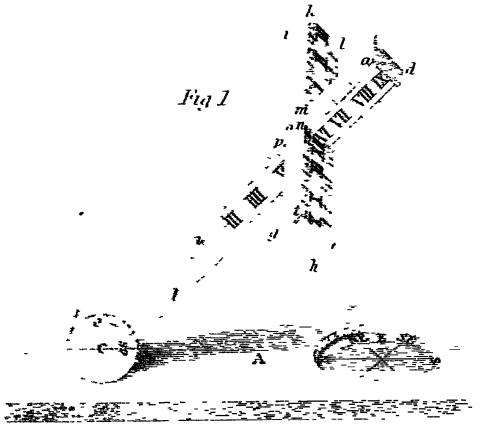


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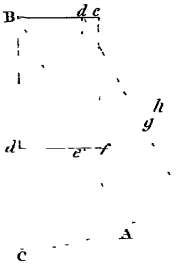


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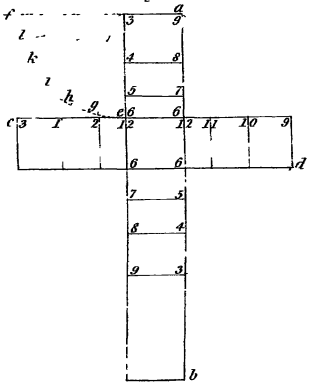


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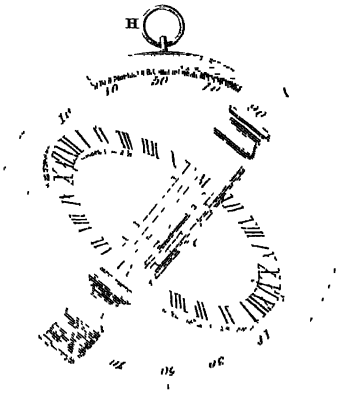


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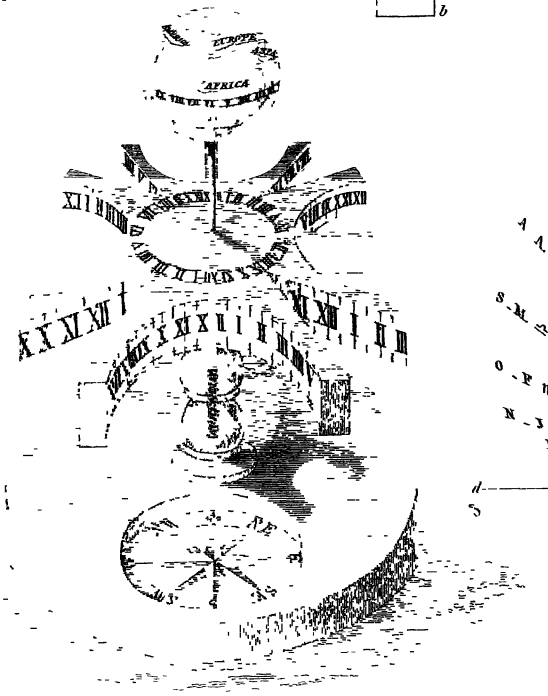


Fig 8.

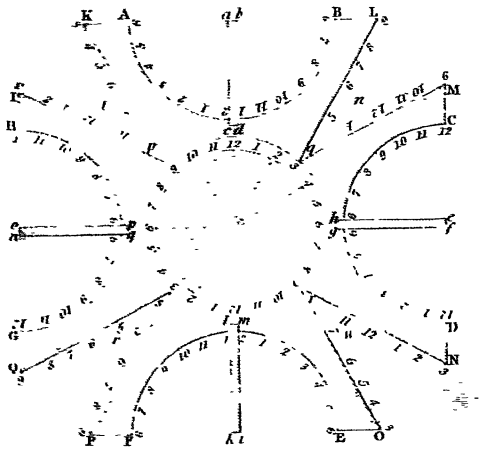
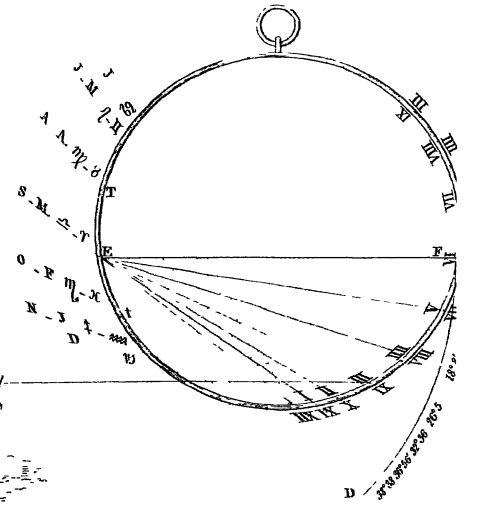


Fig 7



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Fig 1

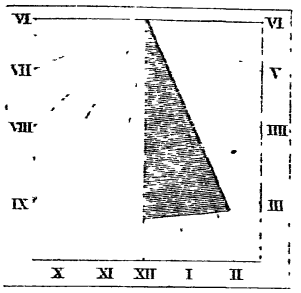


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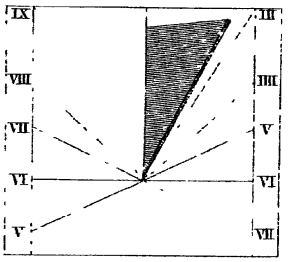


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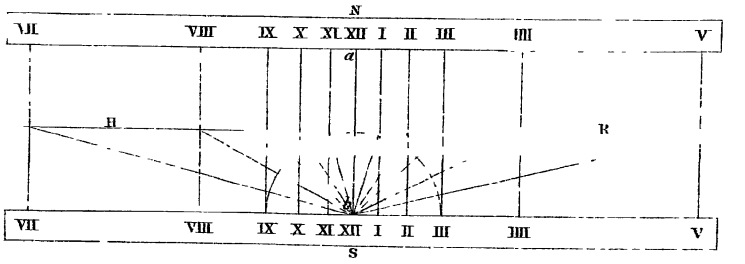


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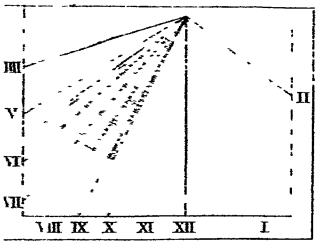


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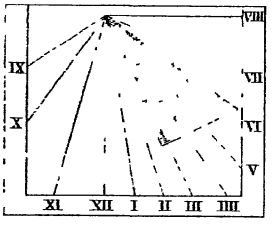


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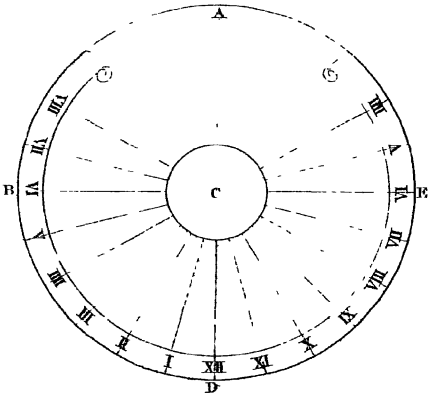


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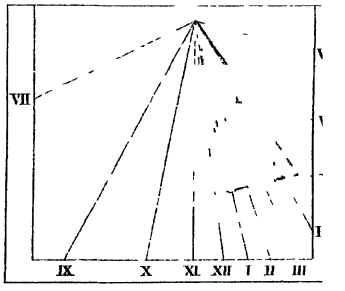


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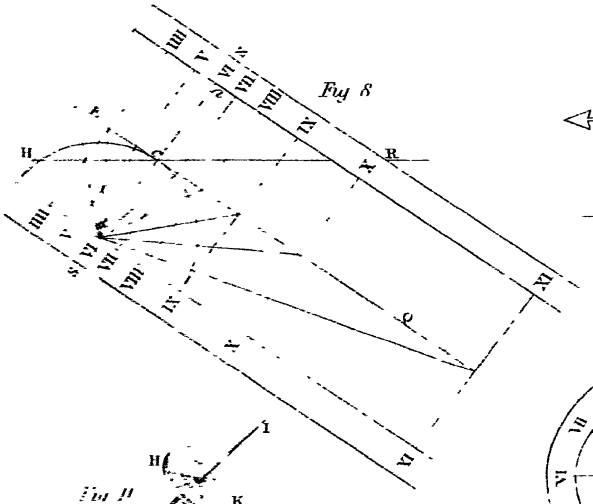


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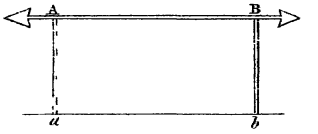


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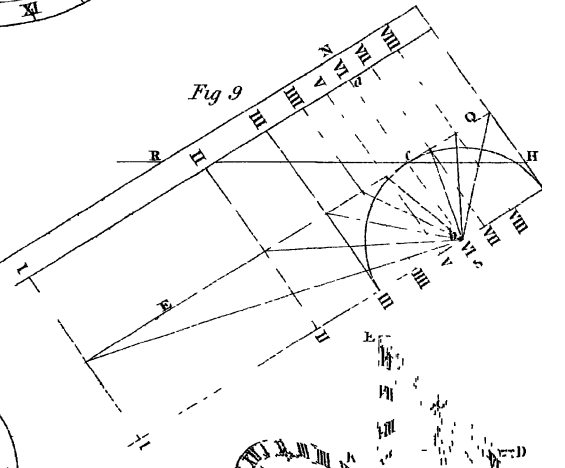


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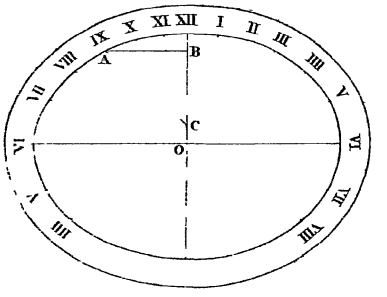


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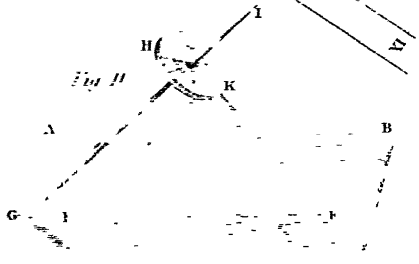


Fig 12



Fig 15

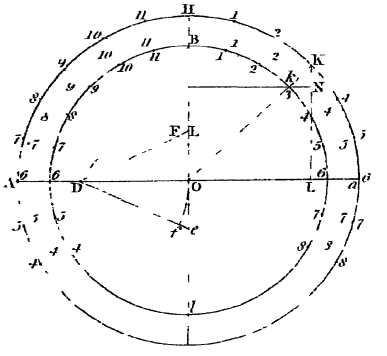
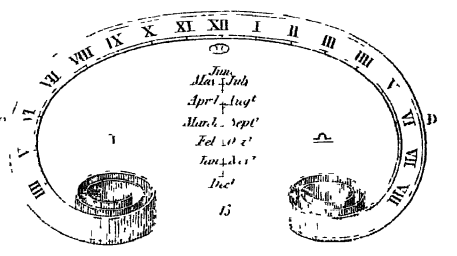


Fig 16



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